POLOMOLOK WATER DISTRICT Polomolok South Cotabato

BIDDING DOCUMENTS

For the

CONSTRUCTION OF 300 CU.M. REINFORCED CONCRETE GROUND RESERVOIR AT ANTIPORTA

APRIL 2024

Preface

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

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

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

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

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

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

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

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Glossary of Terms, Abbreviations, and Acronyms

ABC – Approved Budget for the Contract.

ARCC – Allowable Range of Contract Cost.

BAC – Bids and Awards Committee.

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

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

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

- **BIR** Bureau of Internal Revenue.
- **BSP** Bangko Sentral ng Pilipinas.

CDA – Cooperative Development Authority.

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

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

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

CPI – Consumer Price Index.

DOLE – Department of Labor and Employment.

DTI – Department of Trade and Industry.

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

GFI – Government Financial Institution.

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

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

GOP – Government of the Philippines.

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

LGUs – Local Government Units.

NFCC – Net Financial Contracting Capacity.

NGA – National Government Agency.

PCAB – Philippine Contractors Accreditation Board.

PhilGEPS - Philippine Government Electronic Procurement System.

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

PSA – Philippine Statistics Authority.

SEC – Securities and Exchange Commission.

SLCC – Single Largest Completed Contract.

UN – United Nations.

Section I. Invitation to Bid

Notes on the Invitation to Bid

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

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

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

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



INVITATION TO BID FOR CONSTRUCTION OF 300 CU.M. REINFORCED CONCRETE GROUND RESERVOIR AT ANTIPORTA

- 1. The Polomolok Water District, through the Government of the Philippines under the Corporate Budget for the Contract approved by the Board for FY 2024 intends to apply the sum of FOUR MILLION ONE HUNDRED FIFTY THOUSAND PESOS & 00/100 (PHP 4,150,000.00), inclusive of VAT and all other applicable government taxes, fees and other charges, being the Approved Budget for the Contract (ABC) to payments under the contract PB 25-15, CONSTRUCTION OF 300 CU.M. REINFORCED CONCRETE GROUND RESERVOIR AT ANTIPORTA. Bids received in excess of the ABC shall be automatically rejected on bid opening.
- 2. The Polomolok Water District now invites bids for the above Procurement Project. Completion of the Works is required within 100 calendar days from receipt of Notice to Proceed or Purchase Order. Bidders should have completed, within 3 years from the date of submission and receipt of bids, a contract similar to the Project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II. Instructions to Bidders.
- 3. Bidding will be conducted through open competitive bidding procedures using nondiscretionary "*pass/fail*" criterion as specified in the 2016 revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184.
- 4. Interested bidders may obtain further information from Polomolok Water District and inspect the Bidding Documents at the address given below from 8:00 AM to 5:00 PM and/or at the PhilGEPS website and Polomolok Water District website.
- 5. A complete set of Bidding Documents may be acquired by interested Bidders on *April* 24, 2024 from the given address and website(s) below:

PhilGEPS website (https://www.philgeps.gov.ph) and Polomolok Water District website (polwaterdistrict.gov.ph) and upon payment of the applicable fee for the Bidding Documents, pursuant to the latest Guidelines issued by the GPPB, in the amount of **PHP 5,000.00**. The bidder shall present its proof of payment for the fees by facsimile (083 - 500 - 8008), or through e-mail (bacpolwd@gmail.com) the scanned proof of the payment.

6. The Polomolok Water District through its Bids and Awards Committee will hold a Pre-Bid Conference on **May 2, 2025, 9:00 AM** at the Conference Room, 2nd Floor Admin. Bldg. Polomolok Water District which shall be open to prospective bidders.

Prospective bidders can also attend **via video conferencing thru Zoom.** A link shall be provided by the BAC Secretariat.

- 7. Bids must be duly received by the BAC Secretariat at the address below on or before May 20, 2025 at 9:00 AM. If a bidder chooses to submit a soft copy of the bids online, the bidder shall send it to a unique shared link which will be provided by the BAC Secretariat to a particular bidder. The confidentiality of the submitted bids is protected by the bidder's password. Late bids shall not be accepted.
- 8. All bids must be accompanied by a bid security in any of the acceptable forms and in the amount stated in **ITB** Clause 16.
- 9. Bid opening shall be on **May 20, 2025 at 9:00 AM** at the Conference Room, 2nd Floor Admin. Bldg. Polomolok Water District. Bids will be opened in the presence of the bidders' representatives who choose to attend the Bid Opening at the address below and at the same time.
- 10. For the online submission of bids, the bidders will be given a link where to submit its bids. Bidders must submit a PDF copy of the notarized Bid Securing Declaration or a scanned copy of any acceptable form of Bid Security, together with the eligibility requirements, technical and financial proposals, as specified in the Bidding documents. The date and time appearing in the e-mail of BAC for the bids submitted online must be on or before **May 20, 2025 at 9:00 AM** to be on time.
- 11. The BAC shall open the online submitted bids with the bidder's password, which is only known to the bidder, during the opening of bids. This is to maintain the integrity of the government bidding process
- 12. The Polomolok Water District reserves the right to reject any and all bids, declare a failure of bidding, or not award the contract at any time prior to contract award in accordance with Sections 35.6 and 41 of the 2016 revised IRR of RA No. 9184, without thereby incurring any liability to the affected bidder or bidders.
- 13. For further information, please refer to:

BAC - Secretariat Polomolok Water District TeleFax No. : (083) 500-8008 E-mail address : <u>bacpolwd@gmail.com</u>

14. You may visit the following websites:

https://www.philgeps.gov.ph - PhilGEPS polwaterdistrict.gov.ph - Polomolok Water District

> SGD JOENEIL S. ASILO BAC Chairman

Notes on the Instructions to Bidders

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

1. Scope of Bid

The Procuring Entity, *POLOMOLOK WATER DISTRICT* wishes to receive Bids for the **CONSTRUCTION OF 300 CU.M. REINFORCED CONCRETE GROUND RESERVOIR AT ANTIPORTA** with identification number *PB 25-15*.

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

2. Funding Information

- 2.1. The GOP through the source of funding as indicated below for *FY 2024* in the amount of **FOUR MILLION ONE HUNDRED FIFTY THOUSAND PESOS & 00/100 (PHP 4,150,000.00).**
- 2.2. The source of funding is:
 - a. GOCC and GFIs, the Corporate Operating Budget.

3. Bidding Requirements

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

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

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

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

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

5. Eligible Bidders

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

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

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

6. Origin of Associated Goods

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

7. Subcontracts

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

The Procuring Entity has prescribed that:

a. Subcontracting is not allowed.

8. **Pre-Bid Conference**

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

9. Clarification and Amendment of Bidding Documents

Prospective bidders may request for clarification on and/or interpretation of any part of the Bidding Documents. Such requests must be in writing and received by the Procuring Entity, either at its given address or through electronic mail indicated in the

IB, at least ten (10) calendar days before the deadline set for the submission and receipt of Bids.

10. Documents Comprising the Bid: Eligibility and Technical Components

- 10.1. The first envelope shall contain the eligibility and technical documents of the Bid as specified in Section IX. Checklist of Technical and Financial Documents.
- 10.2. If the eligibility requirements or statements, the bids, and all other documents for submission to the BAC are in foreign language other than English, it must be accompanied by a translation in English, which shall be authenticated by the appropriate Philippine foreign service establishment, post, or the equivalent office having jurisdiction over the foreign bidder's affairs in the Philippines. For Contracting Parties to the Apostille Convention, only the translated documents shall be authenticated through an apostille pursuant to GPPB Resolution No. 13-2019 dated 23 May 2019. The English translation shall govern, for purposes of interpretation of the bid.
- 10.3. A valid special PCAB License in case of Joint Ventures, and registration for the type and cost of the contract for this Project. Any additional type of Contractor license or permit shall be indicated in the **BDS**.
- 10.4. A List of Contractor's key personnel (e.g., Project Engineer, Project Engineers, Materials Engineers, and Foremen) assigned to the contract to be bid, with their complete qualification and experience data shall be provided. These key personnel must meet the required minimum years of experience set in the **BDS**.
- 10.5. A List of Contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of PolWDship, certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be, must meet the minimum requirements for the contract set in the **BDS**.

11. Documents Comprising the Bid: Financial Component

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

12. Alternative Bids

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

13. Bid Prices

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

14. Bid and Payment Currencies

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

15. Bid Security

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

16. Sealing and Marking of Bids

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

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

If the Procuring Entity allows the submission of bids through online submission to the given website or any other electronic means, the Bidder shall submit an electronic copy

of its Bid, which must be digitally signed. An electronic copy that cannot be opened or is corrupted shall be considered non-responsive and, thus, automatically disqualified.

17. Deadline for Submission of Bids

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

18. Opening and Preliminary Examination of Bids

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

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

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

19. Detailed Evaluation and Comparison of Bids

- 19.1. The Procuring Entity's BAC shall immediately conduct a detailed evaluation of all Bids rated "*passed*" using non-discretionary pass/fail criteria. The BAC shall consider the conditions in the evaluation of Bids under Section 32.2 of 2016 revised IRR of RA No. 9184.
- 19.2. If the Project allows partial bids, all Bids and combinations of Bids as indicated in the **BDS** shall be received by the same deadline and opened and evaluated simultaneously so as to determine the Bid or combination of Bids offering the lowest calculated cost to the Procuring Entity. Bid Security as required by **ITB** Clause 15 shall be submitted for each contract (lot) separately.
- 19.3. In all cases, the NFCC computation pursuant to Section 23.4.2.6 of the 2016 revised IRR of RA No. 9184 must be sufficient for the total of the ABCs for all the lots participated in by the prospective Bidder.

20. Post Qualification

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

21. Signing of the Contract

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

Notes on the Bid Data Sheet (BDS)

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

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

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

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

Bid Data Sheet

ITB Clause			
5.2	For this purpose, contracts similar to the Project refer to contracts which have		
	the same major categories of work, whi	ch shall be:	
	RESERVOIR		
7.1	Not Applicable		
10.3	PCAB License – Small B Category C &	D(GE-3, Small B Category C and D)	
10.4	The following key personnel shall be p	resent during the implementation of the	
	project and must meet the required mini	imum years of experience set below:	
	Key Personnel	Relevant Experience	
	Project Engineer/Manager	minimum of 5 years	
	Materials Engineer	minimum of 5 years	
	Foreman	minimum of 5 years	
	Mason/Carpenter	minimum of 5 years	
	Carpenter	minimum of 5 years	
	Laborer (skilled/unskilled)	minimum of 5 years	
	Safety Officer	minimum of 5 years	
	First Aider	minimum of 5 years	
10.5	The minimum major equipment require Equipment Dumptruck Backhoe Water Truck	ments are the following: No. 2 1 1 5	
	Concrete Miyor (1 hagger)	<u> </u>	
	Concrete Wilker (1 – Dagger)		
	Der Cutter	4	
	Bar Cutter Der bondor	4	
	Bar bender	4	
	Plate Compactor		
	Welding Machine	1	
	Pneumatic Vibrating Koller	2	
	Sheep Foot Roller	1	
12	Not allowed		
15.1	The bid security shall be in the form of a	a Bid Securing Declaration or any of the	
	following forms and amounts:		

	 a. The amount of not less than PHP 83,000.00, if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit; or b. The amount of not less than PHP 207,500.00 if bid security is in Surety
	Bond.3
16	Each Bidder shall submit 1 original of the first and second components of its bid or two (2) password-protected Bidding Documents in compressed archive folders, in case of electronic bid submission, and which shall be submitted simultaneously. The first shall contain the technical component of the bid, including the eligibility requirements under Section 23.1 of this IRR For authentication purposes, all pages of the bidding documents for submission
	must be certified by the authorized signatory of the participating Bidder/Company. The bidders are also reminded to PUT PROPER TAB ON EACH BIDDING DOCUMENTS .
	Unsealed or unmarked bid envelopes, or in case of electronic bid submission, Bidding Documents not in compressed archive folders and are not password protected, shall be rejected. However, bid envelopes that are not properly sealed and marked shall be accepted, provided that the bidder or its duly authorized representative shall acknowledge such condition of the bid as submitted. The BAC shall assume no responsibility for the misplacement of the contents of the improperly sealed bid envelopes or improperly compressed or password- protected folder, or for its premature opening.
19.2	Partial bids are not allowed.
20	Permit to Drill
21	 The winning bidder shall submit the following additional documents relevant to the Project ten (10) calendar days from the receipt of the Notice of Award: construction schedule and S-curve, manpower schedule, construction methods, equipment utilization schedule, <i>construction safety and health program approved by the Department of Labor and Employment</i>, and PERT/CPM or other acceptable tools of project scheduling. Contractor's All Risk Insurance (CARI)
	 Note during the Implementation of the Project the winning bidder shall comply to the following: Written request prior to the commencement of any activity for approval Activity must strictly follow the activity sequence as listed above Strata samples collected every meter shall be properly marked and submitted to PolWD
	Pump test results (i.e. step – drawdown and constant discharge result) shall be submitted to PolWD.

Section IV. General Conditions of Contract

Notes on the General Conditions of Contract

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

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

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

1. Scope of Contract

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

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

2. Sectional Completion of Works

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

3. Possession of Site

- 3.1 The Procuring Entity shall give possession of all or parts of the Site to the Contractor based on the schedule of delivery indicated in the SCC, which corresponds to the execution of the Works. If the Contractor suffers delay or incurs cost from failure on the part of the Procuring Entity to give possession in accordance with the terms of this clause, the Procuring Entity's Representative shall give the Contractor a Contract Time Extension and certify such sum as fair to cover the cost incurred, which sum shall be paid by Procuring Entity.
 - 3.2 If possession of a portion is not given by the above date, the Procuring Entity will be deemed to have delayed the start of the relevant activities. The resulting adjustments in contract time to address such delay may be addressed through contract extension provided under Annex "E" of the 2016 revised IRR of RA No. 9184.

4. The Contractor's Obligations

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

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

5. **Performance Security**

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

6. Site Investigation Reports

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

7. Warranty

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

8. Liability of the Contractor

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

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

9. Termination for Other Causes

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

10. Dayworks

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

11. Program of Work

- 11.1. The Contractor shall submit to the Procuring Entity's Representative for approval the said Program of Work showing the general methods, arrangements, order, and timing for all the activities in the Works. The submissions of the Program of Work are indicated in the **SCC**.
- 11.2. The Contractor shall submit to the Procuring Entity's Representative for approval an updated Program of Work at intervals no longer than the period stated in the **SCC**. If the Contractor does not submit an updated Program of Work within this period, the Procuring Entity's Representative may withhold the amount stated in the **SCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program of Work has been submitted.

12. Instructions, Inspections and Audits

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

13. Advance Payment

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

14. **Progress Payments**

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

15. Operating and Maintenance Manuals

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

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

Section V. Special Conditions of Contract

Notes on the Special Conditions of Contract

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

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

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

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

Special Conditions of Contract

GCC Clause			
2	2 The Intended Completion Date is One Hundred (100) Calendar (including 18 pre-determined unworkable days and 30 calendar day permit acquisition) which will commence from the date of receipt of Notice to Proceed.		
	1. Completion Date for Construction (Physical) Works is One Hundred (100) Calendar Days (including 18 pre-determined unworkable days and 30 calendar days for permit acquisition). This shall be utilized to complete the construction works and other related works necessary in the physical accomplishment of the project. Delays incurred after this duration shall be subject to negative slippage with corresponding liquidated damages to be determined by the assigned POLWD Project Inspector.		
	2. Submission of Complete Documentary Requirements is within 30 Calendar Days. This shall be utilized to complete the necessary documentary requirements required for the completion of the project. This shall commence upon issuance of letter of instruction to proceed with the documentation works which will come after the issuance of certificate of completion of the construction (physical) works. Submission of incomplete required documents shall be subject to non – payment of Final Billing. The following documents shall form part of the documentary requirements required to be submitted within 30 calendar days:		
	 A. 95% to 100% Project Accomplishment: Request for joint inspection/punch listing Submission of the updated Performance Bond (if applicable) Request for Final Variation Order/Final Quantification with complete attachments: Detailed Estimates Shop Drawings Documentation Pictures 		
	 Submission of complete As-Built Drawings for approval (20" x 30" tracing paper and A3 sheet size) including the Editable Auto CAD File. The schedule of submission of As Built Drawings shall be in accordance with the SCC 15.1 and 15.2; penalties for late submission shall be applied accordingly. Submission of five sets blue printed As Built Drawings (approved) Updated Well Driller Certificate of Registration issued by National Water Resource Board (NWRB) 		

	7. Request for joint inspection with DPWH/City Engineers/other concerned agencies, if applicable.
	B. After approval of Final Request for Variation Order
	 Request for Final Inspection for Final Billing Submission of Final Billing with complete attachments
	NOTE: The contract duration shall be reckoned from the start date which is from the receipt of the Notice to Proceed (NTP) and not from contract effectivity date.
3.1	The Procuring Entity shall give possession of all parts of the Site to the Contractor after a pre-construction meeting between authorized representatives of the Procuring Entity and the Contractor.
4	The Contractor shall employ the following Key Personnel:
	[List key personnel by name and designation]
	Key Personnel Contractual Obligation:
	 Supervision of Key Personnel are essential for successful accomplishment of the work to be performed under this contract. The Contractor agrees that such personnel shall be present at all times to supervise the execution of the contract division where it is obligated to perform professional services. It shall also agree that the contracted Key Personnel shall not be removed from the contract work or replaced without compliance with the following: a. If the key personnel, for any justifiable reasons, becomes or is expected to become unavailable for work under this contract or is expected to devote substantially less effort to the work than indicated in the manpower utilization schedule or initially anticipated, the Contractor shall, only upon prior approval of the Polomolok Water District promptly replace personnel with personnel of equal ability or better qualifications. All requests for approval of substitutions hereunder must be in writing and provide a detailed explanation of the circumstances necessitating the proposed substitutions. The request must contain a resume for the proposed substitute, and any other information requested by the Contracting Officer. The Contracting Officer shall promptly notify the contractor of approval or disapproval in writing.
	b. If the Contractor introduces changes in Key Personnel for reasons not complying the provisions mentioned in Item a,

 the Contractor shall be liable for the imposition of damages as described in Item c. c. When Item a and Item b are violated under this contract, an amount equal to one hundred percent (100%) of the total basic rate of the key Personnel for the duration of the engagement as indicated in the Contractor's detailed cost estimates, shall be deducted from the Contractor's Progress Billing.
3. The Contract Division work components which requires the supervision of the Key Personnel shall only be considered for payment upon submission of the Supervising Key Personnel of a Certification/Undertaking that it has supervised and inspected the works according to the required specifications stipulated in the Contract. The Certification/Undertaking shall form part of the supporting documents for the request for progress billing.
The Project Engineer of the Contractor shall be authorized to sign request for variation order, final billing, as built plan, and other documents to expedite processing and completion of works.
NOTE: The names of the Key Personnel and their designation shall be filled out by winning contractor prior to contract signing.
Project Engineer refers to the representative of the PolWD coming from the Engineering and Operations Department who is authorized to oversee all the works required in the execution of the contract. He/she shall act on behalf of the PolWD either directly, indirectly or through its authorized project inspectors while the construction work is in progress.
Contractor's On-Site Representative/Project Coordinator shall act in behalf of the Contractor and is authorized to sign, receive and/or accept service of any notice or document issued pursuant to this contract in behalf of the Contractor.
PERMITS AND LICENSES:
The procurement and payment of permits and licenses necessary for the project implementation shall be the responsibility of the Contractor. The PolWD shall provide assistance whenever necessary.

4.1	The schedule of delivery of the possession of the site to the Contractor, shall be in full to carry out the projects on its intended completion of date which is one hundred (100) calendar days.
6	No further instructions.
7.2	Five years (semi – permanent structures)
10	Dayworks are applicable at the rate shown in the Contractor's original
	Bid.
11.1	The Contractor shall submit the Program of Work to the Procuring Entity's Representative within <i>ten</i> (10) <i>calendar</i> days of delivery of the
	Notice of Award.
11.2	The amount to be withheld for late submission of an updated Program of Work is 5% of the contract amount .
13	The amount of the advance payment shall not exceed 15% of the total contract price and schedule of payment.
14	Materials and equipment delivered on the site but not completely put in place shall not be included for payment.
15.1	The date by which "as built" drawings are required is 15 calendar days after the date of physical completion. However, the Contractor shall supply to the PolWD through Engineering and Operations Department the draft As-Built Drawings upon reaching ninety-five percent (95%) accomplishment to give ample time for review and checking. Upon reaching the 100 percent (100%) physical completion, the Contractor shall finalize its As-Built drawings and the final draft of the said drawings shall be submitted to the PolWD (PolWD) through its Production Division for final review and checking within the 15 calendar day's period from project physical completion. The Production Division shall conduct its final review and checking within forty-eight (48) hours upon receipt of the Contractor's final draft. The Contractor's obligation to submit the correct As-built Drawings, which is ready for approval, must be done within 15 DAYS AFTER THE DATE OF PHYSICAL COMPLETIION.
15.2	The request for final payment shall not be processed pending submission and approval of the "As Built Plans" and other required documents as stipulated in SCC Clause 2.

Section VI. Specifications

Notes on Specifications

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

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

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

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

Sample Clause: Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified will be accepted

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

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

Republic of the Philippines
POLOMOLOK WATER DISTRICT

National Highway, Brgy. Poblacion, Polomolok, South Cotabato



SPECIFICATION ON CONSTRUCTION OF 300 CU.M. REINFORCED CONCRETE GROUND RESERVOIR

(Pump Station #12)

Brgy. Lamcaliaf, Polomolok, South Cotabato

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1.0 GENERAL REQUIREMENTS

1.1 GENERAL DESCRIPTION OF WORK

The work covered in this Contract comprise the provision by the Contractor at his own risk and cost of all materials, shoring, tools, plants, labor, transports, water, power, and attendance, overhead and everything else necessary for the construction, installation and completion of the Works for the following:

1. Construction of 300 Cubic Meter Capacity Reinforced Concrete Ground Reservoir, Valve Box with Cover, Inlet and Outlet Steel Pipe and installation of its appurtenances.

2. Pipelaying of 250mm Ø Cement Mortar Lined – Epoxy Coated Steel Transmission/Distribution Pipelines.

to the entire approval of the PROCURING ENTITY.

All materials or workmanship shall comply with the specifications. Other standards superior to those enumerated in this specification shall be acceptable, subject to the approval of the PoIWD PIU representative, the authorized representative of the PoIWD. The opinion of the PoIWD PIU representative must be obtained prior to utilizing such materials or workmanship on or off the site.

1.2 PROJECT SITE

The location of the Site is at Brgy. Lamcaliaf, Polomolok, South Cotabato as shown on the Drawings. The Contractor shall be deemed to have inspected the Site before tendering and to take into account all the conditions there, such as means of access, facilities for transport, storage and movement of plants and materials, and any other contingencies liable to affect his tender price, as no claim for extra payment in this connection will be entertained.

The Contractor shall be liable for and shall indemnify the Procuring Entity against any damage, expense, liability, loss, claim or proceedings whatsoever whether arising at common law or by statute in respect of personnel injury to death of any person whomsoever or to any property arising out of or in the course of or by reason of the visit to the Site.

1.3 PLANS AND SPECIFICATIONS

Any conflict in the plans and specifications and applicable codes and standards, shall be referred to the PoIWD PIU representative for evaluation and appropriate action.

1.4 PERMITS

The processing and payment of building, sanitary / plumbing, mechanical, electrical, fire, and zoning certificate of compliance, all excavation permits and other permits necessary in the project implementation shall be the responsibility of the PolWD. The processing and payment of all construction and post construction permits necessary shall be the responsibility of the Contractor in the name of the PolWD as specified in *SCC Clause 11. Permits and licenses.* Cost of permits to be used by the Local Government Units (LGUs) and National Agencies such as the Department of Public Works and Highways (DPWH) shall be deemed as
included in the unit prices of every item in the contract. No separate payment will be paid to the Contractor for any permit arising from the work items in the contract.

1.5 RIGHT-OF-WAYS

- a. Lands of right-of-way for the Works to be constructed under the Contract will be provided by the PolWD or as shown on the Drawings. Nothing contained in the Contract Documents shall be interpreted as giving the Contractor exclusive occupancy of lands or right-of-way provided. Any additional lands or right-ofway required for construction operations shall be provided by the Contractor at his own expense.
- b. Except as may be provided, the Contractor shall secure, from the agencies having jurisdiction, the necessary permits to create obstructions, to make excavations if required under the Contract, and to otherwise encroach upon rights-of-way, and present evidence to the PolWD PIU representative that such permission has been granted, before work is commenced. Regulations and requirements of all agencies concerned shall be strictly adhered to in the performance of this Contract, including the furnishing of insurance and bonds required by such agencies. The enforcement of such requirements under this Contract shall not be made the basis for claims for additional compensation.

1.6 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

In the event the existing laid pipes of the PolWD, subscriber loop or communication facilities of the telecommunication companies, or any properties owned by the private establishments have been damaged during construction, the PolWD will not be held liable or obliged to pay for it. The Contractor must assure that there are no properties, whether owned or not by the PolWD, will be damaged; otherwise the Contractor shall be responsible for all the damages resulting from their operations, thus; these must be properly restored to the satisfaction of the private property PolWD or the agency having jurisdiction over public property.

1.7 BARRICADES AND WARNING LIGHTS

The Contractor shall provide and maintain sufficient number of barricades at any time, located in strategic locations of the project site or as directed by the PolWD PIU representative. These will serve as warning signs to ensure the safety within the PolWD Property as the project progresses.

Obstruction such as material piles and equipment shall be provided with similar warning signs and lights.

1.8 TRAFFIC COORDINATION AND MAINTENANCE OF TRAFFIC

Whenever work interferes with the flow of traffic along a roadway, the Contractor shall provide for traffic management rules and regulation. The Contractor shall provide traffic aides and watchmen/flagmen, when necessary, to ensure smooth flow of traffic. Where road closures or detours are permitted by the Local Government Unit (LGUs) or any concerned local authorities, the Contractor shall determine the appropriate agencies, boards, or departments the Contractor must notify prior to taking the action and the proper advance notice to be provided to each body.

Coordination with local police department and agencies concerned with vehicular traffic problems shall be responsibility of the Contractor. Prior to the start of the pipelaying activities, the Contractor shall show proof to the PolWD PIU representative that the aforesaid coordination was made and shall present to the present to the PolWD PIU representative for approval that safety arrangement and traffic deviation or rerouting program.

1.9 CLEARING OF ROUTES IN ROADS/STREETS

Routes of the proposed project are shown in the plans, clearing of said routes shall be the responsibility of the Contractor including the settlement of claims and complaints by the affected public.

1.10 MATERIAL TESTING

An independent testing laboratory will be nominated by the Contractor, which will be approved by the PolWD PIU representative. The approved laboratory shall undertake all testing material of sample required under the various Sections of this Specification. All tests shall be made in a laboratory. The cost of all tests required in this Contract shall be borne by the Contractor, and shall be deemed as included in the unit prices of the Contract.

1.11 INSPECTION AND TESTING

- a. All materials furnished and all work performed under the Contract shall be subject to the inspection by the **PolWD PIU representative and/or COA Auditor as the case may be.** Such inspection includes mill, plant, shop, or field inspection as required. The PIU inspectorate team shall be permitted to access to all parts of the work, including plants where materials or equipment are manufactured or fabricated; and they shall be furnished with such materials, information and assistance by the Contractor and Suppliers as required to make a complete and detailed inspection.
- b. Work done in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection; and the entire cost of removal and replacement, shall be borne by the Contractor regardless of whether the work removed is found to be defective or not.
- c. The cost of carrying out the required inspections and tests such as factory tests for materials and equipment to be delivered under the Contractor's expense under their normal contractual obligations. Whenever the place of plant and materials inspection is outside the Municipality of Polomolok where an accommodation of the PIU inspectorate team is necessary, the Contractor shall bear all the expenses to be incurred in the conduct of the inspection.
- d. The PIU inspectors will make, or have made, such required tests as they deem necessary to insure that the work is being accomplished in accordance with the requirements of the Contract.

In the event such tests conducted reveal non-compliance with the requirements of the Contract, the Contractor shall bear the cost of such

corrective measures deemed necessary by the PolWD PIU representative, as well as the cost of subsequent retesting.

e. For locally manufactured materials, the Contractor shall request PolWD PIU representative to witness the production/manufacturing of materials based on schedule.

1.12 DELAYS AND STOPPAGE

All delays and stoppages in the progress of the Work arising from disputes as to the quantity of materials, insufficient supply of materials, plants, etc and all damage or injury caused to the work of the Contract, or to the adjoining or adjacent works, buildings, streets, land, etc., in consequence of such delays and stoppages shall be solely and entirely at the risk and cost of the Contractor.

2.0 CONSTRUCTION OF 300 CU.M. RESERVOIR AND PIPING WORKS

2.1 WORK DESCRIPTION

The work to be performed under this item in these specifications includes furnishing all labor, materials, tools and equipment necessary to construct, inspect and test a reservoir and all its associated works as specified and included herein under the Contract.

The work shall also include all labor, materials and equipment necessary to clean, coat and disinfect the reservoir as specified herein.

The reservoir shall have an overflow pipe, inlet pipe, outlet pipe, drain pipe, pipe connection, access manhole and ladders (inside and outside), mechanical water level indicator, air vents and other necessary appurtenances, all in accordance to the approved plans.

2.2 SITE PREPARATION

A. GENERAL

All materials or workmanship shall comply with the specifications. Other standards superior to those enumerated in this specification shall be acceptable, subject to the approval of the PoIWD PIU representative, the authorized representative of the PoIWD. The approval of the PoIWD PIU representative must be obtained prior to utilizing such materials or workmanship on or off the site.

B. CLEARING AND GRUBBING

B.1 Description

This item shall consist of clearing, grubbing, removing and disposing all vegetation and debris as designated in the Contract, except those objects that are designated to remain in place or are to be removed in consonance with other provisions of this Specification. The work shall also include the preservation from injury or defacement of all objects designated to remain.

B.2 Construction Requirements

b.2.1 General

The PolWD PIU representative will establish the limits of work and designate all trees, shrubs, plants and other things to remain. The Contractor shall preserve all objects designated to remain. Paint required for cut or seared surface of trees or shrubs selected for retention shall be an approved asphaltum base paint prepared especially for tree pruning.

b.2.2 Clearing and Grubbing

All surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed, including mowing as required, except as provided below:

- Removal of undisturbed stumps and roots and nonbreakable solid objects with a minimum of 900mm (36inches) below sub grade or slope of embankments will not be required.
- (2) In areas outside of the grading limits of cut and embankment area, stumps and non-breakable solid objects shall be cut off not more than 150mm (6 inches) above the ground line or low water level.
- (3) In areas to be rounded at the top of cut slopes, stumps shall be cut off flush with or below the surface of the final slope line.
- (4) Grubbing of pits, channel changes and ditches will be required only to the depth necessitated by the proposed excavation within such areas.
- (5) Except in areas to be excavated, stumps holes and other holes from which obstructions were removed shall be backfilled with suitable material and compacted to the required density.
- (6) If perishable material is burned, it shall be done in accordance with applicable laws, ordinances, and regulations.
- (7) The disposal of materials and debris shall be approved by the PolWD PIU representative at the Contractor's expense.

B.3 Materials

Embankment fill shall be of suitable material, earth, gravel, sand, shale, coral, or rock approved by the PolWD PIU representative containing no rubbish, roots, muck, or any objectionable material.

B.4 Disposal of Objectional Materials, Cuttings and Demolished Materials

Cuttings, objectionable and demolished materials shall be disposed of in a manner and place as designated by the PoIWD PIU representative or as agreed by the PoIWD PIU representative and the Contractor at the expense of the Contractor. Salvageable materials shall be retained to the PoIWD and shall be stockpiled properly to protect them from vandals and the weather, if necessary, before these can be hauled to the PoIWD designated area.

B.5 Rolling to Grade

Embankment shall be placed and compacted in the following manner unless otherwise directed by the PolWD PIU representative.

Fill material composed of soil, sand, gravel or shale shall be spread in successive horizontal layer thickness not exceeding 200 mm on the full width of the area to be filled and then rolled in succession as specified, with a combination of tamping roller unit, with a minimum weight of 5 tons.

Rolling shall start longitudinally at the sides of the area being filled, proceeding towards the center, overlapping each pass by at least one half of the roller width on successive trips. The moisture content of the soil materials at the start of rolling shall approach the optimum moisture, as determined by Standard Laboratory test on soils.

B.6 Filling and Grading around Concrete Foundations

Filling and grading work around concrete foundations are subject to approval of PolWD PIU representative, and in any case shall be done only after at least 14 days from casting of affected parts. Compaction of fill around these structures shall be accomplished by approved manual tampers.

2.3 EARTHWORKS

A. GENERAL

a. The work includes the furnishing of all labor, materials, equipment, plant and other facilities and satisfactory performance of all work necessary to complete the preparation of site grading and excavation as shown in the drawing and specified herein for the construction of structures. b. All work included shall be subjected to the General Conditions, accompanying this Specifications. The Contractor for this portion of the work is required to refer specifically thereto.

B. STAKES AND BATTER BOARDS FOR STRUCTURES

- a. The Contractor shall stake out the reservoir/structure accurately and shall establish grades, after which approval by the PolWD PIU representative shall be secured before any excavation work is commenced.
- b. Basic Batter Boards and basic reference marks as directed by the PolWD PIU representative shall be erected at such places they will not be disturbed during construction.
- c. Materials shall be stored and work shall be conducted in such manner as to preserve all reference marks set by the PolWD PIU representative. Re-establishment of lines and grades when necessitated due to negligence on the part of the Contractor shall be done at the expense of the Contractor.
- d. The Contractor shall construct two permanent benchmarks of previously known elevations near or within the site of construction for the purpose of determining any settlement that may occur during the progress of construction.

C. EXCAVATION

a. Excavation, Filling, Grading & Backfilling

a.1 Scope

The work covered by this section of the specifications consists the furnishing all items, plants, labor, equipment, appliances, and materials, and in performing all operations that may be necessary, proper and incidental; to complete excavation, filling, backfilling and grading in accordance with this specifications and all applicable plans and drawings subject to the terms and conditions of the Contract.

a.2 Excavation

- (1) The Contractor shall make all necessary excavations, for foundations to grades indicated on drawings without extra compensation including all other excavations required and necessary for the proper execution of the work. Incidental excavation to level the bottom of slab, compacting and tamping the same are included in the contract.
- (2) Trim excavation bottoms to required lines and grades.

- (3) Materials: The materials to be excavated shall include any rock, earth and other materials of any nature and description encountered in obtaining indicated lines and grades, which, in the PoIWD PIU representative's opinion, can be loosened, removed by hand with hand tools or with proper shovel. Assume that all excavation to indicated lines and grades can be done by the aforementioned.
- (4) If the required safe bearing power is not obtained at the excavation indicated on drawings, the contractor shall inform the PolWD PIU representative accordingly before proceeding with the excavation. Thereafter, the excavation shall be continued until such bearing strength/pressure is obtained, piers and walls being lengthened accordingly and the footing shall be revised accordingly to suit the new conditions.
- (5) Unauthorized Excavation: Where existing surface levels are lower than sub-grade levels required for work, where excess or authorized excavation takes place beyond indicated line and grade at no extra cost to the PolWD as follows:
 - (5.1) where the footings and foundations occur, use concrete fill of the same class as specified for footings and foundation.
 - (5.2) where slabs occur, use well-compacted sand and gravel fill.
- (6) Omitted Excavation: When the nature of soil is such that good bearing or safe bearing is found to exist at higher grades than sub-grade levels indicated, the PoIWD PIU representative may decide to stop excavation work at those higher grades.

Should the PoIWD PIU representative so decide, it will be ordered in writing. This will be subject to reduction in the contract price in favor of the PoIWD at unit price bid, and/or at established unit price, based upon measurements taken between authorized higher grades and grades indicated on drawings. Some is true for omitted filling due to change of grade.

- (7) Footings shall not be placed on fill.
- (8) Protection, Pumping, Maintenance, etc.: The contractor shall protect at all times the excavations and trenches from damage of rainwater, spring water, backing of drains and from all other water. He shall provide and operate all pumps or other equipment necessary to drain

and keep excavations, pits, trenches and the entire subgrade area free of water under any circumstances and contingencies that may arise. He shall build all necessary enclosure, construct and maintain temporary drainage for the purpose. He shall provide all shoring, bracing and sheathing as required for safety, or necessary to support adjoining wall, walks, soils, streets, buildings, fences, etc., and for execution of the work, all these to be removed when work is completed, and/or required by the PolWD PIU representative.

a.3 Inspection

No pouring of concrete shall be done by the contractor unless bearing surface has been approved by the PoIWD PIU representative and the authority to proceed has been received by the Contractor.

a.4 Drainage System at Site

The Contractor shall provide, construct and maintain for the duration of the work, drainage system of site as approved and/or as directed by the PolWD PIU representative.

a.5 Utilities

- (1) The Contractor shall protect and maintain all conduits, drains, sewer pipes and other utility services that are to remain in the property or in the site, where required for the proper execution of the work.
- (2) The Contractor shall notify all corporations, companies, individuals, or other authorities concerned with the above conduits, drains, sewer pipes, etc., running to the project site; and protect, relocate, remove, cap or discontinue all pipes, sewer, and other utility services, which interface with the excavation of the work in accordance with instruction and requirements of the above parties.

a.6 Filling and Grading

- All excavation shall be backfilled presently as work permits after concrete walls and piers have attained full design strength and/or as directed by the PolWD PIU representative.
- (2) After forms have been removed from footings, walls and piers, the materials from excavations (free from waste and objectionable matter) shall be used for backfilling around them. This filling shall be made in layers not exceeding 150 mm (6") and thoroughly tampered. Materials not so used (excess excavated materials) shall

be placed and spread on the immediate premises as directed by the PoIWD PIU representative. However, when there is no available area for the excess excavated material, the Contractor disposes the same in appropriate disposal areas.

- (3) Open tile drains around the building (if any) shall be covered with crushed rock or gravel for a depth of 300 mm (12") and the same shall be graded from coarse to fine.
- (4) Open tile drains under floor slab (where so indicated on drawings) shall be covered with broken stones or gravel up to the bottom of the slab.
- (5) In spaces where slabs rest on ground, or on earth fill (as specified) in the plan, shall be leveled and accurately graded with 100 mm (4") of gravel and sand, and tampered thoroughly before concrete pouring is done.

a.7 Pipeline Trench Excavation

Pipeline trench excavation for the piping works of the reservoir shall be in accordance to the provisions in Section 3. Pipelaying Works, herein.

b. Backfilling

b.1 General

After the forms are removed, all trash, wood chips and other debris shall be removed from areas to be backfilled. Backfill shall not be dropped directly upon any structure or pipe. All materials used for backfill shall be new and selected material, free from grass, roots, brush, other vegetation, or rocks having a maximum dimension larger than 150 mm (6 in.). Material placed within 150 mm (6 in.) of any structure shall be free of rocks, unbroken masses or earthly materials having maximum dimension larger than 75 mm (3 in.) which would be detrimental to compaction requirements. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed.

b.2 Backfill Around Reservoir Walls

Backfill around reservoir walls shall consist of selected material obtained from the excavation and shall be placed in uniform layers not more than 200mm (8 in.) in thickness before compaction, where compaction is attained by means of sheep foot rollers. When the use of sheep foot rollers is impractical, the layers shall not exceed 150mm (6 in.) in thickness before compaction shall be attained by means of hand-operated

power-driven tampers. The backfill shall be brought up evenly with each layer moistened and compacted by mechanical means to ninety percent (90%) of maximum density. Flooding, ponding, or jetting will not be permitted. The reservoir shall remain filled with water while said backfill is being placed. Loaded carry walls or vehicles weighing more than 4500 kg (9,900 lbs) when loaded shall not be permitted closer to the walls than a horizontal distance equal to the depth of the fill at that time.

No backfill shall be placed against wall or other vertical surfaces until they have been inspected for leakage and backfilling is authorized by PoIWD PIU Representative.

b.3 Pipeline Trench Backfill and Backfill Materials for Pipe Trenches

Pipeline trench backfill and materials for the piping works of the reservoir shall be in accordance to the provisions in Section 3. Pipelaying Works.

b.4 Placement

Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or pneumatic roller. Where specified, every third and top most layer shall also be consolidated with power roller of weight approved by the PolWD PIU representative. Wherever depth of filling exceeds 1.5-meter vibratory power roller shall be used to consolidate the filing unless otherwise directed by PolWD PIU representative. The contractor shall make good all subsidence and shrinkage in earth fillings and embankments.

All foundation excavation and preparation shall be completed before placing fill. After placement, fill materials must be spread and blended by motor grader or other approved equipment. Except as required by the drawings, fill material shall be mixed and uniformly placed throughout the entire fill without lenses, streaks, pockets, or layers of material that differ significantly from surrounding material.

Placement and compaction methods must prevent damage to structures and allow the structure to assume backfill loads gradually and uniformly. Within 2 feet of any structure, fill layer thickness must not exceed 4 inches.

Fill shall be placed in approximately horizontal layers. Except as described above, compacted fill layer thickness shall not exceed six inches for compaction by large machines or four inches for small hand directed power tampers. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill, to a depth of not less than two inches, before the next layer is placed.

When filling the opening, the bonding surface of the fill in place shall be stripped of all materials not meeting the requirements of this specification and shall be scarified, moistened, and recompacted as new earth fill is placed.

b.6 Control of Moisture Content

During placement and compaction of earthfill, the moisture content of the material being placed shall be maintained within the specified range. Unless otherwise specified, the fill shall be compacted at a moisture content within two percent of optimum moisture. Application of water to earthfill material shall be accomplished at the borrow areas insofar as practicable, but may also be applied by sprinkling the material after placement on earthfill. Uniform moisture distribution shall be obtained by disking or blading.

Material that is too wet shall either be removed from the fill or dried to the specified moisture prior to compaction. If the top surface of the preceding layer becomes too dry to permit suitable bond, it shall be removed or scarified, moistened by sprinkling water to acceptable moisture content, and recompacted.

b.7 Fill materials adjacent to structures shall be placed and spread in layers not over 4 inches (100 mm) thick before compaction.
Fill materials adjacent to structures shall be manually tampered in a manner that will prevent damage to the structures.

The methods of compaction listed below are intended to achieve at least 90 percent of the maximum density as determined by the Standard Proctor Test, ASTM D 698. All fill materials, not placed adjacent to structures, shall be placed and spread in layers not over 9 inches (230 mm) thick before compaction. Each layer shall be compacted by traversing the entire surface using one of the methods listed:

For all other earthfill installations, use one of the following compaction methods:

(1) Tamping (Sheepsfoot) Roller - Minimum of 4 passes with contact pressure of at least 100 pounds per square inch (700 kPa), towed at speeds not exceeding 5 miles per hour (8 km/h). (2) Pneumatic (Rubber Tire) Roller - Minimum of 4 passes with a wheel load of at least 2.5 metric tons, towed at speeds not exceeding 5 mph (8 km/h).

b.8 Compaction Test Around Reservoir Wall

The backfill/embankment is required to be compacted to a specified density; tests for compliance may be made by and at the expense of the Contractor, using the test procedure specified in Methods of Tests for Moisture-Density Relation in Soils using a 10-lb hammer and 18-in. drop (ASTM D1557), modified to use three (3) layers. All field density tests shall be performed in accordance with the test procedure specified in Method of Test for Density of Soil in Place by the Sand Cone Method (ASTM D 1556).

A minimum of one (1) Field Density Testing samples shall be taken from every layer of compacted soil. It shall be laboratory tested to a degree of compaction of not less than ninety-five (95%) percent under structures and ninety percent (90%) elsewhere.

2.4 FOUNDATION REQUIREMENTS

- 1. No footing shall rest neither on un-compacted fill nor loose soil. The minimum concrete protection for reinforcement shall be 75mm clear.
- 2. All column reinforcement shall rest above the bottom reinforcements of the footing with 90-degree bend plus 12 times bar diameter extension at the free end but not less than 300mm. Hoops in the column shall continue below the top of the footing at 0.10m O.C.
- 3. No footing shall rest on fill, footing for CHB walls at other minor structures shall be embedded at least 600mm from the natural ground level.
- 4. Provide temporary removal of water from any source during construction. Dewatering shall be carefully and properly performed to avoid disturbing the foundations and slab bearing surfaces.
- 5. Contractor shall design, install and monitor excavations retention systems, as required for the protection of adjacent properties and provide all measures and precautions necessary to minimize settlement and prevent damage to adjacent existing or new construction.
- 6. Prepare conditions of concrete supply and placement of the complete foundation for the full thickness as a continuous monolithic casting.

2.5 FALSEWORKS

A. GENERAL

This work shall consist of the design, supply and construction of falseworks which will provide the necessary rigidity, support the loads imposed, and produce in the finished structure the lines and grades indicated in the drawings or as ordered by the PolWD PIU representative.

B. MATERIALS REQUIREMENT

Timber and lumber to be used for falsework shall be sound and comply with the requirements of AASHTO M183.

C. CONSTRUCTION REQUIREMENT

c.1 Falsework Design and Drawings

- (1) Detailed working drawings and supporting calculations of the falsework shall be furnished by the Contractor to the PolWD PIU representative. No falsework construction shall start until the PolWD PIU representative has reviewed and approved the designs. However, such approval by the PolWD PIU representative does not relieve the Contractor of his obligation to ensure safety and stability of the structure to which it is being served for. The Contractor shall provide sufficient time for the PolWD PIU representative to complete this review. Such time shall be proportionate to the complexity of the falsework design and in no case shall be less than 2 weeks.
- (2) The Contractor may revise the falsework drawings at any time provided sufficient time is allowed for the PolWD PIU representative to review before construction is started on the revised portion.

c.2 Falsework Construction

- (1) The falsework shall be constructed to conform to the falsework drawings. The materials used in the falsework construction shall be of the quantity and quality necessary to withstand the stresses imposed. The workmanship used in falsework shall be of such quality that the falsework will support the loads imposed on it.
- (2) Suitable jacks or wedges shall be used in connection with falsework to set the forms to their required grade and to take up any excessive settlement in the falsework either before or during the placing of concrete.
- (3) The Contractor shall provide tell-tales attached to the soffit forms easily readable and in enough systematically placed locations to determine the total settlement of the entire portion of the structure where concrete is being placed.
- (4) Should unanticipated events occur, including settlements that deviate more than +/- 20mm from those indicated on the falsework drawings, which in the opinion of the PolWD PIU

representative would prevent obtaining a structure conforming to the requirements of the Specification, the placing of concrete shall be discontinued until corrective measures satisfactory to the PoIWD PIU representative are compliant. In the event satisfactory measures are not provided prior to initial set of the concrete in the affected area, the placing of concrete shall be discontinued at a location determined by the PoIWD PIU representative. All unacceptable concrete shall be removed.

c.3 Removing Falsework

- (1) Unless otherwise shown in the drawings or permitted by the PolWD PIU representative, no falsework shall be released until the supported concrete has attained a compressive strength of at least 80 percent of the required 28-day strength.
- (2) All falsework materials shall be completely removed on site.
- (3) All debris and waste materials resulting from work shall be removed and the site left in a neat and presentable condition.

2.6 REINFORCED CONCRETE (Long Form)

A. GENERAL

The work to be undertaken shall include all labor, materials, equipment, plant and other facilities and the satisfactory performance of all works necessary to complete all concrete work shown in the drawings and specified herein. All works included under this section shall be subject to the General Conditions accompanying these specifications.

B. MATERIALS

b.1 Cement

Except as may be otherwise provided in these Specifications, cement shall conform to ASTM C-150-Latest Revision "Standard Specification for Portland Cement" and shall be Type I.

b.2 Concrete – Aggregates

- Concrete aggregates shall be well-graded, clean, hard particles of gravel or crushed rock conforming to ASTM C-33 Latest Revision "Standard Specification for Concrete Aggregates".
- (2) The maximum size of the aggregates shall not be larger than one-fifth (1/5) of the narrowest dimension between forms and not larger than three-fourth (3/4) of the minimum clear spacing between individual reinforcing bars or bundles of bars, and in no case larger than 38 mm (1-1/2 in.) in diameter except that larger diameters may be allowed in massive concreting with written permission from the PoIWD PIU representative.

b.3 Water

Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkali, organic materials, or other substances that may be deleterious to concrete or steel.

b.4 Reinforcing Steel

All reinforcing steel bars used shall be new and free from rust, oil, defects, greases or kinks and shall have **275.86 MPa (40,000 psi)** yield strength. It shall be of the size and number indicated in the drawings. It shall conform to the latest edition of the ASTM "Specifications for Deformed Billet Steel Bars for Concrete Reinforcement" grade 40 as shown or to the latest edition of the **National Structural Code of the Philippines for Buildings. Test on steel bars shall be borne by the Contractor.** It shall be accurately spaced and secured against displacement by the use of Gauge #16 G.I. Tie Wire.

b.5 Admixture

At the Contractor's option or at the request of the PoIWD PIU representative, but in either case at the expense of the Contractor, an admixture may be added to the concrete to control the set, effect water reduction and increase workability. Such admixture may be either a hydroxylated polymer type, but shall contain no calcium chloride. The required quantities of cement shall be used in the mix regardless of whether or not any admixture is used. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions. Where the air temperature at the time of placement is expected to be consistently over 26.7 °C (89 °F), such admixture shall be in accordance with approved standard.

b.6 Calcium Chloride

Except as otherwise specified for architectural finish, the use of calcium chloride in concrete will not be permitted.

C. STORAGE OF MATERIALS

Cement and aggregates shall be stored in such manner as to prevent deteriorations or intrusion by foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete. Steel shall be under cover or otherwise prevented from rusting.

D. TESTING OF MATERIALS

The PolWD PIU representative shall periodically order the test of any material supplied by the Contractor entering into concrete or reinforced concrete to determine its suitability for the intended purpose. Such test shall be in accordance with the standards of the American Society of Testing Materials,

as noted elsewhere in these Specifications. Samples shall be provided by the Contractor without cost to the PolWD. Expenses for the testing and cost of transporting samples to testing laboratory shall be borne by the Contractor. Copies of the result of tests shall be furnished to the PolWD promptly. Compressive strength specimens for test of concrete during construction shall be in accordance with ASTM C-31 "Standard Practice for Making and Curing of Concrete Test Specimens in the Field". Testing for compressive strength specimens for tests of reinforcing bars during construction shall be a minimum of four (4) samples for every batch of concrete. Tensile strength specimens for tests of reinforcing bars during construction shall be in accordance with the American Standard of Testing Materials. Testing for tensile strength specimen shall be a minimum of three (3) samples for every bar diameter for each delivery.

E. CONTROLLED STRENGTHS OF CONCRETE

Concrete for structural elements shall develop a minimum of **28th day** compressive cylinder strength of **27.60 MPa (4,000 psi)**, unless otherwise specified in the plans.

F. METHOD OF DETERMINING STRENGTH TRIAL BATCH

The Contractor shall submit design mixes and test results of samples made in accordance with ASTM C-192 Latest Revision "Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory" and ASTM C-39 "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens" for each strength required, stating the proposed slump and the proportional weights of cement, saturated surface dry aggregates and water. These mixtures shall be proved by preliminary test thirty (30) days before concreting and shall show a 28-day strength of fifteen percent (15%) higher than the ultimate strength required. No substitution shall be made in the materials or mixed without additional test to show that the quality is satisfactory.

G. CONCRETE PROPORTION AND CONSISTENCY

- (1) The proportions of aggregate to cement for any concrete shall be such as to produce a mixture that will work readily into the corners and angles of the forms and around reinforcement with the method of placing employed on the work but without permitting the materials to segregate, or excess free water to collect on the surface. The combined aggregates shall be of such composition of sizes that when separated on the no. 4 sieve, the weight passing the sieve (fine aggregate) shall not be less than thirty percent (30%) of the total, except that these proportions do not necessarily apply to lightweight aggregates.
- (2) The methods in measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked at anytime during the work. Measurement of materials for ready-mixed concrete shall conform to ASTM C-94 Latest Revision "Standard Specification for Ready-Mixed Concrete" where applicable.

- (3) Aggregates shall be measured out by weight and to within one percent (1%). Cement shall conform to 40 kgs. (88 lbs.) per bag and has to be verified from time to time. Water shall be measured by weight or volume to within one and one-half percent (1-1/2%).
- (4) The water shall in no case exceed 21.24 liters (5.62 US gallons) and 25.67 liters (6.79 US gallons) per bag of cement for all concrete with specified strength of f'c = 27.60 MPa (4,000 psi) and 17.25 MPa (2,500 psi), respectively. Slumps shall be within the following limits:

Portion of Structure	Slumps	
Fortion of Structure	Millimeters	Inches
Columns	50 - 100	2 – 4
Footing and Slabs	50 – 125	2 - 5

Slumps shall be in accordance with ASTM C-143 "Standard Test Method for Slump of Hydraulic-Cement Concrete".

- (5) The minimum cement content for 27.60 MPa (4,000 psi) concrete shall be 12 sacks per cubic meter of concrete.
- (6) Job mix adjustment on water content shall be allowed only with PolWD PIU representative permission and provided that cement is also to maintain the original water-cement ratio of the design mix.

H. EXCLUSION OF WATER

No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut-off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited under water without explicit permission of the PolWD PIU representative, and then only in strict accordance with his direction; nor shall the Contractor, without explicit permission allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the approval of the PolWD PIU representative.

I. MIXING OF CONCRETE

- a. No hand mixing shall be allowed except in emergency such as mixer breakdown during concreting operations and this shall stop as soon as the pour is completed, at a construction joint shown or otherwise designated by the PolWD PIU representative. All concrete shall be machine mixed for at least one and one-half (1-1/2) minutes after all materials, including water, are in the mixing drum.
- b. The mixer shall be of an approved size and type that will ensure a uniform distribution of materials throughout the mass. It shall be equipped with a device for accurately measuring and controlling the amount of mixing water in each batch.

- c. The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat the inside of the drum without reducing the cement of the mix to be discharged.
- d. Re-tampering i.e., remixing with the addition of water to concrete that has been partially hardened will not be permitted.

J. PREPARATION OF SURFACES FOR CONCRETING

a. Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete.

Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, in the opinion of the PolWD PIU representative, the new concrete cannot be incorporated integrally with that previous placed, are defined as construction joints. The surfaces of horizontal joints shall be leveled with a wooden float to provide a reasonably smooth surface. The surface consisting largely of coarse aggregate shall be avoided. Except where the drawings call for joint surfaces to be painted, the joint surfaces shall be cleaned of all laitance, loose or defective concrete and foreign materials. Such cleaning shall be accomplished by sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed. After the surfaces have been prepared to the satisfaction of the PolWD PIU representative, all approximately horizontal construction joints shall be covered with a layer of mortar approximately 25 mm (1 in.) thick. The mortar shall have the same proportion of cement and sand as the regular concrete mixture, unless otherwise directed by the PoIWD PIU representative. The watercement ratio of the mortar in place shall not exceed that of the concrete to be placed upon it, and the consistency of the mortar shall be suitable for placing and working in a manner hereinafter specified. The mortar shall be spread uniformly and shall be worked thoroughly into all irregularities of the surface, and wire brooms shall be used where possible to scrub the mortar into the surface. Concrete shall be placed immediately upon the fresh mortar.

b. When the placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that secure proper union with subsequent work, provided that construction joints shall be made only where approved by the PoIWD PIU representative.

K. PLACING CONCRETE

a. Concrete, which upon or before placing is found not to conform to the requirement specified herein, shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these

specifications, or which is of inferior quality as determined by the PolWD PIU representative, shall be removed and replaced by and at the expense of the Contractor. No concrete shall be placed except in the presence of the PolWD PIU representative or his duly authorized representative. Concrete shall not be placed when unsuitable heat or wind condition will prevent proper placement and curing, as determined by the PolWD PIU representative. Prior to placing any concrete, the Contractor shall give the PolWD PIU representative twenty-four (24) hours written notice.

- b. Concrete shall be deposited in its final position without segregation, rehandling, or flowing. Placing shall be done preferably with buggies, buckets, or wheelbarrows. No chutes will be allowed except to transfer concrete from hoppers to buggies, wheelbarrows, or buckets in which case, they shall not exceed six (6) meters (20 feet) in aggregate length.
- c. Placing of concrete with a free drop or fall more than 1.20 meters (4 ft.) shall not be allowed, except when approved by the PoIWD PIU representative and when approved, sheet metal conduits, pipes, or "elephant trunks" are employed. When employed, these conveyors shall be kept full of concrete and the ends kept buried in the newly placed concrete as pouring progresses. The pouring scheme plan shall be provided or submitted by the Contractor.
- d. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 450 mm (18 in.) and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 1.4 meters (4.6 ft.) of vertical rise per hour.

L. FORMWORKS

a. General

The Contractor shall provide forms to confine and shape into the required lines. Plastering, in general, shall not be allowed. Contractor shall assume full responsibility for the adequate design of all forms. However, forms, which in the opinion of the PolWD PIU representative are unsafe or inadequate in any respect, may at any time be condemned by the PolWD PIU representative; and the Contractor shall promptly remove the condemned forms from the work and replace them at his own expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. Whenever, in the opinion of the PolWD PIU representative, additional forms are necessary to maintain the progress schedule, such additional forms shall be provided by the Contractor at his own expense. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable safety regulations, and as may be specified in the General Conditions of these specifications.

All removed forms and scaffoldings after completion of the project shall be retained to the PolWD and shall be stockpiled properly to protect them from vandals and the weather, if necessary, before these can be hauled to the designated area.

b. Materials

Except as otherwise expressly approved by the PolWD PIU representative, all lumber brought at the job site for use as forms, shoring, or bracing shall be new materials. All forms shall be smooth surface forms and shall be of the following materials:

Walls	-	Steel or Plywood Panels
Columns	-	Steel, Plywood, or surface lumber
All other work	-	Steel panels, plywood, or surface lumber

Plywood shall be manufactured especially for concrete formwork and shall be oiled with an approved form oil and edge sealed.

c. Column Forms

Column forms shall be checked for plumbness before concrete is deposited. Hand holes shall be provided in column forms at lowest point of pour lifts to render this space accessible for cleaning.

All girder, beams and slab centerlines shall be crowned at least 6.3mm
(4 in.) in all directions for every 4.57 meters (15 ft.) span. However, cambers from all cantilevers shall be as indicated in the plans or obtained from the PolWD PIU representative by the Contractor.

e. The following are the tolerance limits for formworks:

(i) Variation from plumb:

In lines and surfaces of columns and walls:

In 3.05m (10 ft.)	6.3mm (1/4 in.)
6.10m (20 ft.) max	9.5mm (3/8 in.)
12.20m (40 ft.) or more	19.0mm (3.4 in.)

For exposed corner columns, control joint grooves and other conspicuous lines:

In any bay 6.10m (20 ft.) max	6.3mm (1/4 in.)
In 12.20m (40 ft.) or more	13.0mm (1/2 in.)

 Variation in cross-sectional dimensions of columns, beams, and thickness of walls and slabs:

Minus	6.3mm (1/4 in.)
Plus	13.0mm (1/2 in.)

f. Design

All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 16 mm. (5/8 in.) and greater in thickness, may be fastened directly to studding if the studs are close enough to prevent visible deflection marks in concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Adequate clean out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be subject to the approval of the PolWD PIU representative.

Concrete construction joints will not be permitted at locations other than those shown or specified, except, as may be approved by the PoIWD PIU representative. When a second lift is placed on hardened concrete, special precaution shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

Reservoir forms and falsework supporting the roof slab shall be designed for a minimum additional live load of 146 kg/m2 (30 psf).

g. Maintenance of Forms

Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The forms" surfaces shall be treated with non-staining mineral or other lubricant approved by the PoIWD PIU representative. Any excess lubricant shall be satisfactorily removed before placing the concrete. In addition, all forms shall be given a preliminary oil treatment by the manufacturer or shall be oiled by the Contractor at least two (2) weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embodied in the concrete.

Forms may be re-used if in good condition and if approved by the PolWD PIU representative. Light sanding between uses will be required wherever necessary in the opinion of the PolWD PIU representative to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic structures, unused tie rod holes shall be covered with metal caps or shall be filled by other methods approved by the PolWD PIU representative.

h. Form Ties

Form ties with integral water stops shall be provided with a cork or other suitable means for forming conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removal cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 38 mm (1-1/2 in.) and all such fasteners shall be such as to leave holes of regular shape for reaming. Holes left by the removal of fasteners from the ends of snap-ties or formties shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough before being filled with mortar as provided in Section 4.20. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete, nor shall any tie be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the forms in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 25 mm. (1 in.) back from the formed face(s) of the concrete. Form ties or metal rods left embedded in concrete of water retaining tanks shall be equipped with integral metal water stop of not less than 38 mm (1 1/2 in.) in diameter.

i. Vertical Surfaces

All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for in the drawing or explicitly authorized by the PoIWD PIU representative. Not less than 25mm (1 in.) of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited heights and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

j. Removal of Forms

Directions of the PoIWD PIU representative concerning the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 158 kgf/cm2 (2,250 psi) provided that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained a strength of 158 kgf/cm2 (2,250 psi) and has been in place for a minimum of fourteen (14) days. The time required to establish such strength will be determined by the PoIWD PIU representative who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If

the time so determined is more than the fourteen-day minimum, then it shall be used as the minimum length of time.

Forms for all vertical walls and columns shall remain in place at least fourteen (14) days after the concrete has been placed. Forms for all parts of the work not specifically mentioned herein shall remain in place for periods of time as ordered by the PolWD PIU representative.

M. CONSTRUCTION JOINTS

a. General

Construction joints shall be provided where shown on the drawings. Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated on the drawings, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with Section (j). Except where otherwise shown or specified, at all joints where waterstops are required, the joint face of the first pour shall be coated with an approved bond breaker applied in accordance with the recommendations of the manufacturer. It shall contain a coloring agent so that areas of application will be readily distinguishable for a six-month period in sunlight. The surfaces of the groove for the sealant shall not be coated. Concrete next to waterstops shall be placed in accordance with subsection p. (2).

b. Construction Joint Sealant

Where shown, construction joints in floor slabs shall be provided with tapered grooves that shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sandblasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed and filled with the construction joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant. The sealant shall be polyurethane polymer or substitute designed for bonding to concrete which is continuously submerged in water. No material will be accepted which has an unsatisfactory history as to bond or durability when used in the joints of hydraulic structures. Prior to ordering the sealant material, the Contractor shall submit to the PolWD PIU representative for approval sufficient data to show general compliance with the specification requirements. The material shall meet the following requirements:

Work Life	45 to 90 minutes
Time to Reach 20 Shore "A"	24 Hours, Max
Hardness	
(at 25 °C, 200 gr. Quantity)	

Ultimate Hardness	30 to 40 Shore "A"	
Tensile Strength	17.58 kgf/cm ² (250 psi), min.	
Ultimate Elongation	400 percent, min.	
Tear Resistance	13.4 kg per cm	
(Die C ASTM D624)	(75 lb per inch)	
	Of thickness, min.	
Color	Light Gray	

In addition, the material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure:

- (i) Sealant specimen shall be prepared between two concrete blocks 25mm x 50mm x 76mm (1 in. x 2 in. x 3 in.) in size. Spacing between the blocks shall be 13mm (1/2 in.). Coated spacers 50mm x 38mm x 13mm (2 in. x 1 1/2in. x 1/2 in.) shall be used to insure sealant cross-sections of 13mm x 50mm (1/2 in. x 2 in.) with a width of 13mm (1/2 in.).
- Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall not exceed twenty-four (24) hours.
- (iii) Following the curing period, the gap between blocks shall be widened to 31.70 mm (1-1/4 in.). Spacers shall be used to maintain this gap for twenty four (24) hours prior to inspection for failure.

Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements shall be furnished to the PolWD PIU representative before the sealant is used on the job. The primer and the sealant shall be placed strictly in accordance with the recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. Before any sealant is placed, the crew doing the work shall be carefully instructed as to the proper method of application by a representative of the sealant manufacturer. All sealant shall cure at least seven (7) days before the structure is filled with water.

c. Waterstop

- (i) PVC Waterstop
 - (1) Where PVC waterstop is used, it shall be extruded from an elastometric polyvinyl chloride compound containing the necessary plasticizers, resins, stabilizers and other materials necessary to meet the requirements of these specifications. No reclaimed or scrap material shall be used. The waterstop manufacturer shall furnish to the PolWD PIU representative current test reports and a

written certification that the material to be shipped to the job site meets the following physical requirements:

Physical Property	Value	ASTM Std.	
Sheet Material			
Tensile Strength (minimum)	123 kgf/cm ² (1750 psi)	D412, Die C	
Ultimate Elongation (minimum)	350%	D412, Die C	
Low Temp. Brittleness	-37°C (-35°C)	D746	
Stiffness in Flexure (minimum)	28 kgf/cm ² (400 psi)	D747	
Accelerated Extraction			
Tensile Strength (minimum)	105 kgf/cm ² (1500 psi)	D412, Die C	
Ultimate Elongation (minimum)	300%	D412, Die C	
Change in weight (%)	+0.25 / -0.10		
Change in Durometer, Shore A	+5	D2240	
Tensile Strength (minimum)	98 kgf/cm ²	D412, Die C	
Ultimate Elongation (minimum)	280%	D412, Die C	

- (2) Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be furnished under this Contract. The balance of the material to be used under this Contract shall not be produced until after the PolWD PIU representative has approved the qualification samples.
- (3) Prior to use of the waterstop material in the field, a sample of a fabricated cross constructed of each size or shape of material to be used shall be submitted to the PolWD PIU representative for approval. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this Contract. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the

PolWD PIU representative for testing by a laboratory at the Contractor's expense. When tested, they shall have tensile strength across the joints equal to at least 42.2 kgf/cm2 (600 psi). Field splices and joints shall be made in accordance with the waterstop manufacturer's instruction using a thermostatically-controlled heating iron.

- (4) Center Bulb Waterstops, where required, shall be as shown. At no place shall the thickness be less than 4.76 mm (0.1875 in.). Adequate means shall be provided for anchoring the waterstop in concrete. In placing 6" Center Bulb Waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Horizontal waterstops shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. Vertical waterstops shall be held in place with light wire ties on 450mm (18 in.) centers that shall be passed through the edge of the waterstop and tied to the two curtains of reinforcing steel. In placing concrete around waterstops, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- (ii) Bentonite/Butyl Rubber Based Waterstop

Property	Value	Test Method
Specific Gravity @ 15 °C	1.57 g/m ³	ASTM D71
Penetration		ASTM D217
	58	150 GTL
	85	300 GTL
Flash Point	185 °C	ASTM D93-97
Max. Head Pressure	70m (7 bar)	Hydrostatic Pressure Test
Accelerated Aging	Maintained 99% Solid	(Mechanical Oven for 4 hours at 100 °C)
Flow Resistance	No Flow	(200mm Overhead Joint Exposed to 57°C for 7 days)
Storage Life	Indefinite	
Adhesion to Concrete	Mechanical Fastening or Adhesive	

(1) Where Bentonite/Butyl Rubber Based Waterstop is used, it shall have the following properties:

Application Temperature Change	(-15°C ÷ 52°C)	
Service Temperature Range	(-40°C ÷ 100°C)	

When using Bentonite/Butyl Rubber Based Waterstop, an adhesive is required to secure it to the concrete. This material should only be used in applications where the material is encapsulated within the concrete. Split forming and seam welding will not be permitted. Installation of Bentonite/Butyl Rubber Based Waterstop shall be as shown in the drawings.

- (2) The material shall be applied to both vertical and horizontal non-moving concrete construction, irregular surfaces, new to existing concrete construction and around through-wall penetrations.
- (3) Prior to its use, surfaces shall be clean and dry. All dirt, rocks, rust, or other construction debris shall be removed. Installation of waterstop in standing water will not be permitted. Primer or adhesive shall be applied in accordance with AWWA C550 and C116, along the entire surface length to receive the waterstop. Adhesive shall be allowed to dry for 5 10 minutes or until black, except during damp conditions where a longer period is required until satisfactory result is attained.
- (4) After allowing the adhesive to dry black, firmly press the entire length of the waterstop onto the adhesive within two (2) hours of adhesive turning black to obtain best results. Areas not receiving waterstop within six (6) hours should be recoated with adhesive.
- (5) Tightly butt coil ends together to form a continuous waterstop; do not overlap coil ends. It shall be placed in maximum practicable lengths to minimize coil end joints. Where required, cut coils with a sharp knife or utility blade to fit coil ends together. Make horizontal to vertical transitions by abutting coil sections together, no special accessory pieces are required. Mechanical fasteners should not be used to secure waterstop alone, conjunctive use with adhesive is required.
- (6) Waterstop should not be pre-hydrated by being subjected to submersion or remain in contact with water prior to concrete pour. If the material exhibits considerable swell prior to confinement in the joint, it must be replaced with new material.

d. Expansion Joint Filler

Where expansion joint filler is indicated in the drawings, the material shall be of the pre-formed non-extruding type joint filler which may be constructed of open cellular sponge rubber, or closed cellular sponge rubber of firm texture. Bituminous fiber type will not be permitted. All nonextruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in "Specifications for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction", Type I (ASTM Designated D1752), except as otherwise provided herein.

N. CORROSION PROTECTION REQUIREMENTS

Pipes, conduits, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 50 mm (2 in.) clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding those to the reinforcement will not be permitted.

O. ORDER OF PLACING THE CONCRETE

- a. The order of placing concrete in all parts of the work shall be subject to the approval of the PolWD PIU representative. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown in the drawings. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least seven (7) days before the contiguous unit or units are placed, except that beams and columns shall be placed until the footings have cured at least fourteen (14) days.
- b. The surface of the concrete shall be leveled whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 19mm (3/4 in.) thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 13mm (1/2 in.) above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

P. TAMPING AND VIBRATING

- a. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted throughout the entire depth of the layer which is being consolidated into a dense, homogenous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets and bringing only a slight excess of water to the exposed surface of concrete during placement.
- b. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets had been eliminated. The concrete shall be worked

under the waterstops by hand or vibrated for 1 minute, making sure that all air and rock pockets have been eliminated.

c. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Except in special cases where their use is deemed impracticable by the PolWD PIU representative, the Contractor shall use a minimum of six (6) internally vibrated, high speed power vibrators not less than 8,000 rpm of an approved immersion type or in sufficient numbers, with four (4) standby units or as required, to accomplish the results herein specified within fifteen (15) minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents or tends to bring an excessive amount of water to the surface.

Q. CURING AND WATERPROOFING

a. General

All concrete shall be cured for not less than fourteen (14) days after placing, in accordance with the methods specified herein for the different parts of the work, and described in detail in the following subsections.

Surface to be cured or waterproofed	Method
Unstripped Wooden forms	1
Construction Joints between footings and walls, and between floor slabs and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces, not specifically provided for elsewhere in the subsection	4
Floor slabs in hydraulic structures and exterior surfaces of exposed roof slabs	5
Exterior buried surfaces of walls	6

b. Method 1

Wooden forms shall be wetted immediately after concrete has been poured and shall be kept wet with water until removed. If forms are removed within fourteen (14) days of placing the concrete, curing shall be continued in accordance with the applicable method for the particular structures as set out in Methods 2, 4, 5 and 6 below.

c. Method 2

The surface shall be covered with burlap mats, which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

d. Method 3

The surface shall be covered with moist earth, not less than four (4) hours nor more than twenty-four (24) hours, after the concrete is placed.

e. Method 4

- (i) The surface shall be sprayed with a liquid curing compound, which will not affect the bond of paint to the concrete surface. It shall be applied in accordance with the manufacturer's instructions at a maximum coverage rate of 4.91 sq.m./liter (200 sq.ft. /gal) in such manner as to cover the surface with the uniform film, which will seal thoroughly.
- (ii) Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
- (iii) Wherever curing compound may have been applied by mistake to surfaces, against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by sandblasting just prior to the placing of new concrete.
- (iv) Where curing compound is specified, it shall be applied within two (2) hours after completion of the finish on unformed surfaces, and within two (2) hours after removal of forms on formed surfaces. Repairs required to be made to form surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wetsandblasted to remove the curing compound, following which, repairs shall be made as provided under Section 4.20.

f. Method 5

Immediately after the concrete has been troweled, it shall be given a coat of curing compound in accordance with Subsection (5) – Method 4 herein. Not less than one (1) hour or more than four (4) hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle and concrete curing blankets shall be placed on the slabs. The curing blankets shall consist of one of the following two types:

- Sheets of heavy, waterproof sisal kraft paper laid with the edges butted together and with the joints between strips sealed with 50mm (2 in.) wide strips of sealing tape or with the edges lapped not less than 76mm (3 in.) and fastened together with a waterproof cement to form a continuous watertight joint.
- (ii) Sheets of clear polyethylene having a thickness of not less than six (6) mils laid with edges butted together and with joints between sheets sealed with 25mm (1 in.) wide strips or acetate tape. The curing blankets shall be left in place during the 14-day curing period and shall not be removed until after concrete for adjacent work has been placed. Should the curing blankets become torn or otherwise ineffective, the Contractor shall replace damaged sections. During the first seven (7) days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 16mm (5/8 in.) minimum thickness laid over the curing blanket.

g. Method 6

- (i) The surface shall be sprayed with a waterproofing agent consisting of a bituminous paint immediately after the wall forms have been removed. Application shall be in two coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 2.45 sq.m./L (100 sq.ft./gal) of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 2.45 sq.m./L (100 sq.ft./gal).
- (ii) As soon as the bituminous paint applied in accordance with Method 6 (a) has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until backfill is placed, the Contractor shall apply additional whitewash as ordered by the PoIWD PIU representative.

R. CARE AND REPAIR OF CONCRETE

The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other causes until final acceptance by the PolWD. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the complete work, or which departs from the established line or grade, or which for any other reason does not conform with the specifications, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

S. FINISH OF CONCRETE SURFACES

- a. All finished or formed surfaces shall conform accurately with the shape, alignment, grades and sections as indicated in the plans or as prescribed by the PolWD PIU representative. Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface.
- b. Except as otherwise provided herein, unformed top surfaces of concrete shall be brought to uniform surfaces and worked with suitable tools to a reasonably smooth woodfloat finish. Excessive floating of surfaces while the concrete is plastic will not be permitted. All surfaces shall be placed monolithically with the base slab. Dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted.

T. TREATMENT OF SURFACE DEFECTS

- a. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the PoIWD PIU representative, and then, only in strict accordance with his directions. Concrete containing voids, holes, honeycombs, or similar depression defects shall be completely removed and replaced; provided that where required or approved by the PoIWD PIU representative, defects shall be repaired with gunite or with cement mortar placed by an approved compressed air mortar gun. In no case will extensive patching of honeycombed concrete be permitted. All repairs and replacements herein specified shall be promptly executed by the Contractor at his own expense.
- b. Defective surfaces to be repaired as specified in Sub-section 20. (a) herein shall be cut back from true line a minimum depth of 13mm (1/2 in.) over the entire area. Feathered edges shall be avoided. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding for the removal of all laitance or soft materials, and not less than 0.79mm (1/32 in.) depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with gunite or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair purposes shall consist of mixture of one (1) bag of cement to 0.08 cu.m. (3 cu. ft.) of sand. For exposed beams and columns, the cement shall contain such a proportion of white portland cement as is required to make the color or the patch match the color of the surrounding concrete.

- c. Holes left by the tie rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry packed mortar. Holes left by form-typing devices having a rectangular cross section and other imperfections having a depth greater than their least surfaces dimension, shall not be reamed but shall be repaired in an approved manner with dry packed mortar.
- d. All repairs shall be built up and shaped in such manner that the completed work will conform with the requirements of Sub-section 19. using approved methods which will not disturb the bond, cause sagging, or horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- e. Prior to filling any structure with water, any crack that may have developed shall be "vee'd" as shown in the drawings, and filled with sealant conforming to the requirement of Subsection m. (2).

U. READY - MIXED CONCRETE

- At the Contractor's option, ready-mixed concrete may be used in meeting the requirements as to materials, batching, mixing, transporting and placing as specified herein and in the requirements of the ASTM C-94 "Standard Specification for Ready-Mixed Concrete", including the supplementary requirements specified in Subsections (2) through (7) herein.
- b. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one (1) hour after the addition of the cement to the aggregates or before the drum has been revolved to 250 revolutions, whichever is first. In hot weather, or other conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 29.44°C (85°F) or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed forty-five (45) minutes.
- c. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of resettable, recording type and shall be mounted in the driver"s cab. The counter shall be actuated at the time of starting mixers at mixing speeds.
- d. Each batch of concrete shall be mixed in a truck mixer for not less than seventy (70) revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

- e. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately ¼ and ¾ points of the load during discharge give slumps differing by more than 25 mm (1 in.) when specified slump is 76 mm (3 in.) or less, or if they differ by more than 50 mm (2 in.) when the specified slump is more than 76 mm (3 in.), the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump test. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- f. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a ticket furnished to the PolWD PIU representative showing volume of concrete, the weight of cement in kilograms (pounds), and total weight of all ingredients in kilograms (pounds). The ticket shall also show the time of day at which the materials were batched.
- g. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batched aggregates shall be subject to continuous inspection at the batching plant by the PolWD PIU representative.

V. ARCHITECTURAL FINISH

All prominently exposed exterior, vertical, above ground concrete surfaces shall be given an architectural finish as follows:

Immediately after the forms are stripped, the concrete surface shall be inspected and all poor joints, void, rock pockets, or other defective areas shall be repaired and all form tie fastener holes filled as required in Section 4.20. After the concrete has cured at least fourteen (14) days, wet the surface and apply with a brush, a grout made by mixing one (1) part portland cement and one (1) part of fine sand that will pass a no. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be one-half gray and one-half white Portland cement, or as directed by the PolWD PIU representative. Calcium chloride in the amount of five percent (5%) by volume of the cement shall be used in the brush coat. The freshly applied grout shall be vigorously rubbed into the concrete surface with wood float filling all small air holes. The surface shall then be kept moist for an hour or more, depending on the weather, until the grout hardens sufficiently so that it can be scraped from the surface with the edge of a steel trowel without disturbing grout in the air holes. After all the surface grout has been removed with a steel trowel, the surface shall be allowed to dry, and when dry, shall be vigorously rubbed with a burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area must be completed the day it is started, and no grout shall be left on the surface overnight. Cleaning operations for any given day shall be terminated

at panel joints. It is essential that the various operations be carefully timed to secure the desired effect, which is a light-colored concrete surface of uniform color and texture without any appearance of paint or grout film. In the event that improper manipulation results in an inferior finish, the Contractor shall rub such inferior areas with carborundum bricks as directed by the PolWD PIU representative. Before beginning any of the final treatment on exposed surfaces, the Contractor shall treat in a satisfactory manner an area of at least 18.60 sq.m. (200 sq.ft.) in some inconspicuous place selected by the PolWD PIU representative and shall preserve said treated area undisturbed until the completion of the job. All architecturally treated concrete surfaces shall conform to the approved sample in texture, color, and quality. It shall be the Contractor's responsibility to maintain and protect the concrete finish.

W. SLIPFORM PROCESS IN CONCRETE WORK

a. General

The use of slipform in concrete work is optional for this project. However, should the Contractor decide to adopt slipform in concreting, the procedures/guidelines outlined below shall be followed.

b. Form Material

The material to be used shall be steel, plywood, or timber sheathing.

c. Depth of Forms

The effective depth of any slipform shall be a minimum of 1.00 m (39 in.) and a maximum of 2.00 m (78 in.).

d. Yokes

Additional supports shall be provided in order to prevent buckling of the jack rods.

e. Bracing and Working Platform

The Contractor shall provide adequate bracing which shall be a part of the working platform. Plywood not less than 19mm (0.75 in.) thick may be used as the working platform. The top of the working platform shall be in the same level as the tops of the inside forms, to permit direct shoveling of concrete from the deck into the forms.

f. Jacking System

The Contractor shall use hydraulic lifting gear with hydraulic jacks bearing against rod buried in the concrete. Alternately, the forms may be lifted by winches and cable, rack and pinion, or hung from steel rods. Hydraulically operated jacks with capacities ranging from 3,000, 4,500 and 6,000 kilograms shall be used. Jacks shall be cylindrical in shape with a hole in the center through which the jack rod passes, with two sets of jaws that alternately lift and grip.

g. Jack Rods

The Contractor shall use 25 mm (1 in.) diameter smooth mild steel bars with threaded ends for easy coupling for extension. Jack rods shall remain in place as part of the reinforcement. Unsupported length of jack rods shall not be more than 0.6 m (2 ft.) on maximum load. Where rods pass through large formed openings, they must be braced adequately.

h. Control of the Jacking Process

A suitable process distribution system from a control hydraulic pump shall be used. The Contractor shall operate all jacks at the same speed to give uniform lift, care being taken that the jacks carry the same loads. All jacks shall be provided with the same hydraulic pressure to avoid cases where some will lift more slowly than the others. To control the level of the forms during the jacking process, plastic pipes with colored water may be used, care being taken to purge out or remove entrapped air in the plastic pipe.

i. Control and Tolerances

As jacking proceeds, provisions shall be made to limit any deviations from the vertical. A plumb bob shall be used during the entire operation.

j. Reinforcement

- (i) Placed vertical reinforcement shall be held in position by templates mounted on the forms and moving with them. Steel shall be lapped and tied to the rod below and shall be held at the top by the templates at heights of 1.20 to 3.00 m (3.94 to 9.84 ft.) from the deck. Where difficulties are encountered in the use of templates, the Contractor shall weld a piece of steel to the yokes just above the top of the forms to guide the reinforcement into the correct position.
- Horizontal reinforcement shall be placed as work progresses. The Contractor shall thread the bars through the yokes and tie or weld these to the vertical steel to control buckling. Steel should be of short lengths, say, 3.00 m (9.37 ft.) to permit easy handling. The reinforcement steel should be placed on the working platform in the correct order for placement.

k. Forming Openings and Recesses

The Contractor shall employ special techniques to form openings for doors, for connections of beams and floors, and for provisions of nibs and haunches. Toothed or dovetailed connections shall be used.

I. Handling Concrete
The Contractor shall use the common method for slipforming structural cores by depositing the concrete on the working platform and shoveling it into its final position. Crane and bucket or hoist and barrows may be used.

m. Normal Concreting Operation

After the slip process has started, the workmen shall place the concrete continuously around the structure in 150 mm to 220 mm (6 to 8.8 in.) layers by shoveling it into forms. On ceasing concreting, the forms shall be kept moving to prevent formation of excessive adhesion. The "hack off" process shall involve jacking at a decreasing rate, about 2-3 hours after placing or until the freeboard is about 450 mm to 500 mm (18 to 20 in.). When concreting resumes again, the worker shall jack the forms up about 25 to 50 mm (1 to 2 in.) before pouring concrete.

n. Care and Maintenance of Formwork

After concreting has ceased, the exposed forms must be cleaned and oiled. Care should be taken to prevent coating of reinforcing steel and spillage onto the set concrete.

o. Finishing and Curing

(i) Finishing

Where small holes and depressions occur, a sponge float to fill small holes shall be used to improve the overall appearance of the finished surface.

(ii) Curing

Potable water shall be used for curing. Whenever possible, water shall be sprayed directly into the surface. The Contractor shall provide suitable and adequate water supply at the working platform. Workers shall apply water to the concrete surface intermittently. Where the finished structure is to be exposed to the elements, the wetting action of rain to complete the cement hydration may be used as a curing method. Covering of the interior and exterior surfaces of the formed structure with plastic sheets to keep the moisture always in contact with the concrete surface will be an acceptable method of curing.

X. PLACING REINFORCEMENT

- a. All reinforcement shall be placed in accordance with the plans furnished by the PoIWD PIU representative, in case of any doubt or ambiguity in placing of steel, the Contractor shall consult the PoIWD PIU representative whose decision shall be final in such cases.
- b. All loose rust or scale, all adhering materials, and all oil or other materials which tend to destroy bond between the concrete and the reinforcement shall be removed before placing the steel and before concreting begins.

- c. Metal reinforcement shall be accurately placed and adequately secured by using annealed iron wire ties or suitable clips at intersections and shall be supported by concrete or metal support, spacers, or metal hangers. The minimum clear distance between parallel bars shall be 1-1/2 times the diameter for round bars and twice the side dimension for square bars. In no case shall the clear distance be less than 25 mm (1 in.) nor less than 1-1/3 times the maximum size of the coarse aggregates. Where bars are used in 2 or more layers, the bars in the upper layers shall be placed directly above those in the lower layers at a clear distance of not less than 25 mm (1 in.).
- d. Bends for stirrups and ties shall be made around a pin having a diameter not less than six (6) times the minimum thickness of the bar, except that for bars larger than 25 mm (1 in.), the pin shall not be less than eight (8) times the minimum thickness of the bar. All bars shall be bent cold.
- e. Reinforcement steel shall not be straightened or re-bent in a manner that will injure the material. Bars with kinks or bends not shown in the drawings shall not be used. Heating of the reinforcement will be permitted only when approved by the PoIWD PIU representative.

Y. OFFSETS AND SPLICES IN REINFORCEMENT

- a. In slabs and splices of reinforcement at points of maximum stress shall be generally avoided, and may be allowed only upon written approval of splice details by the PoIWD PIU representative. Splices shall provide sufficient lap to transfer stress between bars by bonding shear or by butt welding to develop in tension at least one hundred twenty-five percent (125%) of the specified yield strength of the reinforcing bar. Splices in adjacent bars shall be generally staggered.
- b. Where changes in the cross-section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion of the bar with the axis of the column shall not be more than one in six and in the case of tied columns, the ties shall be spaced not over 75 mm (3 in.) on center for a distance of 300 mm (12 in.) below the actual point of offset unless otherwise shown in plans.

Z. TESTS ON CONCRETE

- a. The PolWD or the PolWD PIU representative may require a reasonable number of tests on the concrete to be made during the progress of the work. Not less than four (4) cylindrical specimens shall be made for every batch of concrete of which at least two (2) shall be reserved for 28-day test. Not less than four (4) tests shall be made for every 5 cubic meter of concrete; one (1) for 7-day test, one (1) for 14 day test and two (2) for 28day test.
- b. Samples shall be secured and molded in accordance with ASTM C-172 Latest Revision "Standard Practice for Sampling Freshly Mixed Concrete"

and ASTM C-31 Latest Revision "Standard Practice for Making and Curing Concrete Test Specimens in the Field". Strength test shall be made in accordance with ASTM C 39 Latest Revision "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens".

- c. The Contractor shall provide the samples to be taken at the place of deposit and as specified by the PoIWD PIU representative and shall take care of transporting the specimens to the approved testing laboratory, without cost to the PoIWD.
- d. To conform to the requirements of these specifications, the average strength of test samples representing each class of concrete as well as the average of any five consecutive strength tests representing each class of concrete shall be equal to or greater than the specified strength and not more than one strength test in ten shall have an average value less than ninety percent (90%) the specified strength.
- e. Should the test fail to give the required strength, the PolWD shall have the right to order a change in the proportions or in the procedures of curing the concrete for the rest of the structure.

Ñ. LIQUIDATED DAMAGES (For Failure to meet concrete strength requirement at 28 days)

For failure to meet the specified strengths of concrete which has been designed, prepared and deposited by the Contractor, the Contractor shall pay the PolWD as liquidated damages, not as penalty or forfeiture, the following schedule applied on the amount of concrete represented by the samples:

- a. For concrete less than one hundred percent (100%) but greater than or equal to ninety percent (90%) of specified strengths, payment of ten percent (10%) of the unit bid cost per cubic meter of concrete;
- For concrete less than ninety percent (90%) but greater than or equal to eighty five percent (85%) of specified strength, payment of fifteen (15%) percent of the unit bid cost per cubic meter of concrete;
- c. For concrete less than eighty-five percent (85%) of the specified strength, removal of the concrete so deposited and the replacement of same at the expense of the Contractor;
 - (i) In any case of failure to meet specified strength, the Contractor may, at his expense, obtain concrete core samples from the poured concrete and the compressive strength of same, as determined by a competent testing authority, shall be taken as conclusive evidence of its strength and integrity, provided the coring will not impair the safety of the structure and can be satisfactorily replaced.
 - To determine adequacy of affected parts, the PolWD shall have the option to order load test on parts of the structure where concrete strength tests are below eighty percent (80%) of

specified. These tests shall be in accordance with ACI-318, Latest Revision; recommendations and their costs shall be borne by the contractor.

(iii) In case of failure of samples to meet specified strengths to the extent mentioned in Items (c.1), (c.2) or (c.3) above, the Contractor shall be required to prolong the curing of the poured concrete as directed by the PoIWD PIU representative, in addition to payment of the liquidated damages mentioned herein.

2.7 PLAIN CEMENT PLASTERING FINISH

1. DESCRIPTION

a. SCOPE OF WORK

The work includes cement plastering as indicated in the plans.

b. GENERAL REQUIREMENTS

Portland cement shall be provided where plastering is noted in the drawings and schedules. Plastering work shall be properly coordinated with the work of other trades. The work of other trades shall be adequately protected from damage during plastering operations. Finishing work shall be protected with a covering of heavy craft, waterproof paper or other approved protective covering with lapped and sealed joints. Scaffolding shall be amply strong, well braced, tied securely and inspected regularly. Overloading of scaffolding will not be permitted.

2. PRODUCTS

a. MATERIALS

- a.1 Portland cement shall conform to standard specifications of the ASTM C 150, type 1, latest edition.
- a.2 Hydrated lime shall conform to the standard specifications of the ASTM C 6, latest edition.
- a.3 Sand shall be hard, sharp, well washed, siliceous, clean and free from deleterious materials.
- a.4 Water shall be fresh, clean and free from organic matter, acids and alkalis.

b. DELIVERY, STORAGE, AND HANDLING

Manufactured materials shall be delivered in the manufacturer's original unbroken packages or containers, which are labeled plainly with the manufacturer's name and brands. All cementious materials shall be kept dry until ready to be used. They shall be stored off the ground, under cover and away from sweating walls and other damp surfaces within the premises of the Contractor approved by the PolWD PIU Representative.

c. MIXTURE

- c.1 Plaster materials, specified on a volume basis, shall be measured accurately in approved containers that will insure the specified proportion. Measuring materials with shovels, (shoved count) will not be permitted.
- c.2 Mortar for brown coat shall be mixed in the proportion (by volume) of 1 part Portland cement, 3 parts sand, and ¼ part hydrated lime. Mortar for finish coat shall be the same as specified for brown coats, except that the proportions of sand shall be increased to not more than four (4) parts.

3. EXECUTION

a. APPLICATION OF PLASTER

Surfaces to receive shall be cleaned of all projections, dust, loose particles, grease bond breakers and other foreign matter. Plaster shall not be applied directly to a concrete masonry surfaces that have been painted or previously plastered. Before the plastering work is started, masonry surfaces shall be wetted thoroughly with a fog spray of clean water to produce a uniformly moist condition. Metal ground, corner, beads screeds and other accessories shall be checked carefully for alignment before work is started.

Brown coat. The brown coat shall be applied with sufficient pressure to fill the grooves in hollow block or concrete to prevent air pockets and secure a good bond. The brown coat shall be lightly scratched and broomed. Each coat of cement plaster shall be kept moist for 48 hours after application and then allowed to dry.

Finish coat. The finish coat shall not be applied until after the brown coat has seasoned for 7 days. Dust before the application of the finish coat, the brown coat shall again be evenly moistened with a fog spray. The finish coat shall be floated first to a true and even surface then trowelled in a manner that will force the sand particles down into the plaster. Plastered surfaces shall be smooth and free from rough areas, trowelled marks, checks and blemishes. The thickness of plaster shall be 10 mm (3/8") on vertical concrete and on masonry.

b. WORKMANSHIP

Plaster work shall be finished level, plumb, square and true within a tolerance of 3 mm (1/8") in 3 meters, without waves, cracks, blisters, pits, cracking, discolorations, projections and other imperfections. Plaster work shall be formed carefully around angles, contours, and well-up to screeds. Special care

shall be taken to prevent sagging and consequent dropping of application. There shall be no visible junction marks in the finish coat where on day work adjoins the other.

c. PATCING, PAINTING, AND CLEANING

Upon completion, of the fence and when directed, all loose, cracked, damage or defective plastering shall be cut out and re-plastered in a satisfactory and approved manner. All painting and patching of plastered surfaces and plaster work abutting or adjoining any other finish work, shall be done in a neat and workmanlike manner. Plaster dropping or spattering shall be removed from all surfaces. Exposed plastered surfaces shall be left in a clean unblemished condition ready to receive paint or other finish. Protective covering shall be removed from floors and all rubbish and debris shall be removed from the building/fence.

2.8 MISCELLANEUOS METALWORKS

A. GENERAL

The Contractor shall furnish all materials, labor, equipment and the satisfactory performance of all works necessary to complete all the miscellaneous metalwork as shown in the drawings and/or specified herein. Miscellaneous metalwork is defined as all items required to be fabricated from structural steel shapes, plates, bars, and their products. The equipment supplied by the Contractor shall conform with the US standards as mentioned in the following articles or to any other International Standard of equal value.

B. GALVANIZING

All structural steel shapes, plates, bars and fabricated assemblies that required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the "Specification for Zinc (Hot-Galvanized) Coatings on products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip" (ASTM A123). Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Field repairs to galvanizing shall be made using "Galvanox", Galvo-Weld", or approved equal.

C. WELDING

All welding shall be by the shielded arc method and shall conform to the "AWS Code for Arc and Gas Welding in Building Construction". Qualification of welders shall be in accordance with the "Specifications for Standard Qualification Procedure" of the AWS.

D. BOLTS

a. The Contractor shall furnish and set all bolts and anchor bolts. Except where otherwise shown or specified, all bolts, anchor bolts, washers, and nuts shall be steel, galvanized after fabrication in accordance with Section 2.8.B.

- b. Except as otherwise provided herein, steel for bolts, anchor bolts, and cap screws shall be in accordance with "Specifications for Structural Joints", High Strength Bolts (ASTM A-325) approved by the Research Council on Structural Connections (RCSC) of the Project Engineering Foundation or threaded parts of ASTM A36 and shall meet the following additional requirements: (1) the nut material shall be free cutting steel, and (2) the nuts shall be capable of developing the full strength of the bolts. Thread shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads, and nuts shall be Heavy Hexagon Series.
- c. Threads on galvanized bolts and nut shall be formed with suitable taps and dies such that they retain the normal clearance after hot dip galvanizing.
- d. Unless otherwise shown, all bolts, anchor bolts, and nuts which are buried, submerged, or inside a covered hydraulic structure shall be Hot-Dip galvanized per Section 2.8.B. and then coated with two coats of coal tar epoxy, after installation.

E. LADDERS

a. OUTSIDE LADDER

Except where otherwise shown or specified in the drawings, all ladders shall be galvanized iron steel pipe in accordance with sub-section B.

b. INSIDE LADDER

The inside ladder must be made of stainless steel and shall conform to the standards set in AWWA D103-97.

F. IRON CASTING

Iron casting shall conform to the "Specifications for Gray iron Castings", (ASTM A48) unless otherwise shown.

G. GRAB RAIL

Inside pipe handrails shall be a standard 19mmØ (3/4 in.) round bar stainless steel, schedule 40, made up by welding. Railing shall be shop-fabricated into easily handled units. Runners shall be serrated stainless steel. Outside pipe handrails shall be a standard 19mmØ (3/4 in.) galvanized iron steel pipe, schedule 40, made up by welding. Railing shall be shop-fabricated and hot-dip galvanized after fabrication.

Field welding of grab rail joints will be permitted only if approved by the PoIWD PIU representative, and then only in accordance with his instructions. Submerged steel pipe shall be coated with red lead before installation and two coats of coal-tar epoxy after installation.

H. MECHANICAL WATER LEVEL INDICATOR (Reservoir Wall)

- a. Level indicator board shall be constructed of aluminum with graduations in height (meters) and corresponding volume (cubic meters). The volume gradations shall be from zero at the bottom level of the reservoir and the highest level shall be at the top elevation of the reservoir.
- b. The interior float shall be 316 stainless steel.
- c. Float cable and guide wires shall be stainless steel.
- d. All brackets and anchor bar shall be steel and coated with the same system as the interior of the reservoir.
- e. The target shall be steel and painted bright red.
- f. The sheave assembly:
 - f.1 Housing and cover shall be cast aluminum
 - f.2 The sheave shall be Delrin
 - f.3 All bearings shall be Teflon
 - f.4 Bearing shafts shall be stainless steel
- g. The guide wire housing assembly shall be galvanized steel with a steel spring.

2.9 CONCRETE JOINT SEALING AND WATERPROOFING

1. GENERAL

- a. The work shall include the furnishing of all materials, equipment, tools, labor and any other means necessary to complete all works required in the furnishing and application of sealant and waterproofing on reservoir slabs and walls as an extra protection against water leaks.
- b. Sealant and waterproofing materials shall be delivered to the site in its original sealed container or package bearing the manufacturer's name and brand designation.
- c. Materials stored at the job site shall be secured and protected from weather moisture and extreme temperature.
- d. All materials used for the application shall be food grade base materials.
- e. Surfaces to which materials are to be applied shall be free from foreign matter, clean and smooth, dry and free from protrusions.
- f. No material will be accepted which has an unsatisfactory history as to bond or durability when used for hydraulic structures. Prior to ordering the material, the Contractor shall submit to the PolWD PIU representative for approval sufficient data to show general compliance with the specification requirements.
- g. All materials used for the application shall be **food grade** base materials. The Contractor when conducting the necessary and appropriate painting on the

concrete that is in contact with water shall be in accordance and compliant with the **NSF 61 (Drinking Water System Components - Health Effects)** standards for potable water.

g.1 Waterproof Sealant must have the following specifications and			
features:			
COLOR	Clear		
VOLUME SOLIDS	85%		
TYPICAL THICKNESS	40-100 microns (1.6-4 mils) dry equivalent to 47-118 microns (1.9-4.7 mils) wet		
THEORETICAL COVERAGE	11.30 m ² /liter at 75 microns d.f.t and stated volume solids, 454 sq.ft/US gallon at 3 mils d.f.t and stated volume solids		
METHOD OF APPLICATION	Airless spray, Brush, Roller		

g.2 Top Coat must have the following specifications and features:		
COLOR	White	
VOLUME SOLIDS	100%	
TYPICAL THICKNESS	12-24 mils (300-600 microns) dry equivalent to 12-24 mils (300-600 microns) wet	
THEORETICAL COVERAGE	100 sq.ft/US gallon at 16 mills d.f.t and stated volume solids, 2.50 m ² /liter at 400 microns d.f.t and stated volume	
METHOD OF APPLICATION	Airless spray, Brush, Roller	

The epoxy coating to be used for this contract shall be a two component solvent free epoxy especially designed for drinking water reservoir suitable for concrete surfaces, 100% volume solid, color white, and certified to ANSF/ANSI 61. For this purpose, **ANSI/NSF authenticated certification** is required to be submitted to the PolWD prior to any coating application.

2. APPLICATIONS

- a. Thoroughly clean and hose down concrete surfaces. Surfaces must be free from all laitance, oils, grease, loose dust and mud.
- b. Ensure that no honeycombs and cracks on concrete surfaces; make necessary repairs if needed. Defective surfaces to be rep aired shall be cut back from true line a minimum depth of 13mm (1/2") over the entire are of interior and exterior surface of wall and bottom slab surface then seal with high performance elastomeric sealant.
- c. Route out all cracks 1/16th of an inch or larger over the entire area of interior and exterior surface of wall and bottom slab surface then seal with high performance elastomeric sealant.
- d. Tapered groove shall be installed on all construction joints. The material used for forming the tapered grooves shall be left in the grooves until just before

the grooves are cleaned and filled with construction joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed and the grooves shall be sandblasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown-out; immediately thereafter, they shall be primed and filled with the construction joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer.

- e. Detail coat on all joints, cracks and corners with two (2) coats of waterproofing. Apply waterproofing in two (2) full coats over the entire area of interior surface of wall and bottom slab surface.
- f. Let the final coat cure for twenty-four (24) hours then filled continuously for a period of thirty (30) days. If leakage is such that the water surface drops more than 5.10cm (2 in) in a 30-day period, the Contractor shall empty the reservoir to permit close examination for evidence of any crack or other conditions that might be responsible for the leakage. Any cracks be "vee"d" and sealed with sealant. PIPES AND APPURTENANCES 1. GENERAL a. However, any evidence of leakage shall be repaired to the satisfaction of the PoIWD PIU representative.

2.10 PIPES AND APPURTENANCES

1. GENERAL

The Contractor shall furnish and install all pipes, fittings, closure pieces, supports, bolts, nuts, gaskets, joining materials, and appurtenances as shown and specified, and as required for a complete and workable piping system in accordance to Item 3. Pipelaying Works of this specification. Shop drawings of all piping shall be furnished by the Contractor to the PolWD PIU representative.

2. OTHER RESERVOIR COMPONENTS

a. RESERVOIR OVERFLOW AND DRAIN PIPE

Reservoir overflow shall consist of **150mmØ cement lined-epoxy coated steel pipe** that is securely attached to the outside of the reservoir and Drain pipe shall consist of **200mmØ cement lined-epoxy coated steel pipe**. See drawings provided.

b. RESERVOIR INLET PIPE

Inlet piping shall be **150mmØ cement lined-epoxy coated steel pipe** with locations as indicated in the drawings provided.

c. RESERVOIR OUTLET PIPE

Outlet piping shall be **250mmØ cement lined-epoxy coated steel pipe** with locations as indicated in the drawings provided.

d. PIPE DESIGN

Steel pipe shall be designed, manufactured, and tested in accordance to **Section 3. Pipelaying Works.**

3. VALVES

a. **GENERAL**

The Contractor shall furnish and install all valves as shown and specified, and as required for a complete and workable valves in accordance to **Sub-section D. VALVES under Item III. Pipelaying Works** of this specification. Shop drawings for all valves shall be furnished to the PolWD for approval in accordance with Section VII. Clause 2.2. Shop Drawings. All valves shall be new and of current manufacture.

2.11 HYDROTESTING, LEAK TEST, AND DISINFECTION

1. GENERAL

The Contractor shall furnish all equipment, labor and materials including the water for testing and proper disinfection of the Reservoir. The water used for testing shall be furnished by the Contractor. All testing and chlorinating operations shall be done in the presence of the PolWD PIU representative.

2. CLEANING

Prior to disinfecting, the reservoir shall be thoroughly cleaned by hosing down with a high pressure hose and nozzle of sufficient size to deliver a minimum flow of 3.15 L/s (50 gpm).

3. **DISINFECTION**

 The Reservoir structure shall be disinfected at the time of testing by chlorination in accordance with AWWA Standard C652-02 "Disinfection of Water Storage Facilities".

Before commencing any disinfection activities, the following shall be considered:

- a.1 Conduct inspection of reservoir interior before beginning disinfection:
 - (1) Verify reservoir is clean and free of polluting materials.
 - (2) Verify reservoir pipe and vent connections are properly made and clear of obstructions.
 - (3) Verify coatings are thoroughly cured in accordance with the manufacturer's instructions.
- a.2 The reservoir structure shall be disinfected at the time of testing by chlorination in accordance with AWWA C652-02, or latest revision, "Disinfection of Water Storage Facilities".

- a.3 Acceptable method of disinfection: Chlorination Method 1, 2 or 3 per AWWA C652-02 as directed by the PolWD PIU representative.
- a.4 Acceptable form of chlorine for disinfection: Sodium Hypochlorite, as specified in AWWA C652-02.
- a.5 Disinfection shall not take place until the reservoir coating is fully cured.

4. DISPOSAL OF TEST WATER

- a. All water used in testing and disinfecting the reservoir, including that used for retesting, shall be disposed of following such testing, retesting and disinfecting by the Contractor at his sole expense.
- b. If required by the District, the Contractor shall apply a reducing agent to the solution to neutralize residual chlorine or chloramines remaining in the water prior to disposal. The disposal of water shall, in all cases, be carried out in strict observance of the water pollution control requirements of the applicable agencies. The flow of water from the reservoir shall be controlled to prevent erosion of surrounding soil, damage to existing roads, vegetation, irrigation ditches and altering of ecological conditions in the area.

5. BACTERIOLOGICAL SAMPLING AND TESTING

After the chlorination procedure is completed and before the storage facility is placed in service, water from the full facility shall be sampled and tested for coliform organisms in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter techniques by any DOH accredited testing laboratories.

- a. Test for odor: The water in the full facility should also be tested to assure that no offensive odor exists due to chlorine reactions or excess residual.
- b. Results of testing: If the test for coliform organisms is negative, then the storage facility may be placed in service. If the test shows the presence of coliform bacteria, then the situation shall be evaluated by the PolWD PIU representative through PolWD Water Quality personnel. In any event, repeat samples shall be taken until two consecutive samples are negative and the storage facility shall again be subjected to disinfection.
- c. Care in sampling: The samples shall be taken from a sample tap on the outlet piping from the storage facility or from a sample tap connected directly to the storage facility. In either case, the operation shall ensure that the water sample collected is actually from the storage facility.
- d. Recommended additional samples: During the disinfection operation and the required water sampling from the storage facility, it is recommended that the samples be taken from water inflowing to the storage facility to determine if coliforms are present in the typical potable water source.

Water testing shall be performed on the completed reservoir after it is painted and disinfected. The Contractor is responsible for furnishing the water to the site with sufficient pressure to fill the reservoir. Water should be filled to the top capacity level, and weld seams should be inspected for any signs of leakage. If leaks are found, the water must be lowered at least 2 ft (0.6 m) below the point of repair, and the defect must be repaired and re-welded. If no leaks are found, the reservoir can be put directly into service, which eliminates the need to dispose of the test water.

The reservoir shall have no leaks at the end of a **30 - day test period.** Any leaks disclosed by this test shall be repaired in accordance with the approved standards and subject to the approval of the PolWD PIU representative. The reservoir shall be retested and repaired until no leaks occur.

Water required for testing shall be furnished by the PolWD when available but it shall be paid by the Contractor. Accordingly, the cost of equivalent volume used in the testing shall be included in the bid price of the Contractor. The cost of the water consumed by the Contractor shall be subject to the prevailing water rate schedule of the PolWD. Disposal of test water shall be the responsibility of the Contractor.

2.12 PAINTING (Outside Reservoir, Piping, and Appurtenances)

1. GENERAL

The work included in this section consists of the furnishing of all labor, materials, and the satisfactory performance of all works necessary to complete all paintings and coatings as shown in the drawings and/or specified herein. All paints and coatings shall be applied by painting workmen approved by the PolWD PIU representative.

2. SCOPE

The following surfaces are to be painted except where otherwise shown:

- a. All exterior above ground or exposed steel pipes, specials and fabricated assemblies.
- b. Outside Reservoir Wall & Top Slab, Pipe Support and Pedestal.
- c. Manhole Cover, Air Vent, Steel Ladder, Valve Box Cover, Company Logo and Signage.
- d. Water Level Board

In no case shall any concrete, metal or any other surface **requiring protection** be left unpainted even though not specifically defined herein.

3. MATERIALS

Materials used for the work shall be as follows:

For above ground and exposed piping refer to Sub-section: Painting Pipeworks under Section 3. Pipelaying Works.

For Outside Reservoir Wall, Top Slab, Company Logo, Signages and Water Level Board.

1 coat	-	Concrete Primer
2 coats	-	Acrylic Latex Paint (Blue and White)

Manhole Cover, Air Vent, Steel Ladder

1 coat	-	Metal Primer	
2 coats	-	Epoxy Enamel	

Deliver specified products in original containers, with seals unbroken and labels intact.

4. WORKMANSHIP

- a. There should be quality workmanship. All materials shall be spread evenly and smoothly flowed on, without runs and sags.
- b. Surfaces to be painted shall be clean, free from dust and dirt before painting.
- c. Touch up knots, pitch streaks, sappy spots, etc., with shellac where finish calls for interior paint or epoxy paint.
- d. Except as otherwise specified, all paints shall be applied in three coats (priming, body and finish). Each coat shall be allowed to dry thoroughly before the succeeding coat is applied. In general, or unless otherwise instructed by the PolWD PIU representative, the time between the application of succeeding coats shall not be less than 48 hours. Each coat shall be inspected and approved before the succeeding coat is applied.
- e. Do not paint exterior while surface is damp, or during rainy or damp weather.
- f. Do necessary putty for nail holes, cracks, etc., after prime coat. Bring putty flush with adjoining surface in a neat, workmanlike manner.
- g. Tint undercoats of paint or enamel to the same or appropriate shade of final coat.

5. STORAGE OF MATERIALS

The Contractor shall store all painting materials and equipment not in immediate use in area designated by PoIWD PIU representative for that purpose. The receiving and opening of all paint materials and mixing shall be done in this area.

Necessary precautions shall be taken to prevent fire. Rags, waste, etc., soiled with paint shall be removed from the premises at the end of each day's work, or stored in metal containers with metal covers.

6. PREPARATION OF PAINT

Paint containers shall be delivered to the job site in the manufacturer's unopened; containers shall be opened only when required for use. Paint shall be mixed only in the designated area or space in the presence of the PolWD's PIU representative. Paint shall be thoroughly stirred or agitated to uniformly smooth consistency suitable for proper application. Unless otherwise specified or approved, no materials shall be reduced, changed, or used except in accordance with manufacturer's label or tag on container. In all cases, paint shall be prepared and handled in a manner to prevent deterioration and inclusion of foreign matter.

7. PREPARATION OF SURFACES

- a. General Except as otherwise specified, surfaces to be painted shall be clean, smooth and dry. The Contractor shall report to the PolWD PIU representative in writing any surface, which cannot be properly prepared for painting. If work is commenced before defects have been reported and corrected, any resulting unsatisfactory finish shall be rectified at no cost to the PolWD.
- b. Concrete All concrete and masonry surfaces shall be cured thirty days prior to painting. Dirt, dust, oil, grease, efflorescence and other deleterious matter shall be removed and surface roughened when necessary to insure good paint adhesion. The method of surface preparation shall be left to the discretion of the Contractor, provided results obtained are satisfactory to the PolWD PIU representative. Before application of resin emulsion paint, surfaces shall be prepared in accordance with manufacturer's directions. Before application of oil base or latex paints, surfaces shall be tested for presence of alkali; if alkali is present, neutralize as recommended by the manufacturer of the paint materials to be applied.
- c. Plaster Dirt, dust, loose plaster and other deleterious matter, which would prevent good paint adhesion, shall be removed. All holes, cracks and depressions shall be neatly filled with patching plaster, mixed and applied to match existing plaster. Plaster shall be sanded flush and smooth and properly sealed before applying prime coat. After priming surfaces, suction spots shall be touched up with additional prime coat material until surfaces evidence a uniform coating. Enamel undercoats on smooth plaster shall be sandpapered by hand (with No. 1000 Sandpaper) and dusted clean before applying succeeding coat.
- d. Metal Dirt, scale and rust shall be removed by scraping, wire brushing and sanding or sandblasting as required. Oil and grease shall be removed with mineral spirits or appropriate solvent. Before painting, ferrous metal surfaces, including galvanized ferrous metal surfaces shall be pretreated with approved phosphoric acid etching cleaner in accordance with manufacturer's directions

to produce a chemically clean surface. Unless already performed in accordance with specifications of other sections, abrasions and bared spots in shop prime coatings shall be touched up with metal primer matching shop coatings. Enamel undercoats shall be sandpapered by hand (with No. 1000 sandpaper) and dusted clean before applying succeeding coat.

8. APPLICATION OF PAINT

- a. General All painting and finishing shall be performed by skilled craftsmen. Each coat of paint shall be applied at proper consistency, evenly, and free of laps, sags, and runs and cut sharply to required lines. Except as otherwise specified or required, paint shall be applied only under dry and dust-free conditions that will insure properly finished surfaces, free of defects and blemishes. Paint shall not be applied when temperature is likely to be above 90°F. Sufficient time shall be allowed between coats to insure proper drying. All primer and intermediate coats shall be unscarred and completely integral at time of application of each succeeding coat. The PolWD PIU representative should be notified when each coat has been applied and is ready for inspection; until coat is inspected and approved by the PolWD PIU representative, no succeeding coats shall be applied. Whenever two coats of a dark colored paint are specified the first coat shall contain sufficient powdered aluminum to act as an indicator for proper coverage when applying second coat.
- b. Methods of Application Except as otherwise specified or when in the opinion of the PoIWD PIU representative a particular method would produce unsatisfactory results, paint may be applied by brush, spray, or other application method at the opinion of the Contractor.
- c. Priming and Back Painting

Priming – Before installation, all surfaces of millwork which areas are to be painted shall be primed, giving particular attention to sealing of cross-grained surfaces. In all cases, all work shall be primed as soon as possible after delivery to buildings, before or after installation, as required, or in case of prefabricated items, at fabricator's shop or mill before shipment, if practicable. Except as otherwise specified, priming shall consist of first coat hereinafter specified under "Painting System".

Back Painting – Woodwork, millwork, and casework to be installed against concrete, masonry or plaster shall be back painted with one coat of exterior oil paint.

9. RIGHT OF REJECTION

No painting shall be done under conditions which may jeopardize the appearance or quality of the painting or finishing in any way. The PolWD PIU representative shall have the right to reject all materials or works that are unsatisfactory, and require the replacement of either or both at the expense of the Contractor.

10. CLEANING UP

- a. Protect the work at all times and all adjacent work and materials by suitable covering or other methods. Upon completion of the work, remove paint spots from floors, glass and finish hardware.
- b. Remove from premises rubbish, accumulated materials of whatever nature caused by the work. Leave work in a clean, orderly, and acceptable condition.

3.0 PIPELAYING WORKS

3.1 EARTHWORKS

1. SCOPE

Includes all requirements pertaining to site clearing, trenching, subgrade preparation, sheeting and bracing, pipe embedment, backfill, and compaction for the installation of mains, hydrants, services, and appurtenances. Includes all other earthwork required to complete the work as specified.

2. PREPARATION OF THE WORK AREA

a. DETECTION OF EXISTING UTILITIES AND SERVICES

The Contractor shall investigate, and have full knowledge of the position of existing utilities and underground services such as drains, pipes, electric cables, culverts, etc. He shall take all necessary precaution as part of his work. He shall undertake the following:

- Ascertain the locations of the existing utilities that may be affected by the execution of the works; Identify the type of utility, size and depth; coordinate and ask the assistance of the concerned agencies/utilities which may be affected in the implementation of the works.
- (ii) Ascertain the exact portions to be excavated for trial pits and exploration trenches ahead of pipelaying works and shall be backfilled with approved materials.
- (iii) Restore all damages to the existing pipes and appurtenances at no additional cost to the district.

b. SITE CLEARING

The Contractor shall remove and dispose of trees and bushes within the site of the Works as directed by the PolWD PIU representative. The costs for the transportation of the same to dumpsites shall be borne by the Contractor and should be considered in their bid proposal. It is the responsibility of the Contractor to visit the site and orient himself of the possible dumping areas.

c. COMPACTION TEST

Where the backfill is required to be compacted to a specified density, tests for compliance may be made by and at the expense of the Contractor which will be

included in this Contract, using the test procedure specified in Methods of Tests for Moisture-Density Relation in Soils using a 10-lb hammer and 18-in. drop (ASTM D1557), modified to use three (3) layers. All field density tests shall be performed in accordance with the test procedure specified in "Method of Test for Density of Soil in Place by the Sand Cone Method" (ASTM D1556).

d. EXCAVATION

d.1 General

Except when specifically provided to the contrary, excavation shall include the removal of materials of whatever nature encountered, that would interfere with the proper execution and completion of the work. Except for obstructions from other utilities (PLDT, CEO, DLPC & DPWH), the Contractor shall take extra care as to prevent damages. The Contractor shall take full responsibility as to whatever damage he may encounter. The removal of said materials shall conform to the lines and grades shown or ordered. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such materials shall be removed from the site prior to performing any excavation or placing any fill. The Contractor shall secure permits and clearances from Department of Environment and Natural Resources (DENR) concerning the cutting of trees if needed and shall provide the materials required. The Contractor shall furnish, place and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching or other approved measures for the removal or exclusion of water, including taking care of storm water and waste water reaching the site of the work from any source. The walls and faces of all excavations in which workers are exposed to danger from unstable ground shall be guarded against by a shoring system, sloping of the excavation, or some other acceptable method. The Contractor shall furnish, install and maintain such sheeting, bracing, etc., as may be necessary to protect the workers and to prevent any movement of earth which could injure or delay the work or endanger adjacent structures. In excavations which workers may be required to enter, excavated or other material shall be effectively stored and retained at least 60 cm or more from the edge of the excavation.

All excavation and trenching operations shall conform to any and all national, provincial and local safety requirements.

For longitudinal excavations, the maximum length for open continuous excavation per street shall be 150 meters. This shall be fully backfilled and made passable to traffic and continuously maintained in good condition until fully restored before another strip of the same maximum length shall be excavated. For long projects extending to kilometers along a road, 150 meters excavated strips may be made at each end or at 300 meters distances.

d.2 Pipeline Trench Excavation

(1) General

Unless otherwise shown or ordered, excavation for pipelines shall be open-cut trenches. The bottom of the trench, including any shoring shall have a minimum width equal to the outside diameter of the pipe plus 300 mm (12 in.) and a maximum width equal to the outside diameter of the pipe plus 600 mm (24 in.). Except when otherwise shown or ordered by the PoIWD PIU representative, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim using a string line for establishing grade, such that each pipe section when first laid will be wholly in contact with the ground or bedding along the extreme bottom of the pipe. Rounding out the trench to form a cradle will not be required. All newly laid pipes shall be backfilled above the top of the pipe at the end of each day.

No excavation for any section of pipeline installation shall be performed by the Contractor until pipe, valves, fittings, service materials, and all other materials necessary to complete the installation are delivered to the site.

Double trench excavation when required shall be done in accordance with the typical drawings. Trench bottom shall be compacted and tested up to 90% compaction. No payment for over-excavation shall be allowed if no deviation from the drawings for double trench.

(2) Trench Over – Excavation Where Shown

The trenches shall be over-excavated where shown, to the depth shown, then backfilled to the grade of the bottom of the pipe with suitable selected granular material or with sand. Said backfill shall be brought to the optimum moisture content and compacted to ninety-five percent (95%) of maximum density under proposed structures, and ninety percent (90%) elsewhere. Work specified in this subsection shall be performed by the Contractor at his own expense.

(3) Trench Over – Excavation to Clear Obstruction

Trenches shall be over-excavated to the depth approved by the PolWD PIU representative for pipeline clearance of obstruction. All work specified in this subsection shall be performed by the Contractor at his own expense when the over-excavation plus the cover of the pipe measured to existing ground surface does not exceed 1.5 meters; when the additional over-excavation plus the cover of the pipe measured to existing ground surface exceeds 1.5 meters, additional payment will be made to the Contractor for that portion of work located below said depth. Said additional payment will be made under separate unit price bid items for over-excavation if such bid items have been established; otherwise, payment will be made in accordance with negotiated price.

(4) Trench Over – Excavation When Ordered

Trenches shall be over-excavated beyond the depth shown when ordered by the PoIWD PIU representative. Such over-excavation shall be to the depth ordered. The trench shall then be refilled to the grade of the bottom of the pipe with either selected granular material obtained from the excavation, sand, or crushed rock, at the option of the PoIWD PIU representative. When crushed rock bedding is ordered, well-graded material of 40 mm (1.6 in.) maximum size shall be used. Bedding material shall be placed in layers, brought to optimum moisture content, and compacted to ninety-five percent (95%) of maximum density where the pipeline trench passes under structures, and ninety percent (90%) elsewhere. Payment will be made under separate unit price bid item for furnishing and installing bedding and backfill if such bid items have been established; otherwise, payment will be made in accordance with negotiated price.

(5) Over- Excavation not Ordered, Specified, or Shown

Any over-excavation carried below the grade ordered, specified, or shown shall be backfilled to the required grade with suitable selected granular material by the Contractor at his own expense. Such material shall be moistened as required and compacted to ninety-five percent (95%) of maximum density.

(6) Disposal of Excavated Material

The Contractor shall remove and dispose all excavated material at his own expense and in a manner approved by the PolWD PIU representative.

(7) Excavation in Vicinity of Trees

Except where trees are shown on the drawings to be removed, trees shall be protected from injury during construction operations; and no tree is to be removed without written permission from the PoIWD PIU representative. No tree roots over 50 mm (2 in.) in diameter shall be cut without permission of the PoIWD PIU representative. Trees shall be supported during excavation as may be directed by the PoIWD PIU representative.

(8) Rock Excavation

Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 0.25 cubic meters (0.33 cubic yards) or more in volume; (2) all rock material and ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting. Said rock excavation shall be performed by the Contractor at his own expense provided that should the quantity of rock excavation be affected by any change in the scope of the work, an appropriate adjustment of the Contractor price will be made under a separate additive – deductive bid item if such bid item has been established; otherwise payment or deduction in the Contract amount shall be made in accordance with a negotiated price.

- e. BACKFILL
 - e.1 General

Backfill shall not be dropped directly upon any structure or pipe. All materials used for backfill shall be new and selected material, free from grass, roots, brush, or other vegetation, or rocks having a maximum dimension larger than 150 mm (6 in.). Material placed within 150 mm (6 in.) of any structure shall be free of rocks or unbroken masses or earthly materials having maximum dimension larger than 75 mm (3 in.).

e.2 Pipeline Trench Backfill

Pipeline Trenches shall be backfilled to a level of 150 mm (6 in.) above the top of the pipe with borrow material having the sand equivalent value of not less than twenty (20) (ASTM D-2419) shall be used for this portion of the trench backfill. Selected material shall first be brought up to mid-diameter of the pipe and compacted; then the remainder of the backfill to 150 mm (6 in.) above the pipe may be placed and compacted. Such material shall be compacted to ninety-five percent (95%) of maximum density. Compaction shall be obtained by tamping in not more than 150 mm (6 in.) layers.

After the initial portion of backfill has been placed as specified above, the remainder of the trench shall be backfilled. When compaction of the initial portion of backfill is obtained with excess water, not less than four (4) hours shall have elapsed between the placement of initial backfill and subsequent backfill. The remainder of the backfill shall be selected material obtained from the excavation and shall be placed in horizontal layers. Each layer shall be no more than 400 mm (16 in.) in depth. Layers shall be moistened, tamped, paddled, rolled, or otherwise compacted to:

(1) ninety-five percent (95%) of maximum density where the trench is located under proposed paved areas; ninety percent (90%) of maximum density where the trench is located under unpaved shoulders, gravel roadways or dirt roads; one hundred percent (100%) of the natural density of surrounding areas where the trench is located in unimproved right-ofway.

If the backfill material is sandy or granular in nature and the trench is not located under a structure, the layer construction may be eliminated.

e.3 Embankment Fill

The area where an embankment is to be constructed shall be cleared of all vegetation, roots and foreign materials. Following this, the surface shall be moistened, scarified to a depth of 15 cm (6 in) and rolled or otherwise mechanically compacted to 95% of maximum density. Embankment fill shall be placed in horizontal layers not to exceed 20 cm (8 in) in thickness, as measured before compaction, where compaction is attained by means of sheepsfoot rollers. Where the use of sheepsfoot rollers is impracticable, the layers shall not exceed 15 cm (6 in) in thickness before compaction, and compaction shall be brought up evenly with each layer moistened and compacted by mechanical means to 95% of maximum density elsewhere. The top 50 cm (20 in) of backfill on embankments shall consist of loamy earth, free of rocks larger than 2.50 cm (1 in) in maximum dimension.

e.4 Backfill Materials for Pipe Trenches

- (1) Native Backfill native materials (except clay, silt, muck) that are free from grass, roots, or other vegetation, boulders or rock having maximum dimensions less than 75mm may be used as native backfill. For alleys and roads not subject to traffic load, excavated materials may be used as backfilling materials above pipe zone provided it is properly tamped to attain 90% compaction.
- (2) Imported Backfill Any earth material (except clay, silt, muck) and satisfying the specification for native backfill may be used to replace unsuitable material. If excavated material from trench excavation is not suitable for backfill as mentioned in item 1, imported or borrow materials from approved source shall be used.
- (3) Sand Bedding Sand bedding unless, otherwise specified, shall be borrowed material, the cost of which is included in the unit cost of the pipelaying and with minimum characteristics specified herein. In case selected bedding material from trench is suitable, corresponding cost shall be deducted from the cost of pipelaying.

Material that is free of organic matter does not contain stone or rock fragments larger than 10mm in greatest dimensions and non-cohesive shall be used as selected sandy material. Not more than 50% of the material shall pass the No. 200 sieve (0.075mm).

3.2 SURFACE RESTORATION AND PAVING

1. GENERAL

The Contractor shall furnish all materials, labor, plant, and equipment for the removal of all pavement, sidewalks, curbs and gutters, fences, poles, driveways, walks, other property, and surface structures that are necessary for the proper prosecution of the work, but only upon approval of the parties having jurisdiction thereof and of the PolWD PIU representative. Unless otherwise shown, the Contractor shall restore at his own expense all property removed or destroyed by its operation at least equal to conditions prior to work under this Contract or to the satisfaction of the property PolWD.

2. REMOVAL OF EXISTING PAVEMENT

a. In cutting or breaking up street surfacing required for the performance of the work, the Contractor shall not use equipment which will damage the adjacent pavement. All concrete pavement surfaces to be removed shall be scored with concrete sawing equipment; provided, that any Portland cement concrete based under asphaltic mix surface will not be required to be scored by sawing. Asphaltic concrete pavement shall be removed to clean straight lines.

The Contractor shall remove the pavement and road surfaces as part of the trench excavation, and the amount removed shall not exceed the maximum width of trench for pipelines as indicated on the drawings, unless otherwise ordered in writing by the PoIWD PIU representative.

The width of the pavement area required to be removed for the installation of the valves, valve chambers, spirals, or other structures shall not exceed the maximum linear dimensions of such structures by more than 0.30 meters on each side.

The width of the pavement area required to be removed for the transfer and installation of service connections shall not exceed the maximum width as shown on the Drawings.

- b. Concrete sidewalks, curbs and gutters required to be removed in connection with performing the work under the contract shall be cut to the nearest score marks and shall be replaced with the same kind or better materials in accordance with the latest specifications, rules and regulations, and subject to inspection and approval of the agency having jurisdiction.
- c. The cutting width of the pavement area for the trench preparation shall be 1.5 meters (for Steel Pipe) regardless of the pipe trench size. Consideration of the thickness for the concrete pavement demolition shall be 0.23 meter.

3. RESTORATION OF DAMAGED SURFACED PROPERTY

Except where shown on the drawings or specified otherwise, any pavement, shrubbery, fences, poles and other property and surface structures which have been damaged, removed or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the contract documents, city ordinances or the specific directions of the PolWD PIU representative, or through failure to employ usual and reasonable safeguards, shall be replaced or repaired at the expense of the Contractor.

4. REPLACEMENT OF SURFACE STRUCTURE AND PRIVATE PROPERTY

Except where shown in the drawings, the Contractor shall restore all private property and surface structures removed or disturbed as a part of the work to a condition equal to that before the work began. He shall also furnish all labor and materials incidental thereto at his own expense.

5. TEMPORARY OF RESURFACING AND REPAVING

Immediately upon completion of backfilling of the trench or excavation in paved areas, the Contractor shall place a temporary pavement, at least 40mm (1.5 in.) in thickness, over all disturbed areas of the streets, paved driveways, alleys, and other traveled places where the original surface has been disturbed by its operation. The temporary pavement shall be of a character satisfactory in all respects and safe for public travel. The temporary surfacing may consist of compacting Item 201 or Earthfill material or as directed by the PoIWD PIU representative. The surface of all temporary repaving shall conform to the street grades. The temporary repaved surfaces and trenches shall be covered with a 20mm -1.219 x 2.438 meters (ASTM A36) "Steel Plates" to ensure safety of the motorist and pedestrians during pipelaying activities. The temporary repavement shall be maintained by the Contractor at his own expense until permanent surfacing is completed. The Contractor shall immediately remove and replace in a

satisfactory condition any and all such pavement as shall become unsatisfactory and not in accordance with the terms and intent of the specification and incompliance with the terms and condition of the excavation permit issued by the City PolWD PIU representative's Office or the DPWH. Upon completion of the substantial parts of the project but not before the pipelines has been tested for pressure and leakage, the temporary resurfacing shall be replaced with permanent resurfacing.

6. PAVING

a. General

Paving materials and methods of construction shall be in accordance with referenced sections of the latest edition of the DPWH Standard Specifications for Public Works and Highways, Republic of the Philippines. Thickness and extent of base course, paving course and other construction details are as shown on the Drawings. All provisions contained in the referenced Standard Specifications involving "measurement" and "payment" are not applicable to work performed in this Contract.

b. Borrow

When sufficient suitable material is not available from the roadway excavations, additional "borrow" materials shall be obtained from other sources at no extra cost to the PolWD.

c. Subgrade Preparation

This item shall consist of the preparation and conditioning of the subgrade to the full width of the roadbed in accordance with Item 105 of the referenced and in conformity with the lines, grades, and cross sections shown on the plans.

d. Aggregate Sub-base Course

This item shall consist of a foundation of the surface course, composed of gravel or crushed stone and filler materials in accordance with Item 200 of the referenced Standard Specifications (DPWH Standard Specifications for Public Works and Highways, Republic of the Philippines). Grading shall be as indicated in Table 200.1 – Grading Requirements of the referenced standards.

e. Bituminous Concrete Surface Course

This item shall consist of a pavement composed of bituminous concrete on a prepared base in accordance with Item 301 of the referenced Standard Specifications.

f. Portland Cement Concrete Pavement

This item shall consist of a pavement composed of Portland cement concrete on a prepared base in accordance with Item 311 of the referenced Standard Specifications.

g. Strength Requirement

The pavement, either concrete or asphalt, shall be restored to its original design, strength and thickness. For concrete, use three (3) to seven (7) days curing period for major thoroughfares and other national roads, both attaining flexural strength of 550 psi and comprehensive strength of 4,000 psi as shown in test results.

3.3 PIPING WORKS

1. GENERAL

- a. The Contractor shall furnish and install all pipes, fittings, closure pieces, supports, bolts, nuts, gaskets, joining materials, and appurtenances as shown and specified in the plans, and as required for a complete and workable piping system. Shop drawings of all piping shall be furnished in accordance with Section 5. Clause 2. "Shop Drawing".
- b. All bolts, anchor bolts, nuts, and studs in the assembly of piping shall be Hot Dipped galvanized per TS-20 and then coated with two coats of coal tar epoxy after installation.
- c. All exposed piping shall be adequately supported with devices of appropriate design. Where details are shown, the supports shall conform thereto and shall be placed as indicated; provided that support for all piping shall be complete and adequate regardless of whether or not supporting devices are specifically shown.
- d. All pipes shall be laid in a uniform profile as shown on the drawings.
- e. All protective barrier materials (cement, paints, coatings, and linings), joining and sealing materials (gaskets, adhesives, and lubricants), mechanical devices (water meters, valves, and filters), pipes and related products (pipe, hose, and fittings) shall be in compliance with NSF/ANSI 61 Drinking Water System Components Health Effects.
- f. For lead content, materials shall be evaluated in accordance with NSF/ANSI 372 – Drinking Water System Components-Lead Content. Testing shall be conducted in any government accredited testing laboratories. Test results shall be submitted to the Procuring Entity for conformation prior to the premanufacturing inspection.

2. CEMENT MORTAR LINED - EPOXY COATED STEEL PIPE

A. GENERAL

This section designates the requirements for steel pipe fabrication, test in shop, installation of steel pipe, fabrication of steel sheet or plate; mill-manufactured steel pipe, bends, and special pipes with outlets, pass holes, flanges and all other fittings. Steel pipe shall conform to ANSI/AWWA C200 (Steel Water Pipe – 6 in. (150mm) and Larger). The steel for the cylinder shall be designed for a minimum of 300 psi working pressure and 36,000 psi minimum yield strength

conforming to requirements of ASTM A-139 [Standard Specifications for Electric Fusion (Arc) - Welded Steel Pipe (NPS 4 and over)].

Coating and lining materials shall conform to the requirements of the following standards.

Lining:

 ANSI/AWWA C205 (Cement Mortar Protective Lining and Coating for Steel Water Pipe-Shop Applied.

Coating:

 ANSI/AWWA C210 (Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines);

Health Effects:

3. NSF/ANSI 61 (Drinking Water System Components Health Effects).

B. LININGS AND COATINGS

- b.1 Cement Mortar Protective Lining
 - (1) Materials
 - (1.1) Reinforcement
 - Wire: Steel wire shall be a minimum size of W0.5 (0.050in [2mm]). The wire shall conform to the requirements of ASTM A82. Reinforcing wire need not be galvanized unless otherwise specified herein.
 - Wire Fabric: Reinforcement shall be 2x4xW0.5 welded wire fabric. The wire shall conform to the requirements of ASTM A185 or ASTM A497. Unless otherwise specified herein, wire fabric reinforcement may be crimped or uncrimped.
 - (iii) Ribbon Mesh: Ribbon mesh shall be 1-in x 1-in (25mmx25mm) mesh of 18-gauge wire or 1 ½ x 1 ½ in. (38mmx38mm) mesh of 17 gauge wire. The wire shall conform to the requirements of ASTM A82. Mesh shall not be crimped.
 - (1.2) Portland Cement
 - Type: Cement used for mortar lining shall conform to ASTM C150 and shall be of Type I for the pipe linings. Sampling and testing shall conform to the individual ASTM specifications.

- (ii) Inspection: Satisfactory facilities shall be provided for identifying, inspecting, and sampling cement at the mill, warehouse, and at the site of lining and coating. The PolWD shall have the right to inspect the cement and obtain samples for testing at any points.
- (iii) Storage: Cement shall be stored in a weather tight, dry, well ventilated
- (iv) Unsuitable Cement: Cement containing lumps shall be rejected and shall immediately be removed from the work site.
- (v) Temperature: If the temperature of the cement exceeds 150°F (66°C), it shall be stored until cooled to or below that temperature.
- (1.3) Fine Aggregate
 - General: Fine aggregate for cement mortar shall consist of natural sand or sand prepared from the product obtained by crushing stone or gravel and shall comply with the requirements of ASTM C-33.
 - (ii) Mortar lining fine aggregate: For cementmortar- lining thicknesses 1/2in. (13mm) or less, 100 percent of the fine aggregate shall pass a US Standard Sieve No. 4.
- (1.4) Water

General: The water used for cement mortar and for curing linings and/or coatings shall conform to the applicable requirements of ASTM C94. The water may be fresh or recycled concrete process water and shall be free from injurious amounts of oil, acid, strong alkalies, slats, and vegetable matter.

(1.5) Admixture

Cement mortar may contain a water reducing, setcontrolling admixture conforming to ASTM C94. No admixture shall contain injurious amounts of chlorides. The purchaser shall be advised of the type and amount of any admixtures.

(1.6) Curing Compound

Curing compound for curing cement-mortar linings and coating shall comply with ASTM C309.

The procedures for the curing of the pipe shall be in accordance with AWWA C205.

(1.7) Paint

The paint or other materials used to prevent the rusting of steel surfaces at holdbacks or mortar lining or coating before pipe installation shall be quick drying, corrosionresistant material with good bonding properties to steel and shall dry tack-free and smooth within 4h after application. The paint shall be applied without sags or runs, to a thickness that will not impair the clearances required for proper installation of the joint.

(2) Surface Preparation

Cleaning surfaces: All surfaces to be cement-mortar lined or cement mortar coated shall be cleaned to remove loose or other foreign matter that could interfere with the adherence of the cement mortar.

- (3) Lining Requirements
 - (3.1) General

Cement-mortar lining shall be composed of cement, sand, and water, well mixed and of proper consistency to obtain a dense, homogeneous lining that will adhere firmly to the pipe surface. Cement mortar for lining shall consist of one part cement to not more than three parts of fine aggregate by weight. Excessive amounts of batch mix water shall be avoided. Only enough water to obtain proper placement characteristics of the batched cement mortar shall be used. The water-soluble chloride ion (CI-) content of the cement-mortar lining mix, expressed as a percentage of the weight of cement, shall not exceed 0.15 percent.

(3.2) Thickness

Cement – mortar lining shall be uniform in thickness, except at joints or other discontinuities in the pipe wall. Lining thickness shall be as listed in the Table 1 below or as specified by the purchaser. Ends of lining shall be left square and uniform with regard to the longitudinal axis of the pipe, and lining holdback shall be specified by the purchaser for the type of joint required. The lining thickness requirements shall be maintained by mechanical end retaining rings and verified by physical measurements.

Table 1 – Cement Mortar Lining Thickness				
Nominal Pipe Size	Lining Thickness	Tolerance		

in.	mm.	in.	mm.	in.	mm.
4-10	(100-250)	1/4	6	-1/16, +1/8	(-1.6, +3.2)
11-23	(280-580)	5/16	8	-1/16, +1/8	(-1.6, +3.2)
24-36	(600-900)	3/8	10	-1/16, +1/8	(-1.6, +3.2)
> 36	(> 900)	1/2	13	-1/16, +3/16	(-1.6, +4.8)

(3.3) Equipment

- Lining: Straight sections of pipe shall be lined by using a spinning machine specifically designed and built for the purpose of rotating the pipe section and centrifugally applying cement-mortar linings to the interior of steel pipe or by a method known to provide equivalent results.
- (ii) Mixing: The cement mortar shall be mixed in batches. The amount of cement and sand entering into each batch shall be measured by weight. The quantity of water entering the mixer shall be measured automatically by an adjustable device, or it shall be otherwise measured to ensure that the correct quantity of water is being added.

(3.4) Machine Lining

- Bracing: When required to prevent distortion or vibration during the spinning, each section of pipe shall be suitably braced with external or internal supports appropriate to the equipment.
- (ii) Placement: In application of lining by a spinning machine, the entire quantity of mortar required for completion of the lining of the section of pipe shall be placed without interruption.
- (iii) Finish: After the cement mortar has been distributed to a uniform thickness, the rotation speed shall be increased to produce a dense mortar with a smooth surface.
- (iv) Surplus Water: Provision shall be made for removal of surplus water by air blowing, tilting of the pipe, or other methods approved by the purchaser.
- (v) Lining Ends: The lining at the ends of the pipe section shall be left square and uniform with regard to the longitudinal axis of the pipe, and the lining holdbacks shall be as specified by the purchaser for the type of the joint required.

- (3.5) Lining Specials
 - General: The application of cement-mortar lining to miters, angles, bends, reducers, and other special sections, the shape of which precludes applications by the spinning process, shall be accomplished by mechanical placement, pneumatic placement, or hand application and finished to produce a smooth, dense surface.
 - (ii) Reinforcement: Wire-fabric reinforcement or ribbon-mesh reinforcement shall be applied to the interior of fitting larger than 24 inches (610mm) and shall extend circumferentially around the fitting. Repaired areas for machine applied linings at miters, pipe ends, outlets, and other cuts made in the lining for fabrication of fitting need not be reinforced if the width of the repair area does not exceed 12 inches (300mm). Repairs for widths exceeding 6 inches (150mm) shall be bonded to the steel and adjacent faces of the lining with a bonding agent conforming to ASTM C881 (Standard Specification for Epoxy-Resin Based Bonding Systems for Concrete"), Type II (Bonding fresh concrete to hardened concrete (non-load bearing).
 - (iii) Thickness: Thickness shall be as required for spun lining of straight sections, except that it may be varied by feathering of filleting to smooth transition with adjoining sections of pipe.
 - (iv) Handwork: Cement mortar for handwork shall be of the same materials and in the same sandcement proportions as the cement mortar for machine lining except that the plaster sand conforming to ASTM C35 may be used in place of sand conforming to ASTM C33. Areas shall be cleaned to remove loose or other foreign matter that would interfere with the adherence of the cement mortar and, if necessary, shall be moistened with water just before the placing of the cement mortar.

(3.6) Defective Lining

 General: All defects, including, but not restricted to, sand pocket voids, over sanded areas, blisters, and cracking as a result of impacts, shall be cut out and replaced by hand or pneumatic

placement to the same thickness as required for the cement-mortar lining.

- Lining cracks: Temperature and shrinkage (ii) cracks in the cement-mortar lining less than 1/16 in. (1.6 mm) in width need not be repaired. Cracks wider than 1/16 in. (1.6 mm) need not be repaired if it can be demonstrated to the satisfaction of the purchaser that the cracks will heal autogenously under continuous soaking in water. The autogenous healing process may be demonstrated by any procedure that keeps the lining of the pipe continually wet or moist. Pipe used in the demonstration shall be representative of the pipe to be supplied, and water for the moistening of the pipe shall be chemically similar to the water to be carried in the pipeline.
- (3.7) Curing of Lining
 - (i) General: Immediately after completion of spinning, the pipe sections may be moved to a curing area. Care shall be exercised at all times to prevent damage to the lining. At the option of the manufacturer, linings shall be accelerated cured, moist cured, or cured by a combination of accelerated and moist curing. Accelerated curing or moist curing may be used interchangeably on a time-ratio basis of 5 1/3 h of moist curing to 1 h of accelerated curing. In any case, the total curing period shall be equivalent to 96 h of moist cure and the minimum curing period before applying the exterior coating shall be equivalent to 24 h moist cure. The lining shall be kept continually moist until completion of the minimum specified curing period.
 - Moist Curing: Moist curing may be used only if the minimum ambient temperature exceeds 40°F (5°C) continuously during the required minimum curing period. No credit shall be allowed for any time during which the temperature drops below 50°F (10°C).

On arrival at the curing area, but not later than 30 minutes after completion of the lining operation, pipe ends shall be covered with plastic or wet burlap for a minimum moist curing period of 24 h before applying the exterior coating, if such coating is specified. If a cement-mortar lining is not specified, the lining shall be moist cured for 96

h before shipment. The ends of the pipe sections shall be kept closed with plastic caps during the curing period, except when sprinkling heads are used, the reinforcement and outside coatings are being applied, or accelerated curing is being substituted. If the plastic end caps are installed at that time, they can be used for shipping to the jobsite as indicated in Sub-section C Par.5 (Plastic End Caps). The manufacturer shall exercise care and diligence to avoid drying out or cracking of the lining.

- (iii) Accelerated curing: On arrival at the curing area, but not later than 30 minutes after completion of the lining operation, accelerated curing may begin. The temperature of the pipe shall not be raised above 95°F (35°C) by the introduction of heat for 4 h after final placement or until the cement mortar has taken its initial set, whichever occurs first. The ambient vapor shall then be maintained at a temperature between 90 °F (32 °C) and 135 °F (57 °C) at a relative humidity of not less than 85 percent for a minimum curing period of 6 h, after which the exterior coating may be applied, if such coating is specified. The accelerated curing shall be maintained for a a minimum period of6 h before applying exterior coatings is specified. The accelerated curing shall be maintained for a minimum period of 6 h before applying exterior coatings and/or for a total of 18 h before shipment.
- (iv) Alternative curing methods: When allowed by the purchaser, alternative curing methods may be substituted, providing the method used by the manufacturer produces a cured lining equivalent to that set forth in Par. (ii)-Moist Curing and Par (iii) Accelerated Curing.
- (4) Field Joints
 - (4.1) Curing of Lining

This section covers material requirements and application procedures recommended for the application of cementmortar field joints.

- (4.2) Inside Field Joints
 - Material: Cement mortar used for the joints shall be composed of a minimum of one part cement to not more than two parts sand, by weight, dry

mixed, and moistened with sufficient water to permit packing and troweling without crumbling. Sand shall be graded within the limits of the plaster sand conforming to ASTM C35. Water shall be clean and free from injurious quantities of organic matter, alkali, salts, and other impurities.

- (ii) Application: Inside joints of mortar-lined pipe shall be filled with cement mortar and finished of smooth and flush with the inside surface of the pipe by troweling or by equivalent means. Before placing the joint cement-mortar material against the surfaces of the lining, the surfaces shall be carefully cleaned, have all soap removed, and then wetted to ensure a good bond between the lining and the joint cement mortar. The pipeline shall not be put into service until the mortar has cured for a minimum of 24 h.
- (iii) For pipe diameters 22 in. (560 mm) and larger. After the pipe zone bedding and backfill have been densified to at least 1 ft. (0.30 m) above the top of the pipe, the inside joint recess of pipe 22 in. (560 mm) in diameter and larger shall first be moistened, then filled and pointed with a stiff cement mortar consisting of one part cement to two parts of sand, by weight. The finished joint shall be smooth and flush with the adjacent pipe surfaces. Interior joint pointing operations shall not be conducted within two joints of pipe laying operations.
- (iv) For pipe diameters 22 in. (560 mm) and larger: Prior to assembling the joint, the inside shoulder of the bell shall be "buttered" with a stiff mortar consisting of one part Portland cement to two parts sand, by weight. An accessory such as a specially designed rubber ball wrapped with burlap shall be used to (1) provide backup against which the cement mortar is squeezed while the centered spigot is pushed "home", and (2) hold cement mortar in place in the assembled joint while alignment and grade are adjusted, the next bell is "buttered", and the next spigot is centered. The accessory shall screed off excess mortar to leave a smooth and continuous surface between pipe sections as it is drawn through the pipe.
- (4.3) Outside Field Joints

- Material: Grout shall be composed of one part cement to not more than two parts sand, by weight, thoroughly mixed with water to the consistency of thick cream. Sand graduation shall conform to the requirements of ASTM C33, except that 100 percent shall pass a US Standard Sieve No. 16.
- (ii) Application: Outside field joints shall be coated with cement mortar, retained by suitable waterimpermeable bands or diapers to bridge the joint and retain the cement mortar without leakage. Before filling, the cement-mortar space shall be flushed with water so that the surface of the joint to be in contact with the cement mortar will be moistened when the cement mortar is poured. The joint shall be filled with cement mortar by pouring from one side only until the cement mortar reaches at least the pipe spring line on the opposite side, and shall be rodded with a wire or other flexible rod, or vibrated so that the cement mortar completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe, and up the opposite side. Pouring and rodding the cement mortar shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. The exposed portion of the grout at the top of the pipe shall be coated with a sealing compound or covered with burlap or moist earth.
- (4.4) Sampling and Testing Cement Mortar for Linings

Mixed cement mortar for pipe lining work shall be sampled at the frequency set forth in Par. (i). Compression test cylinders or centrifugal test cylinders shall be prepared according to the procedures set forth in Par. (ii) or Par. (iii).

- Sampling and testing frequency: A set of at least two standards test cylinders, 6 in. (150 mm) in diameter by 12 in. (300 mm) in length, shall be made each day from the cement-mortar lining for each shift to satisfy the quality control requirements of Par. (v). Additional cementmortar testing shall be defined in the Purchaser's specifications.
- Cement-mortar test cylinders: The cement mortar shall be removed from the mix in accordance with ASTM C172 or samples may be prepared by omitting sufficient water from the

production mix to obtain a 1 – to 3- in. (25- to 75 mm) slump. Test cylinders shall be made in conformance with ASTM C31. Other –sized cylinders, such as 2 in. x 4 in. (50 mm x 100 mm), may be used to test compressive strength.

- (iii) Centrifugal test cylinders: Centrifugally spun test cylinders may be substituted for cement-mortar test cylinders, at the option of the manufacturer. Test cylinders shall be spun about their longitudinal axes in 6-in. (150-mm) diameter by 12 in. (300-mm) long steel molds at a speed that will simulate the compaction of mortar in the lining to produce a spun-cylinder wall thickness of approximately 1 ½ in. (38 mm). The net cross-sectional area of the hollow cylinder shall be used to determine its compressive strength. Damaged cylinders shall not be tested.
- (iv) Curing and testing cylinders: All cement-mortar test cylinders shall be cured with the pipe at the same temperature and for the same total length of time, and shall be tested in accordance with ASTM C39 by an approved testing laboratory unless the manufacturer has approved testing facilities at the work site. In such an event, the tests shall be made by the manufacturer. Certified test reports will be submitted by the manufacturer if required by the contract documents of the purchaser. Additional testing shall be defined in the Purchaser's specifications.
- (v) Strength of cement-mortar lining: Cement-mortar test cylinders shall attain a minimum compressive strength of 4,500 psi (31 MPa) in 28 days or at the time of shipment, if less than 28 days. Pipe made with cement-mortar lining that does not meet the strength requirements set forth herein shall be rejected.

The average of any 10 consecutive strength tests of cylinders representing each cement-mortar mix shall be equal to or greater than the specified strength, and not more than 20 percent of the strength tests shall have values less than the specified strength. No cylinder test result shall be less than 80 percent of the specified strength.

(4.5) Inspection and Testing by the Purchaser

- (i) Inspection at the manufacturer's plant. All materials furnished and work performed by the manufacturer shall be subject to inspection by the purchaser at the manufacturer's plant. During the inspection, the purchaser shall have free access to all parts of the manufacturer's plant necessary to ensure compliance with this specification. The manufacturer shall furnish without additional cost to the purchaser, reasonable assistance as necessary for this inspection.
- (ii) Materials Certification. If required by the purchaser, the manufacturer shall furnish a certification that the materials used have been tested in accordance with and meet the requirements of the applicable ASTM specification for wire, wire fabric, ribbon mesh, Portland cement, sand, and curing compound, if used. In addition, if required by the purchaser, the manufacturer shall furnish certified copies of compression test results of the mortar.
- (iii) Responsibility. Inspection by the purchaser, or failure of the purchaser to provide inspection, shall not relieve the constructor or the manufacturer of the responsibility to furnish materials and to perform work in accordance with this specification.
- (iv) Tests. Tests the purchaser makes on the material sample fails to meet the requirements, the manufacturer shall be notified immediately. Material affected by the test results shall be set aside pending final disposition.
- (v) Rejection. Material and pipe that are discovered to be defective or that do not conform to the requirements of this standard will be subject to rejection at any time prior to final acceptance of the pipe. An effort shall be made by the purchaser to inspect the pipe in the manufacturer's plant pursuant to Par. (i). Rejected material and pipe shall be removed from the work site within a reasonable period of time.
- b.2 Liquid Epoxy Coating Systems for the Exterior of Steel Water Pipelines
 - (1) General
Coating of pipe shall conform to the requirements of AWWA Standard C210 or as required for shop and field-applied, liquidepoxy exterior coatings used in the water-supply industry for steel water pipelines installed underground, under normal construction conditions.

- (2) Coating System
 - (2.1) Liquid-epoxy coatings. The coatings used in this standard shall be based on liquid chemically cured epoxies. The curing agent should be an amine. Materials used in both the primer and finish coat(s) shall be products of one manufacturer. It should also be a two component solvent free epoxy, 82% volume solid, color white, should not undergo heating process and certified to NSF/ANSI 61.
 - Shelf life. The component parts shall be stored in unopened original containers at temperatures not to exceed the manufacturer's recommendation. They shall show no instability or settling beyond a state permitting easy, complete redispersion to a smooth, homogeneous consistency. When properly mixed and applied, acceptable drying and curing will result. Stored material that has exceeded the manufacturer's stated shelf life shall not be used.
 - (2.2) Coating thickness. The minimum and maximum dry film thickness (DFT) of the lining and external coating shall be specified by the purchaser. Dry film thickness shall conform to the manufacturer's printed data and shall be tested in accordance with SSPC-PA 2.
 - (i) Minimum thickness. Unless otherwise specified, the minimum DFT provided shall be at least 16 mils (406 μ m).

Table 1. Coated Pipe Inspection Tests				
Test	Minimum	Method		
	Requirement			
Electrical		Sub – section 8 (8.1) Par. V		
Inspection				
(Holidays)				
Adhesion				
ASTM D3359	4A	Sub – section 8 (8.1) Par. VI		
(Method A)	800psi	Sub – section 8 (8.1) Par. VI		
ASTM D4541	(5,515 kPa)			
psi (kPa)				
Thickness, dry	16 mils	Sub – section 2 (2.2) Par. I		
film, mils (μm)	(406 μm)	Sub – section 8(8.1) Par. IV		

Table 2. Qualification Requirements of Laboratory – Applied Epoxy CoatingSystem					
Test	Minimum	Maximum	Method		
Immersion and vapor phase, 30 days			Sub – section 8 (8.2) Par. II		
a. Deionized water	Pass				
b. Sulfuric acid, 1 percent by wt.	Pass				
c. Sodium hydroxide, 1 percent by wt.	Pass				
Catholic disbondment		9.53 mm (0.38 in.) radius	Sub – section 8 (8.2) Par. II		

- (2.3) Applied, cured coating requirements. After curing, but prior to burial, the coating system shall be a continuous film, free of thin spots and other imperfections as defined in Sub-section 8 (8.1) [Inspection and Testing], and shall pass electrical inspection for continuity as defined in Sub-section 8 (8.1) Par. v.
- (2.4) Coated pipe inspection tests. The inspection test requirements for shop or field-applied epoxy coating systems are stated in Table 1.
- (2.5) Qualification requirements. Minimum cured film requirements for laboratory-applied epoxy coating systems are stated in Table 2.
- (3) COATING APPLICATION
 - (3.1)General. The pipe coating shall be applied in accordance manufacturer's with the recommendations. Application by airless-spray or centrifugal-wheel equipment is preferred. Application by other methods is allowed for pipe connections and appurtenances in accordance with Sub-section 6 [Coating Special Pipe Connections and Appurtenances].
 - (3.2) Pipe Preparation
 - Cleaning. Prior to abrasive blast cleaning, surfaces shall be inspected and, if required, cleaned according to SSPC SP 1 to remove oil, grease, or other foreign matter. Only prevailing code safety solvents that do not leave a residue shall be used. Preheating to

remove oil, grease, mill scale, water, and ice may be used provided the pipe is preheated in a uniform manner to avoid distorting the pipe.

- (ii) Abrasive blast cleaning. Pipe surfaces shall be abrasive blast cleaned with mineral abrasives, slag abrasives, steel shot, or steel grit in accordance with SSPC-SP 10/NACE No. 2. The blast anchor pattern or profile depth shall be 2.0 mils to 4.0 mils (50 μm to 100 μm) measured in accordance with ASTM D4417. When using steel abrasives, a sufficient quality of steel grit shall be provided to ensure an angular blast profile is achieved.
- (iii) Visual comparative standards. Prior to abrasive blast cleaning, the constructor shall prepare a representative area of the blastcleaned surface on an actual work surface. as well as a visual comparative standards on steel panels that are a minimum 6-in. x 6-in. x 0.25-in. (150-mm x 150-mm x 6-mm) steel panels. On agreement with the purchaser and the constructor that the visual standard meets the requirements of Sub-section 3 (3.2), Par. ii, the panels shall be wrapped in 4-mil to 6-mil (100-µm to 150-µm) thick plastic, sealed with tape or otherwise protected from surface contamination or corrosion, and maintained as visual reference standards throughout the coating operations. Alternatively, other industryaccepted visual comparative standards, such as those provided by NACE or SSPC and agreed on by the purchaser and constructor may be used.
- (iv) Abrasive working mix. When blasting equipment is employed using a recycled abrasive working mix, the abrasive working mix shall be maintained free of contaminants (oil, water, etc.).
- (v) Surface inspection. The cleaned exterior and interior pipe surfaces shall be inspected for conformance to Sub-section 3 (3.2), Par. ii and Par. iii. Surface imperfections, such as slivers, scabs, burrs, weld splatter, and gouges, shall be removed by grinding. Ground areas shall meet the profile (anchor

pattern) requirements of the coating manufacturer. Imperfections may dictate that the pipe joint be rejected.

- (vi) Interior cleaning. If abrasives or other loose foreign matter has entered the interior of the pipe, clean, dry, oil-free compressed air shall be used to remove the loose foreign matter in a manner that does not adversely affect the cleaned surface. Alternatively, vacuum cleaning or other methods may be used in place of compressed air.
- (vii) Protection from moisture. Abrasive blastcleaned pipe surfaces shall be protected from conditions of high humidity, rainfall, or surface moisture. Pipe shall not be allowed to flash rust before coating.

(3.3) Coating Application

- (i) Materials preparation. Materials preparation shall be in accordance with the manufacturer's recommendations.
- Holdback for field welds. When pipe sections are to be joined together by field welding, a band that is free of lining and coating shall be left on the inside and outside surfaces at the ends of the sections. This band shall be of sufficient widths, as specified by the purchaser, to permit the making of field joints without damage to the lining and coating [Sub section 5 (5.1)]. The manufacturer should be consulted for holdback width.
- (iii) Pipe ends for nonwelded field joints. When rubber-gasketed joints or mechanical couplings are used, the coating shall extend to the ends of the pipe. The coating thickness on the pipe surfaces that receive rubber sealing gaskets shall not exceed what is recommended by the manufacturer of the coupling. However, the coating system"s dry film thickness shall not be less than 16 mils (406 µm). If the purchaser specifies steel pipe with rubber-gasketed joints; an interior lining of liquid epoxy meeting the requirements of this standard; and an external pipe coating of another material, such as those described in ANSI/AWWA C203, ANSI/AWWA C214, or

ANSI/AWWA C215, the liquid-epoxy system shall be extended around the pipe end and shall cover the exterior pipe surface from the end to a point 4 in. (100 mm) past the sealing point of the rubber gasket.

- (iv) Application temperature. Application shall be performed when the metal temperature is more than 5°F (3.0°C) above the dew point. The temperature of the mixed coating material shall not be lower than 50°F (10°C). The temperature of the pipe during application shall conform to the recommendations of the coating manufacturer. Preheating of the coating material: the use of inline heaters to heat the coating material; or heating of the pipe, fittings, or pipe connections or appurtenances and dehumidification equipment may be used to facilitate the application. Heating shall conform to the recommendations of the coating manufacturer.
- (v) Application of epoxy coating system. The epoxy coating system shall be applied as recommended by the manufacturer. If more than one coat is applied, the second coat shall be applied within the time limits, surface conditions, and temperature recommended by the manufacturer. If the period between coats is exceeded, a repair procedure shall be obtained from the coating manufacturer and its recommendations followed.
- (vi) Cure. The coating manufacturer shall be consulted to ascertain the proper cure time and methods. After application, the coating shall be tested for cure in accordance with Sub-section 8 (8.1) Par. iii.

(4) COATING REPAIR

- (4.1) Defective coating. Coating shall be repaired in accordance with the following subsections.
 - Surface preparation. Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means acceptable to the purchaser. The

adjacent coating shall be feathered by sanding, grinding, or other methods approved by the purchaser. Accumulated debris shall be removed by vacuum, blowing with contaminant-free air, or wiping with clean rags.

- Access. Areas not accessible for coating repair, such as interior surfaces of small-diameter pipe, shall be reprocessed and recoated as described in Sub-section 3 (3.2), Par. iii.
- (iii) Coating application. The coating system shall be applied to the prepared areas in accordance with the procedures stated in Sub-section 3 (3.2), Par. iii.
- (iv) Repair inspection. Repairs shall be electrically inspected using a holiday detector in accordance with Sub-section 8 (8.1) Par.V. The coated pipe shipped from the plant shall be holiday-free.

(5) WELDED FIELD JOINTS

- (5.1) Preparation. The weld joint shall be cleaned so that all surfaces are free of mud, oil, grease, welding flux, weld splatter, and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be abrasive blast cleaned, vacuum blasted, or abraded using rotary abrading pads to provide a surface that complies with SSPC-SP 10/NACE No. 2, as defined in Sub-section 3 (3.2), Par. iii. The adjacent liquid-epoxy coating shall be feathered by abrading the coating surface for a distance of 1 in. (25 mm) minimum.
- (5.2) Coating application. The coating system shall be applied to the weld joint in accordance with Subsection 2 and 3. At the option of the purchaser, external weld areas may be protected with materials and methods conforming to ANSI/ AWWA C203, ANSI/AWWA C209, ANSI/AWWA C216, ANSI/AWWA C217, or ANSI/AWWA C222.
- (5.3) Electrical inspection. After curing, the coating system applied to the welded joints shall be holiday tested in accordance with Sub section 8 (8.1) Par. v. Any holidays indicated by the detector shall be marked with chalk or felt-tip marker to identify the area for repair. When alternate materials are used as in Sub-

section 3 (3.3), Par. iii, holiday detection should conform to those standards.

(6) COATING SPECIAL PIPE CONNECTIONS AND APPURTENANCES

- (6.1) General. This section describes the application of liquid-epoxy coatings to mechanical couplings, flanges, and similar appurtenances for steel pipe fittings, as well as to nuts, bolts, and other items used in conjunction with connections and attachments.
- (6.2) Surface preparation. Surfaces of pipe connections and appurtenances to be coated shall be prepared in accordance with Sub-section 3 (3.2).

(6.3) Coating application

- Application. Unless otherwise required by the purchaser, coatings shall be applied in accordance with Sub-section (2) and (3).
- (ii) Coating threaded connections. Prior to shipping, threaded connections and appurtenances that must be assembled and operated in the field shall be left uncoated and shipped with rust-preventing compounds or strippable protective coatings applied to the threads only. After final field assembly, the compound shall be completely removed. The exposed threads shall be coated as provided in Sub-section 3 (3.3). The purchaser should specify the coating requirements for flange faces and other mating surfaces of other types of mechanical connections.
- (iii) Cure. The coating manufacturer shall be consulted to ascertain the proper cure time and methods. After application, the coating shall be tested for cure in accordance with Sub-section 8 (8.1) Par. 3.
- (iv) Electrical inspection for continuity. After the coating has cured, but prior to installation, the coated pipe, fittings, and specials shall be tested for holidays in accordance with Sub section 8 (8.1) Par. 5. Holidays indicated by the detector shall be marked with chalk or felt-tip marker to identify the area to be repaired.

 (v) Coating repair. Coating repair shall be performed in accordance with Sub-section 4.

(7) FIELD PRODECURES

During construction of the pipeline, the constructor shall take precautions to minimize damage to the protective coating. No metal tools or heavy objects shall be permitted to come into contact with the finished coating. Workers shall be permitted to walk on the coating only when necessary, in which case only shoes with rubber or composition soles and heels shall be worn. Coating damaged during installation shall be repaired in accordance with Sub-section 4.

- (7.1) Hoisting. Coated articles shall be hoisted using widebelt slings. Chains, cables, tongs, or other equipment that causes damage to the coating will not be permitted, nor will dragging or skidding of the pipe. The constructor shall allow for inspection of the coating on the underside of coated articles while the articles are suspended. Any coating damage shall be repaired in accordance with Sub-section 4.
- (7.2) Protection during welding. A heat-resistant material with a minimum width of 18 in. (460 mm) shall be draped over the top half of the pipe on each side of the coating holdback during welding to avoid damage to the coating by hot weld spatter.
- Bedding and trench backfill. Backfilling shall be performed in a manner that avoids abrasion or other damage to both factory and field-applied coatings. Unless otherwise specified by the purchaser, the following requirements shall be met:
 - Where the trench traverses rocky ground containing hard objects that could penetrate the protective coating, a layer of screened earth, sand, or rounded river-run gravel no less than 6 in. (150 mm) thick with a maximum particle size of 0.75 in. (19 mm) shall be placed in the bottom of the trench prior to installation of the coated article.
 - Backfill shall be placed around the exterior of the coated pipe only after the purchaser has made the final inspection and has accepted the exterior coating. If rocks or other hard objects are present in the backfill material along any section of the pipeline, screened backfill shall be placed around the coated pipe to a minimum depth of 6 in. (150 mm)

above the coated pipe before backfilling the remainder of the trench. Other rock-shield materials approved by the purchaser may be used.

(iii) Compaction of bedding and backfill in the trench shall be as specified by the purchaser. Rodding with metal rods or other metal tools that could contact and damage the coating shall not be permitted.

(8) VERIFICATION

(8.1) Inspection and Testing

The coating system shall be inspected for adhesion (to the steel and between coats), thickness, blisters, cracks, bubbles, under film voids, holidays, pinholes, discontinuities, and mechanical damage. Imperfections shall be identified and marked for repair with chalk or felt-tip marker.

- (i) Purchaser's inspection option. At the Purchaser's option, the entire procedure of applying the liquid-epoxy coating system shall be inspected from the time of surface preparation to completion of the coating application. Lack of inspection by the purchaser shall not relieve the constructor of responsibility to provide materials and perform work in accordance with this standard.
- (ii) Coating application inspection. When inspection is required by the purchaser, coating work not done in the presence of the purchaser may be subject to rejection. Coating work may be rejected if the procedure used in applying the liquid epoxy coating material does not comply with this standard.
- (iii) Cure. The cure test shall be performed in accordance with the solvent rub procedures as outlined in ASTM 4752 (solvent rub test), ASTM D3363 (pencil hardness), or both, as required by the purchaser. A coating system that has not cured in accordance with the manufacturer's written instructions may be rejected.

- (iv) Thickness test. The thickness of the cured coating system shall be determined in accordance with SSPC-PA 2 (see Sub section 2 (2.2) Par.(i).
- (v) Electrical inspection for continuity. After curing, but prior to installation, the coating system applied to the pipe shall be tested for holidays according to the procedures and using the voltage settings outlined in NACE RP0188 for the specified thickness. Any holidays indicated by the detector shall be marked with chalk or felt-tip marker to identify the area to be repaired.
- (vi) Adhesion. The adhesion or bond of the coating to the steel and the intercoat adhesion of succeeding coats after curing shall be determined in the shop or field in accordance with ASTM D3359, Method A (shear adhesion). Shear adhesion will be considered satisfactory if a rating of 4A is achieved. The adhesion of the coating system may also be performed in accordance with ASTM D4541 (tensile adhesion). Tensile adhesion will be considered satisfactory if a minimum tensile adhesion rating of 800 psi (5,515 kPa) is achieved. In the shop, the adhesion test may be conducted on the coated pipe or on the coating applied at the same time to test panels of the same substrate and surface preparation as the pipe.
- (8.1) Performance Testing of Laboratory-Applied Epoxy Coating System
 - Coating material tests. Prior to acceptance and application of the coating material, samples of material requested by the purchaser and submitted by the constructor may be tested by the purchaser in the Purchaser's laboratory or in an independent commercial laboratory designated by the purchaser.
 - (ii) Immersion. Steel panels of dimensions 2 in. \times 6 in. \times 1⁄4 in. (50 mm \times 150 mm \times 3.2 mm) shall be prepared, coated, and cured in accordance with Sub-section 3 (3.2). The uncoated side and edges shall be sealed with hot wax or other resistant material.

Suitable containers shall be filled to a depth of 4 in. (100 mm).one with deionized water. one with 1 percent by weight solution sulfuric acid and one with 1 percent by weight solution sodium hydroxide. The panels shall be placed in the containers to allow exposure to both the liquid and vapor phases of the fluids. If multiple panels are placed in the same container, a distance of at least 1 in.(25 mm) shall be maintained between panels. The containers shall be covered; but not sealed, and allowed to stand at 75°F± 2°F (24°C ± 1°C) for 30 days, maintaining liquid levels as required. The panels shall be removed, rinsed, and allowed to drv for 24 hr. Blistering, peeling, or disbondment shall constitute failure to pass the test.

- (iii) Cathodic disbondment. Cathodic disbondment is measured following the procedure of ASTM G8. Steel test pipes 2-in. (50-mm) in diameter shall be prepared by abrasive blast cleaning in accordance with Sub-section 3 (3.2) Par. (i). The liquid epoxy coating, with or without primer depending on the coating system, shall be applied to the exterior of the test pipes, at the thickness and by the method recommended by the manufacturer. The coating shall be cured according to the manufacturer's recommendations prior to testing. An average value greater than the limits specified in Sub-section 2 (2.5), Table 2, shall constitute failure of the coating to meet the requirements.
- (8.2) Performance Testing of Laboratory-Applied Epoxy Coating System
 - Coating material tests. Prior to acceptance and application of the coating material, samples of material requested by the purchaser and submitted by the constructor may be tested by the purchaser in the Purchaser's laboratory or in an independent commercial laboratory designated by the purchaser.
 - (ii) Immersion. Steel panels of dimensions 2 in.
 × 6 in. × ¼ in. (50 mm × 150 mm × 3.2 mm) shall be prepared, coated, and cured in

accordance with Sub-section 3 (3.2). The uncoated side and edges shall be sealed with hot wax or other resistant material. Suitable containers shall be filled to a depth of 4 in. (100 mm), one with deionized water, one with 1 percent by weight solution sulfuric acid and one with 1 percent by weight solution sodium hydroxide. The panels shall be placed in the containers to allow exposure to both the liquid and vapor phases of the fluids. If multiple panels are placed in the same container, a distance of at least 1 in.(25 mm) shall be maintained between panels. The containers shall be covered; but not sealed, and allowed to stand at 75°F± 2°F (24°C ± 1°C) for 30 days, maintaining liquid levels as required. The panels shall be removed, rinsed, and allowed to dry for 24 hr. Blistering, peeling, or disbondment shall constitute failure to pass the test.

(iii) Cathodic disbondment. Cathodic disbondment is measured following the procedure of ASTM G8. Steel test pipes 2-in. (50-mm) in diameter shall be prepared by abrasive blast cleaning in accordance with Sub-section 3 (3.2) Par. (i). The liquid epoxy coating, with or without primer depending on the coating system, shall be applied to the exterior of the test pipes, at the thickness and by the method recommended by the manufacturer. The coating shall be cured according to the manufacturer's recommendations prior to testing. An average value greater than the limits specified in Sub-section 2 (2.5), Table 2, shall constitute failure of the coating to meet the requirements.

(8.3) Rejection

- Pipe. The purchaser may reject pipe if the surface condition does not comply with the requirements of Sub-section 3(3.2) Par. (ii) and Par. (iii). Pipe rejected because of inadequate cleaning shall be recleaned.
- Coating materials. If any sample of coating material does not comply with this standard, the coating material represented by such a sample shall be rejected.

C. DELIVERY

- c.1 Packaging, Handling, Stacking, and Storage
 - (1) General. Coated pipe and other articles shall be packaged, handled, and stored in a manner that will minimize damage. Pipe or coating damaged in handling or other operations shall be repaired in accordance with Sub section 4.
 - (2) Packaging. Coating materials shall be supplied to the jobsite in the manufacturer's original, unopened containers. Each container shall be plainly marked with the name and address of the manufacturer, type of material, batch or lot number, date of manufacture (unless contained in the batch or lot number), storage conditions, and information as required by current applicable provincial and local regulations.
 - (3) Storage of materials. Materials shall be stored and protected from the elements as required by the district.
 - (4) Stacking. Stacking of coated pipe shall be in accordance with industry accepted safety practices.
 - (5) Plastic End Caps. Plastic end caps shall be securely fastened to pipe ends of completed pipe for protection of the cement-mortarlining for drying. End caps shall be maintained in place until time of installation. Moisture shall be maintained inside the pipe by periodic addition of water as necessary.
 - (6) Care of Pipe: Care shall be taken to avoid cracking of the cement mortar lining on steel pipe. If necessary, plastic sheet caps shall be used to close pipe ends and keep linings moist.
 - (7) Transport and Handling of Pipe
 - (7.1) General: Cement mortar lined –epoxy coated steel pipe shall be transported and handled as specified herein. Any pipe section that becomes damaged because of improper transporting, handling or stockpiling shall be repaired to the satisfaction of the PolWD PIU representative. Where damaged areas are extensive or where, in the PolWD PIU representative's opinion, field repairs are not practicable, the PolWD PIU representative may order the Contractor to remove the damaged pipe section from the site of the work and replace it with a new section.
 - (7.2) Moving Pipe: Pipe shall be lifted by means of a padded forklift or by belt, slings in such a manner as to minimize bending of the pipe section and prevent

damaged to the coating. When being transported, pipe shall be supported in a manner that will prevent distortion or damaged to the lining or coating. When not being handled, pipe shall be stockpiled on timber cradles or properly prepared ground with all rocks eliminated. Damaged pipe shall be repaired or replaced as specified.

- (7.3) Pipe Caps: Plastic caps placed over the ends of steel pipe shall not be removed until the pipe is ready to be placed in the trench. Plastic caps may be opened temporarily to spray water inside the pipe for moisture control.
- (7.4)Pipes shall be carefully supported during shipment and storage. Pipe, fittings, and specials shall be separated so that they do not bear against each other, and the whole load shall be securely fastened to prevent movement in transit. Store pipe on padded bunks with tie-down straps approximately over stulling. Store pipe on skids, sand or dirt berms, tires, or other suitable means to protect the pipe from damage. Each end of each length of pipe, fitting, or special and the middle of each pipe joint shall be internally supported and braced with stulls to maintain a true a true circular shape. Internal stulls shall consist of timber or steel frirmly wedged and secured so that stulls remain in place during storage, shipment, and installation. Stulls shall not be removed until pipe is laid and set to grade.

c.2 Affidavit of Compliance

(1) For Epoxy Coating

The PolWD requires an affidavit from the manufacturer or supplier that the material provided complies with applicable requirements of ANSI/AWWA C210, and ANSI/NSF 61. The PolWD also requires an affidavit that the coating material supplied is of the same formulation(s) that was laboratory tested by the manufacturer and found to meet or exceed the performance requirements of ANSI/AWWA C210 and ANSI/NSF 61.

(2) For Cement-Mortar Lining

The manufacturer shall furnish an affidavit that the cement-mortar lining furnished complies with all applicable provisions of AWWA C205.

D. TESTING AND INSPECTION

d.1 General

All materials furnished shall be subject to inspection by the PolWD at the manufacture's plant. During inspection, the PolWD shall have free access to all parts of the manufacturer's plant necessary to ensure compliance with this specification. The manufacturer shall furnish without additional cost to the PolWD, reasonable assistance as necessary for this inspection.

Inspection and testing of pipe and pipe materials shall be in accordance with ASTM A-139 Grade B and shall be made by the PolWD's Representative during pre-manufacturing, pre-delivery and final delivery (on site). In such event, all expenses for the inspection including travel and accommodation of the inspectors shall be borne by the Contractor.

d.2 Laboratory and Certification Requirements

After the issuance of the Notice to Proceed, the Contractor shall submit shop drawings of the pipe, fittings and appurtenances to be supplied for the contract as specified herein and as indicated in the construction drawings. After approval of the shop drawings of the pipe materials, fittings and appurtenances to be furnished by the Contractor, the following laboratory results and certifications/affidavits shall be submitted before the pre-delivery schedule of inspection:

- Report of Analysis per AWWA/ANSI C210 and AWWA/ANSI C205 certified by the accredited laboratories;
- Report of Analysis per specification set by DOH for Drinking Water (PNS 2007) certified by the accredited laboratories;
- (3) Certification and listing by the National Sanitation Foundation (NSF) that the material provided complies with applicable requirements NSF Additive Standard No. 61.
- (4) Affidavit that the lining and coating material supplied for the contract is of the same formulation(s) that was laboratory tested by the manufacturer and found to meet or exceed the performance requirements of ANSI/AWWA C210, ANSI/AWWA C205 and ANSI/NSF 61.

E. CYLINDER MATERIAL

Cylinders shall be fabricated from hot-rolled carbon steel sheets or plates conforming with ASTM A-570 Grades C, D, or E, ASTM A-283 Grade D; steel pipe conforming with ASTM A-139 Grade B; or, if approved by the PolWD PIU representative, high strength low-alloy steel conforming with ASTM A-572 Grade 42.

F. RUBBER GASKET

The rubber gasket shall be the continuous ring type, made of a special composition rubber. The compound shall be of first-grade natural crude, synthetic rubber, or a suitable combination thereof. The gasket shall be so formed and cured as to be dense, homogeneous, and have a smooth surface free of blisters, pits, and other imperfections. The gasket shall be of sufficient volume to fill substantially the recess provided when the joint is assembled and shall be the sole element depended upon to make the joint watertight. Gaskets shall be furnished with the pipe. The compound shall conform to the physical requirements listed below:

Physical Requirement	Value		
Tensile Strength, min.	Natural Rubber	15.85 Mpa (2,300 psi)	
	Synthetic Rubber and combination	14.47 Mpa (2,100 psi)	
Illtimate	Natural	500%	
Elongation, percent minimum	Synthetic and combination	425%	
	Shore Durometer, Type A	40-65	
Compression set, pe deflection maximum	20%		
Tensile strength afte original tensile stren pressure test or air h	80%		

G. WELDED JOINTS

Where welded joints are provided, weld bell type joints may be used, or the bell may be cut back, or a filler rod added so as to permit a field weld between the bell and spigot joints rings.

H. PIPE DESIGN

Steel pipe shall be designed, manufactured, and tested in conformance with AWWA C200, AWWA M-11 and with the criteria specified herein. Sizes shall be as shown on the drawings and shall be designed for a minimum of 300 psi working pressure and 36,000 psi minimum yield strength conforming to requirements of ASTM A-139 [Standard Specifications for Electric Fusion (Arc) - Welded Steel Pipe (NPS 4 and over)].

Design parameters are as shown in Figure 1.

I. HYDROSTATIC PRESSURE TEST

All steel cylinders shall be subjected to a hydrostatic pressure test that stresses the steel to 12.36 MPa. While under pressure test all welds shall be thoroughly inspected and all parts showing leakage shall be marked. Cylinders that show any leakage under test be re-weld at the point of leakage and subjected to another hydrostatic test.

J. SPECIALS

j.1 Definition

Specials as defined as bends, tees, reducers, crosses, outlets and manifolds, wherever located, and all piping above ground or in structures. Except as otherwise provided herein, materials, fabrication, and shop drawing of straight pipe shall conform to the "AWWA Standard for Steel Water Pipe 6 Inches and Larger "(AWWA C-200).

j.2 Outlets, Tees, and Crosses

Outlet shall be welded to the steel cylinder of the pipe following application of mortar coating to the cylinder. Following this, all outlets larger than 50 mm (2 in.) in diameter shall be provided with steel reinforcing saddles, wrapper plates, or crotch plates, or they shall be fabricated in their entirely of steel plates having a thickness equal to the sum of the required thickness of the saddle or wrapper plate, plus the cylinder to which they are attached.

Such saddles or wrapper plates shall be of steel plate at least 1.25 times the thickness of the pipe cylinder to which the outlet is attached. The total cross sectional area of the saddle or wrapper plate shall be at least 1.25 times the product of the cutout length and the plate thickness of the pipe. The overall width if the saddle or wrapper plate shall not be more than 2 times, and not less than 1.67 times, the maximum dimension of the cutout. Outlets 300 mm (12") and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, i.e., 324 mm (12-3/4 in.), 273 mm (10-3/4 in.), 219 mm (8-5/8 in.), 169 mm (6-5/8 in.), and 114 mm (4-1/2 in.).



Figure 1. Pipe Parameters

Requirements:

- 1. Steel Pipe:
- 2. Lining:
- 3. Coating (Exterior)

Conformed to AWWA C 200 Cement-Mortar conformed to AWWA C 205 Conformed to AWWA C 210 Conformed to NSF 61

2

Where required, crotch plates shall be provided, designed according to the nomograph method described in AWWA Manual M-11, Section 19.5, or AWWA Journal, Vol. 47, No. 6, June 1955, pp.617 to 623.

Tees, wyes, and crosses shall either be fabricated of steel plate or provided with wrapper plates or with crotch plates. The thickness of the plate or plates, exclusive or crotch plates, being such that when multiplied by the diameter of the opening, will not be less than 1.25 times the cross-sectional area of the cutout. Where tees, wyes, or crosses are fabricated from steel plate without wrapper plates, the thickness of the plate shall not be less than 2.5 times the required plate thickness shown in the preceding table for such fittings.

j.3 Bends

Unless otherwise shown, the minimum radius of bends shall be 2 $\frac{1}{2}$ times the pipe diameter, or 3mm (10 ft.) whichever is less.

j.4 Dimensions

Unless otherwise shown, dimensions of specials shall conform with "AWWA Standard for Dimensions for Steel Water Pipe Fittings" (AWWA C-208) for Service in Transmission and Distribution System".

j.5 Steel Welding Fittings

Steel welding fittings shall conform to ASTM A-234

j.6 Ends for Mechanical-Type Couplings

Except as otherwise provided herein, where mechanical-type couplings are indicated, the ends of the pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 300 mm (12 in.) and smaller is furnished in standard schedule thickness, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

j.7 Flanges

Where the design pressure is 1.2 MPa (175 psi) or less, flanges shall conform to either AWWA C-207 Class D or E, or ANSI B16.5 1.0 MPa (150 psi) Class. Where the design pressure is greater than 1.2 MPa (175 psi), flanges shall conform to ANSI B16.5 2.0 MPa (300 psi) Class. Flanges shall have flat or raised faces. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe.

j.8 Shop Testing

Upon completion of welding, but before lining and coating, each special shall be bulk headed and tested under a hydrostatic pressure of not less than one and one-half (1-1/2) times the pressure for which the pipe has been design; provided however, that if straight pipe used

in fabricating the special has been previously tested in accordance with the design herein, the circumferential welds may be tested by a dye penetrant process using Turco Dy-Check or approved equal, with no further hydrostatic test. Any pinholes or porous welds, which may be revealed by the test, shall be chipped out and rewelded and the special retested.

j.9 Lining

All requirement pertaining to thickness, application, and curing of lining specified for straight pipe shall apply to specials, with the following provision. If the special cannot be lined centrifugally, it shall be lined by hand. In such case, the lining shall be reinforced with 50 mm x 100 mm (2 in. x 4 in.) No. 12 weld wire fabric positioned approximately in the center of the lining. The wire spaced 50 mm (2 in.) on centers shall extend circumferentially around the pipe with fabric securely fastened to the pipe.

Splices shall be lapped 100 mm (4 in.) and the free ends tied or looped to assure continuity.

j.10 Coating

All requirements pertaining to thickness, application, and curing of coating specified for straight pipe shall apply to specials. Unless otherwise shown, the coating on the buried portion of a pipe section passing through a structure wall shall extend to 50 mm (2 in.) inside the outer surface of the wall, or to the wall flange, if one is indicated. Pipe above ground or in structure shall be field-painted as specified in Painting and Coating Section.

j.11 Marking

A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

K. CLEANLINESS OF PIPE

The interior of each pipe section and special shall be free of foreign materials when they are delivered to the site of the work.

L. INSTALLATION OF PIPING

I.1 General

Unless otherwise provided, the Contractor shall furnish and install all pipes, specials, fittings, closure pieces, valves, supports, bolts, nuts, gaskets, jointing materials, and all other appurtenances as shown and

as required to provide a complete and workable installation. Where pipe support details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete adequate regardless of whether or not supporting devices are specifically shown. Concrete thrust blocks, anchor blocks, or welded joints shall be provided at all junctions, changes in direction exceeding 11-1/2 degrees or whether otherwise shown. At all times when the work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in trenches or structures shall be kept tightly closed to prevent entrance of animals and foreign materials. The Contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, shall assume full responsibility for any damaged due to this cause, and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the PolWD.

I.2 Laying

Trenches shall be reasonably dry condition when the pipe is laid. Necessary facilities including slings shall be provided for lowering and properly placing the pipe section in the trench without damaged. The pipe sections shall be laid to the line and grade when shown and they shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.

I.3 Rubber and Gaskets Joints

The rubber gaskets joints shall be made by properly lubricating the rubber gaskets with a suitable vegetable compound soap before it is placed in the groove at the spigot end. The gasket shall be stretched over the spigot of the pipe and carefully seated in the groove, with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise, injured or forced out of position during the closure of the joint. A "feeler" gage shall be used to check the position of the rubber gasket after the joint has been telescope. It shall conform to AWWA C200.

I.4 Field-Welded Joints

Field welding of pipe joints shall conform to the requirements of the "AWWA Standards for Field Welding of Steel Water Pipe Joints" (AWWA C-206). Prior to welding, the joint shall be made up in accordance with Subsection (c) and (e) herein. Such joints shall be inspected and approved by the PoIWD PIU representative before any

protective coating is placed around the outside of the joint. In certain, special conditions, joints should be welded on the inside and outside, in which case field testing method described in AWWA C206, Standards for Field Welding of Steel Water Pipe Joints (latest edition) may be used. Field welding in the interior of steel pipe with lining is ordinarily limited to 24-in. (600mm) or larger pipe, because a worker must enter the pipe after welding to apply lining in the inside at the welded joints. Forced ventilation must be provided to ensure adequate air exchange for workers inside the pipe.

I.5 Protective Coatings

With pipe smaller than 450 mm (18 in.) in diameter before the spigot is inserted into the bell, the bell shall be daubed with mortar containing one (1) part cement to three (3) parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of joint shall be swabbed out. With pipe 450 mm (18 in.) in diameter and larger, joint shall be pointed on the inside with mortar as specified for field joints in AWWA Standard C205 after the backfill has been placed. After coated pipe sections have been joined, the coating shall be made continuous across the joints forming a coating equivalent to the factory-applied coating of adjacent pipe sections. Coating and spark testing of coal tar enamel field joints shall be as specified in AWWA Standard C203 and shall be performed at the expense of the Contractor. The used of coal tar tape to provide the required protection will not be permitted.

After the pipe sections on cement mortar coated pipe have been joined, but before backfilling has been completed, the outside annular space between pipe sections shall be completely filled with grout. The grout shall be poured in such a manner that all exposed portions of metal joints shall be completely protected with cement mortar. Grout shall consist of one (1) part cement to three (3) parts sand, by weight, and shall be sufficiently fluid to permit it to be poured into the joint space. Exterior field joints shall be coated with cement mortar, retained by suitable forms, so as to bridge the joints.

The mortar shall be compacted within the form to produce dense coating without voids. The joint coating shall be kept moist until the backfill is placed.

I.6 Butt-straps

Where a butt-strap is used, both the interior and exterior surfaces of the butt-strap shall be given a coating equivalent to the factory applied coating of the adjoining pipe sections. Mortar coating shall be reinforced with wore mesh. The mortar lining shall be reinforced with wire mesh where the exposed length of the butt-strap, as measured between the ends of the connected pipe sections, exceeds 100 mm (4 in.). Butt-strap used as closure pieces shall be provided with hand holes for repair of the lining.

M. All test results shall be submitted to the PolWD PIU Representative for conformation prior to the pre-manufacturing inspection.

3. REPAIR

Pipes which are damaged during handling and transport shall either be repaired or replaced depending on the extent of damaged to be determined by the PoIWD PIU representative. When pipe's structural integrity is jeopardized, the pipe shall be replaced by the Contractor at no cost to the PoIWD.

Repair of pipes shall be allowed when deep scrapes and gouges on the pipe exterior occurred. Pipe with scratches, scrapes, and abrasions that penetrate the entire liner of the pipe also need repair. However if the pipe is severely damaged, it shall be replaced immediately.

The manufacturer through the Contractor should recommend the appropriate method of repair for evaluation by the PolWD, unless the method of repair is approved by the PolWD, no repair work of the pipe will be undertaken. If the method of repair is not acceptable to the PolWD, the damaged pipe shall be replaced as ordered.

4. MECHANICAL-TYPE COUPLING

Mechanical-type coupling shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed, and shall be equipped with Grade H rubber gaskets. Couplings shall be Gustin-Bacon or Victaulic Style 44 when pipe ends are banded, and Gustin-Bacon or Virtaulic Style 77 when pipe ends are grooved. Buried or submerged couplings shall be coated in accordance with Painting and Coating Section.

5. SLEEVE – TYPE COUPLING

Sleeve-type couplings shall be provided where shown and shall be Smith-Blair, Style 411 or Style 412, equivalent styles manufacturer by dresser, or approved substitute.

Couplings shall be of cast iron with hot-dip galvanized bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. The middle ring shall be not less than 6 mm (1/4 in.) in thickness and shall be 125 to 175 mm (5 to 7 in.) long for standard cast iron couplings, and 400 mm (16 in.) long for long-sleeved couplings.

Bolts for exposed coupling shall be hot-dip galvanized. Buried bolts and sleevetype couplings shall be coated and painted with appropriate painting and coating materials but shall not be limited to anti-corrosion primer for the first coat and epoxy ester enamel for the second coat.

a.	Coupling	:	Ductile Iron
b.	Gasket	:	EPDM Rubber
c.	Flange	:	Ductile Iron
d.	Туре	:	Sleeve Type
e.	Bolt & Nut	:	Hot Dip Galvanized Iron (Flange Type)
f.	Color	:	Black / Blue
g.	Coating	:	Epoxy Coated (Internal and External)

Sleeve Diameter (mm)	Pipe Outside Diameter	Min. No of Bolt & Sizes (mm)	Minimum Coupling Length (mm)
50 (2" Ø)	60	4-12mm	150
100 (4" Ø)	110	6-12mm	150
150 (6" Ø)	160	8-12mm	150
200 (8" Ø)	225	8-12mm	150
250 (10'' Ø)	280	8-12mm	150

6. GASKETS AND BOLTS

a. Gasket for flanged joints shall be a minimum of 3.5 mm thick EPDM Rubber.

3.4 VALVES

1. GENERAL

- a. The Contractor shall furnish and install all valves as shown in the drawings and/or specified herein. All valves shall be new and of current manufacture.
- b. Flanged valves may be raised or plain-faced with serrated gasket surface. Flanges of valves for water working pressure of 175 psi or less shall be faced and drilled to 125-lb American Standard Dimensions; flanges of valves for water working pressures greater than 175 psi shall be faced and drilled to 250lb American Standard Dimension.
- c. Each valve body shall be tested under a test pressure equal to twice its design water working pressure.
- d. All buried valves shall be provided with an exterior protective coating in accordance with the provision of Painting and Coatings section.
- e. When the operating nut of a buried valve is located more than 1.5 meters (5 ft.) below the ground surface, the Contractor shall provide and install in the valve box a stem extension. The bottom of the extension shall be securely fastened to the operating nut of the valve and the top of the extension shall be centered in the valve box.
- f. The Contractor shall furnish a minimum of five (5) tee-handle valve keys of variable lengths sufficient to permit operation of all buried valves regardless of depth, by operators of average height working in normal position. Where the number of valve to be provided exceeds thirty (30) units, The Contractor shall provide one (1) valve key for every five (5) additional valves or a fraction thereof.

- g. Operating nut shall turn counter-clockwise to open. All interior parts of valves manufactured of bronze or brass except valve stems shall conform to the requirements of ASTM Specification B62. Valve stems shall be of stainless steel, having a minimum tensile strength of 2,812 kgf/cm² (40,000 psi) and an elongation of at least 10% in 5.0 cm (2 in.) as determined from a test coupon poured from the same ladle from which the valve stems to be furnished are poured.
- h. Shop drawings for all valves shall be furnished in accordance with Section VII. Clause 2.2. Shop Drawings.
- i. The Contractor shall furnish all the required valves in accordance to these specifications which shall have a warranty of ten (10) years. During the warranty period of ten (10) years, the valves are guaranteed against material defects. In the event that the installed valves are found defective, it has to be repaired or replaced at the no cost to the PoIWD. The valves to be furnished to the PoIWD shall be ANSI/AWWA Compliant, thus ISO Compliant Valves are not applicable in this Contract due to the incompatibility of the ISO Valves to the stocking materials and installed valves and fittings that affects the repair and maintenance of the transmission/distribution lines.

2. BUTTERFLY VALVES AND GATE VALVES

Butterfly valves shall conform to the latest revision of AWWA Standard C-504 for rubber-seated butterfly valves, subject to the following requirements: Valves shall be of Class 150B, and unless otherwise shown, shall be short-bodied. Shaft seals shall be rubber "O"-ring, and journal packing shall be rubber or split-V type packing.

The rubber seated butterfly valves shall be suitable for a maximum steady-state fluid working pressure of 150 psig (1,034 kPa [gauge]) and a maximum of steady-state differential pressure of 150 psi (1,034kPa).

Materials shall be in conformance with the physical and chemical requirements of AWWA C504 which shall be subject to the following requirements: Ductile Iron (ASTM A536, grade 65-45-12 or 70-50-05. Whenever valve components are to be made in conformance with ASTM or other standards that include test requirements or testing procedures, such requirements or procedures shall be met by the valve manufacturer. The records of such tests shall be made available if required by the purchaser.

Valve seats shall be designed to be leak tight in both directions at the following pressure differentials: Class 25A and Class 25B (25psi or 172kPa) upstream; Opsi (0kPa) downstream; Class 75A and Class 75B (75psi or 517kPa) upstream; Opsi (0 Kpa) downstream; Class 150A and Class 150B (150psi or 1,034 kPa) upstream; 0 psi (0kPa) downstream.

All interior and exterior surfaces, except finished or bearing surfaces, shall be carefully prepared by removing all dirt, grease, and rust and shall be cleaned to the extent that the coating will bond to all surfaces.

When valves will be installed in an aboveground location to be subsequently field painted, the exterior of each valve, except flange faces, shall be shop coated with a suitable metal primer to a dry film thickness of not less than 3 mil. The primer shall be compatible with the anticipated field coatings when the field coatings are identified by the purchaser. Flange faces shall be protected from atmospheric corrosion.

DOUBLE ECCENTRIC BUTTERFLY VALVE				
Pa	arts	Material		
1.	Gearbox	Cast Iron		
2.	Body	Ductile Iron		
3.	Shaft, drive	Stainless Steel 420		
4.	Bearing	Bronze/PTFE composite		
5.	Cover	Stainless steel		
6.	Set Screw	Stainless steel A2		
7.	End cover	Stainless steel		
8.	Disk	Ductile iron		
9.	Key	Stainless steel A2		
10.	Gasket	Stainless steel A2		
11.	Screw	Stainless steel A2		
12.	Shaft, Stub	Stainless Steel 420		
13.	End Plate	Ductile iron		
14.	Nut	Stainless steel A2		
15.	Gasket	EPDM rubber		
16.	Spacer	Bronze		
17.	Screw	Stainless steel A2		
18.	Thrust Bearing	Bronze		
19.	Screw	Stainless steel A2		
20.	Washer	Stainless steel A2		
21.	Bolt	Stainless steel A2		
22.	O-Ring	EPDM rubber		
23.	Screw	Stainless steel A2		
24.	Seal Retaner Ring	Steel		
25. Seal Ring		EPDM rubber		

Components





C.I. GATE VALVE F/F

- Fixed, integral wedge nut prevents vibration and ensures durability.
- The ductile iron core is fully vulcanized with drinking water approved EPDM rubber, no iron parts are exposed to the medium and the excellent rubber vulcanization prevents creeping corrosion underneath the rubber.
- Guides in the wedge and on the valve body ensure a uniform closure, safe operation and prevent overloading of the stem.
- The wedge has a large through bore with room for the stem, completely free of hollows or cavities where stagnant water or impurities could collect and cause contamination.
- Stainless steel stem with wedge stop and rolled threads for high strength.
- Full circle brass thrust collar provides fixation of the stem and low free running torque.
- Triple stem seal system with an NBR wiper ring protecting against impurities from outside, a polyamide radial bearing with four NBR O-rings and innermost an EPDM rubber lip seal as the main hydraulic seal to the flow.
- Round bonnet gasket fixed in a recess groove in the bonnet preventing it from being blown out by pressure surges.
- Counter bored and hot-melt sealed bonnet bolts encircled by the bonnet gasket ensures no risk of corrosion.
- Full bore.

• Epoxy coating to DIN 30677-2, GSK approved.

GATE VALVE				
Pa	arts	Material		
1.	Wiper Ring	NBR rubber		
2.	O-ring	NBR rubber		
3.	O-ring	NBR rubber		
4.	Bushing	Polyamide		
5.	Thrust collar	Brass		
6.	Manchette	EPDM rubber		
7.	Stop ring	Stainless steel		
8.	Stem	Stainless steel		
9.	Bonnet bolt	Stainless steel A2		
10.	Bonnet	Ductile iron		
11.	Bonnet gasket	EPDM rubber		
12.	Wedge nut	Brass		
13.	Wedge rubber	EPDM rubber		
14.	Body	Ductile iron		
15.	Wedge core	Ductile iron		
16.	Wedge shoe	Polyamide		





Gate valves and Butterfly Valves should be approved according to WRAS Certificate verifiable online.

Hydraulic test According to EN 1074 - 1 and 2 / EN 12266.

NOTE: Gate valves and Butterfly valves should be PN 10/16.

3. CHECK VALVES

Check valves 100mm (4 in.) and larger shall have flanged connections and be of the swing type with outside lever and weight. The valves shall be designed for a minimum water working pressure of 1.0 MPa (150 psi), and shall have 125-lb American Standard Flanges. Valve bodies shall be cast iron or steel. The valves shall have bronze gate rings and seat rings and type 18-8 stainless steel hinge pins. The check valves shall be designed so that disc and body seat may be easily removed without removing valve from the line. The valves shall be coated in accordance with appropriate painting and coating materials or as directed by the PolWD PIU representative.

3.5 PAINTING PIPEWORKS

1. SCOPE OF WORK

The work include under this section include furnishing of all materials, labor, tools" appliances, and other necessary equipment, and performing all operations required for the completion for all painting and coating work as specified herein.

2. MATERIALS

a. Materials used for the work shall be as follows:

For above ground and exposed piping and other surfaces.

2 coats (top coat) – Quick Drying Enamel, or its equivalent

In no case shall any concrete, metal or any other surface requiring protection be left unpainted even though not specifically defined herein.

b. Deliver specified products in original containers, with seals unbroken and labels intact.

3. WORKMANSHIP

- a. The workmanship shall be of the very best. All materials shall be spread evenly and smoothly flowed on, without runs and sags.
- b. Clean surfaces to be painted, free from dust and dirt before painting.
- c. Touch up knots, pitch streaks, sappy spots, etc., with shellac where finish calls for interior paint or enamel.
- d. Except as otherwise specified, all paints shall be applied in three coats (priming, body and finish). Each coat shall be allowed to dry thoroughly before the succeeding coat is applied. In general, or unless otherwise instructed by the PolWD PIU representative, the time between the application of succeeding coats shall not be less than 48 hours. Each coat shall be inspected and approved before the succeeding coat is applied.

- e. Do not paint exterior while surface is damp, or during rainy or damp weather.
- f. Do necessary putty for nail holes, cracks, etc., after prime coat. Bring putty flush with adjoining surface in a neat, workmanlike manner.
- g. Tint undercoats of paint or enamel to same or appropriate shade of final coat.

4. CLEANING UP

- a. Protect the work at all times and all adjacent work and materials by suitable covering or other methods. Upon completion of the work, remove paint spots from floors, glass and finished hardware.
- b. Remove from premises rubbish, accumulated materials of whatever nature caused by the work. Leave work in a clean, orderly, and acceptable condition.

3.6 WARNING TAPE

1. MATERIAL

The Contractor shall furnish and install for each pipe above or equal to 50 mm an Alu Foil warning/detection tape (minimum width is 5 cm) - (2") with the words "CAUTION – PolWD WATER MAINS BELOW" marked in a continuous manner.

2. INSTALLATION

The tape shall be laid flat on top of an intermediate layer of backfill, after compaction of same and prior to backfilling and compacting, the final top layer. The depth of laying the tape will therefore be about 0.30 m (1 foot) from the finish surface or at about:

- 0.45 m from top of pipes with sizes equal to or under 250 mm diameter except for Asbestos Cement Pipes
- 0.60 m above the top of pipes with sizes equal to or larger than 300 mm

3.7 PRESSURE AND LEAKAGE TESTING AND DISINFECTING

1. GENERAL

The Contractor shall furnish all equipment, labor and materials including the water for testing and proper disinfection of the pipelines. The water used for testing shall be furnished by the Contractor and shall provide the facilities necessary to convey the water from the PolWD-designated source to the points of use. All testing and chlorinating operations shall be done in the presence of the PolWD PIU representative.

2. PIPELINE TESTING

All pipelines shall be thoroughly flushed out with water prior to testing. The Contractor shall test the pipeline in sections after the trench is backfilled, but with joints exposed for examination except in heavily traveled roadways and prior to permanent resurfacing.

The pipeline shall be prepared for testing by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. During the filling of the pipe and before the application of the specified pressure, all air shall be expelled from the pipeline. To accomplish this, taps shall be made, if necessary, at points of highest elevation and after completion of the test the taps shall be tightly plugged unless otherwise specified. After the line or section thereof has been completely filled, it shall be allowed to stand under a slight pressure for a minimum of 48 hours to allow the escape of air from any air pockets and to allow the pipe to absorb as much water as possible.

During this period, all exposed pipes, fittings, valves, hydrants, joints and couplings shall be examined for leaks. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound material at his own expense. The pipeline shall be then be refilled and all bulkheads joints and connections shall be examined for leaks. If any are found, test shall be stopped. The test pressure shall consist of a holding test pressure on each section of the line for a period of two (2) hours. The test pressure at the lowest point shall be 1.0 Mpa (150 psi) according to the class of pipe installed, class 100 or class 150, and as approve by the PolWD's PolWD PIU representative. Pressure gauges shall also be provided at all ends of the section tested. The water necessary to maintain the pressure shall be measured through a meter or by other means satisfactory to the PolWD's PolWD PIU representative. The leakage shall be considered the amount of water entering the pipeline during the two (2)-hour test period. The allowable leakage for cast iron pipe or ductile iron pipe shall not exceed the values listed in Table 3 of AWWA Standard for Installation of Cast Iron Water (AWWA C600). All other types of pipes shall have an allowable leakage not exceeding 1.85L/mm of diameter of pipe per kilometer per day. Should any test of a section of pipeline disclose joint leakage greater than that permitted, the Contractor shall, at his own expense locate and repair or replace the defective pipe, fitting, joint, coupling or other appurtenances. The test shall be replaced until the leakage is within the permitted allowance.

Closure pieces between newly installed and existing mains shall be tested after the pipe has passed the pressure and leakage test specified above. The test shall include subjecting the joint to a pressure of 345 Kpa (50 psi) for a period of five (5) minutes and visually checking for leakage. All visible leaks shall be repaired by the Contractor at no expense to the PolWD.

3. PIPELINE DISINFECTING

Before being placed in service and before certification of completion by the PolWD PIU representative, all new domestic water mains or extensions to existing systems, or valve section of such extension or any replacement in the existing water system shall be disinfected with chlorine in accordance with AWWA Standard C-651-05.

The amount and concentration of chlorine solution applied shall be such as to provide a dosage of not less than 50mg per liter, introduced into the lines or as directed by the PolWD PIU representative. After a contact period of 24 hours, the chlorine residual at the end of pipeline shall not be less than 25 mg per liter. The system shall then be flushed with clean water until the residual chlorine is not greater than 0.75 mg per liter but not less than 0.20 mg per liter. All valves and appurtenances in the pipelines being disinfected shall be operated several times during the chlorine contact periods.

The preferred point of application of the chlorination agent is at the beginning of the pipeline, extension, or any valve section and through a corporation stop inserted on the top of the laid pipes.

Should the initial treatment fail to result in the conditions stipulated above, the chlorination procedures shall be repeated until satisfactory results are obtained.

4. FLUSHING OF PIPELINES

Flushing shall be carried out after disinfection has been achieved. Water sources that are being used for flushing must be clean and meet treated water quality. Flushing shall proceed systematically from water supply source to end of pipe system. Procedure to be used in flushing shall be discussed and agreed to by the DCWD"s representative and the Contractor prior to beginning of flushing works. It shall conform to AWWA C651-92. Flushing of pipeline is deemed to be complete only when the turbidity level of the water is less than 5 NTU and pH level less than 8.5, residual chlorine is between 0.3-1.5 ppm, E. coli and total coliform are absent. Report on flushing shall be completed and signed by Contractor and witnessed by DCWD personnel.

5. PIPELINE HYDROTESTING

At any time, the length of un-hydrotested installed pipelines shall not exceed 500m. No further pipelaying shall be allowed if this is not being complied with.

In heavily traveled roads/streets, hydrotesting should be done within 15 days after pipelaying. No further pipelaying shall be allowed in these roads/streets if previous installation were not hydrotested.

3.8 CONCRETE ENCASEMENT

The Contractor shall furnish all labor, materials equipment and perform all operation in connection with the reinforced concrete encasement, to complete the work, in strict accordance with the applicable requirement of Section - Reinforced Concrete.

Compressive strength of anchor thrust blocks and concrete encasement for pipe shall have a minimum 28 – day compressive strength of 20.68 MPa (3,000 psi) unless otherwise shown.

3.9 PORTLAND CEMENT CONCRETE PAVEMENT (ITEM 311) - RESTORATION

1. SCOPE OF WORK

The work to be undertaken shall include all labor, materials, equipment, plant and other facilities and the satisfactory performance of all work necessary to complete all concrete work shown on the Drawings and specified herein. All works included under this section shall be subject to the General Conditions accompanying these specifications. The General Contractor of the work is required to refer especially thereto.

It shall consist of pavement of Portland Cement Concrete, with or without reinforcement, constructed on the prepared base in accordance with this Specification and conformity with the lines, grades, thickness and typical cross-section shown on the Plans.

2. MATERIALS REQUIREMENTS

a. PORTLAND CEMENT

Cement shall conform to the requirements of the following cited Specifications for the type specified or permitted.

Туре	Specifications		
Portland Cement	AASHTO M 85 (ASTM C 150)		
Blended Hydraulic Cements	AASHTO M 240 (ASTM C 595)		
Masonry Cement	AASHTO M 150-74 (ASTM C 91)		

When Types IV and V (AASHTO M 85), P and PA (AASHTO M 150) cements are used, proper recognition shall be given to the effects of slower strength gain on concrete proportioning and construction practices. Types S and SA cements will be permitted only when blended with Portland cement in proportions approved by the PoIWD PIU representative.

Unless otherwise permitted by the PolWD PIU representative, the product of only one mill of any one brand and type of Portland cement shall be used on the project.

The Contractor shall provide suitable means of storing and protecting the cement against dampness. Cement which, for any reason, has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used.

Only Type I Portland Cement shall be used unless otherwise provided for in the Special Provisions. Different brands or the same brands from different mills shall not be mixed nor shall they be used alternately unless the mix is approved by the PoIWD PIU representative. However, the use of Portland Pozzolan Cement Type IP meeting the requirements of AASHTO M 240/ASTM C 695, Specifications for Blended Hydraulic Cement shall be allowed, provided that trial mixes shall be done and that the mixes meet the concrete strength requirements, the AASHTO/ASTM provisions pertinent to the use of Portland Pozzolan Type IP shall be adopted.

Cement which for any reason, has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used.

Samples of Cement shall be obtained in accordance with AASHTO T 127.

b. AGGREGATES

b.1 Fine Aggregates

It shall consist of natural sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles. Fine aggregate from different sources of supply shall not be mixed or stored in the same pile nor used alternately in the same class of concrete without the approval of the PolWD PIU representative.

It shall not contain more than (3) mass percent of material passing the 0.075 mm (No. 200 sieve) by washing nor more than one (1) mass percent each of clay lumps or shale. The use of beach sand will not be allowed without the approval of the PolWD PIU representative. If the fine aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 10 mass percent.

The fine aggregate shall be free from injurious amounts of organic impurities. If subjected to the colorimatic test for organic impurities and a color darker than the standard is produced, it shall be rejected. However, when tested for the effect of organic impurities strength of mortar by AASHTO T 71, the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95 mass percent.

The fine aggregate shall be well-graded from coarse to fine and shall conform to table below.

Grading Requirements for Fine Aggregates			
Sieve Designation	Mass Percent Passing		
9.5 mm (3/8 in.)	100		
4.75 mm (No. 4)	95-100		
2.36 mm (No. 8)	-		
1.18 mm (No. 16)	45-80		
0.60 mm (No. 36)	-		
0.30 mm (No. 50)	5-30		
0.15 mm (No. 100)	0-10		

b.2 Coarse Aggregates

It shall consist of crushed stone, gravel, blast furnace slag, or other approved inert materials of similar characteristics, or combinations thereof, having hard, strong, durable pieces and free from any adherent coatings. It shall contain no more than one (1) mass percent of material passing the 0.075 mm (No. 200) sieve, not more than 0.25 mass of clay lumps, nor more than 3.5 mass percent of soft fragments.

If the coarse aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 12 mass percent.

It shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96.

If the slag is used, its density shall not be less than 1120 kg/m3 (70 lb./cu. Ft). The gradation of the coarse aggregate shall conform to the table below. Only one grading specification shall be used from any one source.

Grading Requirements for Fine Aggregates					
Sieve Designation		Mass Percent Passing			
Standard	Alternate U.S.	Grading A	Grading B	Grading C	
•••••	Standard				
75.00	3 in.	100	-	-	
63.00	2-1/2 in.	90-100	100	100	
50.00	2 in.	-	90-100	95-100	
37.50	1-1/2 in.	25-60	35-70	-	
25.00	1 in.	-	0-15	35-70	
19.00	3/4 in.	0-10	-	-	
12.50	1/2 in.	0-5	0-5	10-30	
4.75	No. 4	-	-	0-5	

Only one grading specification shall be used from any one source.

c. WATER

Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water will be tested in accordance with, and shall meet the suggested requirements of AASHTO T 26.Water which is drinkable may be used without test. Where the source of water is shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials.

d. REINFORCING STEEL

It shall conform to the requirements of **Item 404** (*DPWH Standard Specification, 2004 edition*), Reinforcing Steel. Dowels and tie bars shall conform to the requirements of AASHTO M 31 or M 42, except that rail steel shall not be used for tie bars that are to be bent and re-straightened during construction. Tie bars shall be deformed bars. Dowels shall be plain round bars. Before delivery to the site of work, one-half of the length of each dowel shall be painted with one coat of approved lead or tar paint.

The sleeves for dowel bars shall be metal of approved design to cover 50 mm (2 inches), plus or minus 5 mm (1/4 inch) of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least 25mm (1 inch) from the end of the dowel. Sleeves shall be of such design that they do not collapse during construction.

e. JOINT FILLERS

Poured joint fillers shall be mixed asphalt and mineral or rubber filler conforming to the applicable requirements of **Item 705** (*DPWH Standard Specifications, 2004 edition*), Joint Materials.

Preformed joint filler shall conform to the applicable requirements of **Item 705** (*DPWH Standard Specifications, 2004 edition*). It shall be punched to admit the dowels where called for in the Plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint.

f. ADMIXTURE

Air-entraining admixture shall conform to the requirements of AASHTO M 154.

Chemical admixtures, if specified or permitted, shall conform to the requirements of AASHTO M 194.

Fly Ash, if specified or permitted as a mineral admixture and as 20% partial replacement of Portland Cement in concrete mix shall conform to the requirements of ASTM C 618.

Admixture should be added only to the concrete mix to produce some desired modifications to the properties of concrete where necessary, but not as partial replacement of cement.

g. CURING MATERIALS

Curing materials shall conform to the following requirements as specified:

- a. Burlap Cloth AASHTO M 182
- b. Liquid Membrane Forming Compound AASHTO M 148
- c. Sheeting (film) materials AASHTO M 171

Cotton mats and water-proof paper can be used.

h. CALCIUM OF CEMENT AND AGGREGATE

It shall conform to AASHTO M144, if specified or permitted by the PolWD PIU representative, as accelerator.

3. STORAGE OF CEMENT AND AGGREGATE

All cement shall be stored, immediately upon delivery in a storage which will protect the cement from dampness. The floor of the storage shall be raised from the ground. It shall be placed in locations approved by the PolWD PIU representative. Provisions for storage shall be ample, the shipments of cement as received shall be separately stored in such a manner as to allow the earliest deliveries to be used first and to provide easy access for identification and inspection of each shipment. Stored cement shall meet the test requirements at any time after storage when retest is ordered by the PoIWD PIU representative. At time of use, all cement shall be free-flowing and free of lumps.

The handling and storing of concrete aggregates shall be such as to prevent segregation or the inclusion of foreign materials. The PolWD PIU representative may require that aggregates be stored separately at satisfactory locations.

In order to secure greater uniformity of concrete mix, the PolWD PIU representative may require that the coarse aggregate be separated into two or more sizes. Different sizes of aggregate shall be stored in separate bins or in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.

4. PROPORTIONING, CONSISTENCY, AND STRENGTH OF CONCRETE

The Contractor shall prepare the design mix based on the absolute volume method as outlined in the American Concrete Institute (ACI) Standard 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete".

It is the intent of this Specification to require at least 364 kg of cement per cubic meter of concrete to meet the minimum strength requirements. The PoIWD PIU representative shall determine from laboratory tests of the materials to be used, the cement content and the proportions of aggregate and water that will produce workable concrete having a slump of between 40 and 75 mm (1-1/2 and 3 inches) if not vibrated or between 10 and 40 mm (1/2 and 1-1/2 inches) if vibrated, and a flexural strength of not less than 3.8 MPa (550 psi) when tested by the third-point method or 4.5 MPa (650 psi) when tested by the mid-point method at seven (7) days in accordance with AASHTO T97 and T177, respectively; or a compressive strength of 27.58 MPa (4,000 psi) for cores taken at seven (7) days and tested in accordance with AASHTO T24.

Slump shall be determined using AASHTO T 119.

The designer shall consider the use of lean concrete (econocrete) mixtures using local materials or specifically modified conventional concrete mixes in base course and in the lower course composite, monolithic concrete pavements using a minimum of 75 mm (3 inches) of conventional concrete as the surface course.

The mix design shall be submitted to the PoIWD PIU representative for approval and shall be accompanied with certified test data from an approved laboratory demonstrating the adequacy of the mix design. A change in the source of materials during the progress of work may necessitate a new design mix.

5. CONSTRUCTION REQUIREMENTS

A. QUALITY CONTROL OF CONCRETE
1. General

The Contractor shall be responsible for the quality control of all materials during the handling, blending, and mixing and placement operations.

2. Quality Control Plan

The Contractor shall furnish the PolWD PIU representative a Quality Control Plan detailing his production control procedures and the type and frequency of sampling and testing to insure that the concrete produces complies with the Specifications. The PolWD PIU representative shall be provided free access to recent plant production records, and if requested, informational copies of mix design, materials certification and sampling and testing reports.

3. Qualification of Workmen

Experience and qualified personnel shall perform all batching or mixing operation for the concrete mix, and shall be present at the plant and job site to control the concrete productions whenever the plant is in operation. They shall be identified and duties as follows:

(i). Concrete Batcher

The person performing the batching or mixing operation shall be capable of accurately conducting aggregate surface moisture determination and establishing correct scale weights for concrete materials. He shall be capable of assuring that the proportioned batch weights of materials are in accordance with the mix design.

(ii). Concrete Technician

The person responsible for concrete production control and sampling and testing for quality control shall be proficient in concrete technology and shall have a sound knowledge of the Specifications as they relate to concrete production. He shall be capable of adjusting concrete mix designs for improving workability and Specification compliance and preparing trial mix designs. He shall be qualified to act as the concrete batcher in the batcher's absence.

4. Quality Control Testing

The Contractor shall perform all sampling, testing and inspection necessary to assure quality control of the component materials and the concrete.

The Contractor shall be responsible for determining the gradation of fine and coarse aggregates and for testing the concrete mixture for slump, air content, water-cement ratio and temperature. He shall conduct his operations so as to produce a mix conforming to the approved mix design.

5. Documentation

The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and nature of any corrective action taken.

The PolWD PIU representative may take independent assurance samples at random location for acceptance purposes as he deems necessary.

B. EQUIPMENT

1. Batching Plant and Equipment

- a. General. The batching shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, a hopper, and separate scale for cement shall be included. The weighing hopper shall be properly sealed and vented to preclude dusting operation. The batch plant shall be equipped with a suitable non-resettable batch counter which will correctly indicate the number of batches proportioned.
- **b. Bins and Hoppers.** Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.
- **c. Scales.** Scales for weighing aggregates and cement shall be of either the beam type or the springless-dial type. They shall be accurate within one-half percent (0.5%) throughout the range of use. Poises shall be designed to be locked in any position and to prevent unauthorized change.

Scales shall be inspected and sealed as often as the PolWD PIU representative may deem necessary to assure their continued accuracy.

d. Automatic Weighing Devices. Unless otherwise allowed on the Contract, batching plants shall be equipped with automatic weighing devices of an approved type to proportion aggregates and bulk cement.

2. Mixers

a. General

Concrete may be mixed at the Site of construction or at a central plant, wholly or in part in truck mixers. Each mixer shall have a manufacture's plate attached in a prominent place showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

b. Mixers at Site of Construction

Mixing shall be done in an approved mixer capable of combining the aggregates, cement and water into a thoroughly mixed and uniform mass within the specified mixing period and discharging and distributing the mixture without segregation on the prepared grade. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and released it at the end of mixing period. In case of failure of the timing device, the mixer maybe used for the balance of the day while it is being repaired, provided that each batch is mixed in 90 seconds. The mixer shall be equipped with a suitable non-resettable batch counter which shall correctly indicate the number of the batches mixed.

c. Truck Mixer and Truck Agitators

Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central-mixed concrete, shall conform to the requirements of AASHTO M 157.

d. Non-Agitator Truck.

Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation.

3. Paving and Finishing Equipment

The concrete shall be placed with an approved paver to spread, consolidate, screed and float finish freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement in conformance with the Plans and Specifications.

The finishing machine shall be equipped with at least two (2) oscillating type transverse screed.

Vibrators shall operate at a frequency of 8,300 to 9,600 impulses per minute under load at a maximum spacing of 60 cm.

4. Concrete Saw / Cutter

The Contractor shall provide sawing/cutter equipment in adequate number of units and power to complete the sawing/cutting with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions and at the required rate. He shall provide at least one (1) stand-by saw/cutter in good working condition and with an ample supply of saw/concrete blades.

5. Forms

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

All forms shall be rigidly supported on bed of thoroughly compacted material during the entire operation of placing and finishing the concrete. Forms shall be provided with adequate devices for secure setting so that when in place, they will withstand, without visible spring or settlement, the impact and vibration of the consolidation and finishing or paving equipment.

C. PREPARATION OF GRADE

After the sub-grade of base has been placed and compacted to the required density, the areas which will support the any paving machine and the grade on which the pavements is to be constructed shall be trimmed to the proper elevation by means of a properly designed machine extending the prepared work areas compacted at least 60 cm beyond each edge of the proposed concrete pavement. If loss of density results from the trimming operations, it shall be restored by additional compaction before concrete is placed. If any traffic is allowed to use the prepared sub-grade or base, the surface shall be checked and corrected immediately ahead of the placing concrete.

The subgrade or base shall be uniformly moist when the concrete is placed.

D. SETTING FORMS

1. Base Support

The foundation under the forms shall be hard and true to grade so that the form when set will be firmly in contact for its whole length and at the specified grade. (Any roadbed, which at the form line is found below established grade, shall be filled with approved granular materials to grade in lifts of three (3) cm or less, and thoroughly rerolled or tamped.) Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

2. Form Setting

Forms shall be set sufficiently in advance of the point where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. The forms shall not deviate from true line by more than one (1) cm at any point.

3. Grade and Alignment

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. Testing as to crown and elevation, prior to placing of concrete can be made by means of holding an approved template in a vertical position and moved backward and forward on the forms.

When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

E. CONDITIONING OF SUB-GRADE OR BASE COURSE

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

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

F. HANDLING, MEASURING, AND BATCHING MATERIALS

The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work.

Stockpiles shall be built up in layers of not more than one (1) meter in thickness. Each layer shall be completely in place before beginning the next which shall not be allowed to "cone" down over the next lower layer. Aggregates from different sources and of different grading shall not be stockpiled together.

All washed aggregates and aggregates produced or handled by hydraulic methods, shall be stockpiled or binned for draining at least twelve (12) hours before being batched.

When mixing is done at the side of the work, aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, with chute, boot or other approved device, to prevent loss of cement, and to provide positive assurance of the actual presence in each batch of the entire cement content specified.

Bulk cement shall be transported to the mixer in tight compartments carrying the full amount of cement required for the batch. However, if allowed in the Special Provisions, it may be transported between the fine and coarse aggregate. When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1-1/2 hours of such contact. Cement in original shipping packages may be transported on top of the aggregates, each batch containing the number of sacks required by the job mix.

The mixer shall be charged without loss of cement. Batching shall be so conducted as to result in the weight to each material required within a tolerance of one (1) percent for the cement and two (2) percent for aggregates.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over than one (1) percent. Unless the water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be equipped with an outside tap and valve to provide checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

G. MIXING OF CONCRETE

The concrete may be mixed at the site of the work in a central-mix plant, or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time will be measured from the time all materials, except water, are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of AASHTO M 157/ASTM C94, except that the minimum required revolutions at the mixing speed for transit-mixed concrete may be reduced to not less than that recommended by the mixer manufacturer. The number of revolutions recommended by the mixer manufacturer shall be indicated on the manufacturer's serial plate attached to the mixer. The Contractor shall furnish test data acceptable to the PoIWD PIU representative verifying that the make and model of the mixer will produce uniform concrete conforming to the provision of AASHTO M 157/ASTM C94 at the reduced number of revolutions shown on the serial plate.

When mixed at the site or in a central mixing plant, the mixing time shall not be less than fifty (50) seconds nor more than ninety (90) seconds, unless mixer performance tests prove adequate mixing of the concrete is a shorter time period.

Four (4) seconds shall be added to the specified mixing time if timing starts at the instant the skip reaches its maximum raised positions. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is

included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate attached on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic meter, as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to ten (10) percent above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batches shall be so charged into the drum that a portion of the mixing water shall be entered in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or non-agitating truck specified in Subsection 9.5b, Equipment. The time elapsed from the time water is added to the mix until the concrete is deposited in place at the Site shall not exceed forty five (45) minutes when the concrete is hauled in non-agitating trucks, nor ninety (90) minutes when hauled in truck mixers or truck agitators, except that in hot weather or under other conditions contributing to quick hardening of the concrete, the maximum allowable time may be reduced by the PolWD PIU representative.

In exceptional cases and when volumetric measurements are authorized for small project requiring less than 75 cu.m. of concrete per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.

Concrete mixing by chute is allowed provided that a weighing scale for determining the batch weight will be used.

Retempering concrete by adding water or by other means shall not be permitted, except that when concrete is delivered in truck mixers, additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements, if permitted by the PolWD PIU representative, provided all these operations are performed within forty-five (45) minutes after the initial mixing operation and the water-cement ratio is not exceeded. Concrete that is not within the specified slump limits at the time of placement shall not be used. Admixtures for increasing the workability or for accelerating the setting of the concrete will be permitted only when specifically approved by the PolWD PIU representative.

H. LIMITATION OF MIXING

No concrete shall be mixed, placed or finished when natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

During hot weather, the PolWD PIU representative shall require that steps be taken to prevent the temperature of mixed concrete from exceeding a maximum temperature of 900F (320C).

Concrete not in place within ninety (90) minutes from the time the ingredients were charged into the mixing drum or that has developed initial set shall not be used. Retempering of concrete or mortar which has partially hardened, that is remixing with or without additional cement, aggregate, or water, shall not be permitted.

In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete.

I. PLACING CONCRETE

Concrete shall be deposited in such a manner to require minimal rehandling. Unless truck mixers or non-agitating hauling equipment are equipped with means to discharge concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade in such a manner as to prevent segregation. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

When concrete is to be placed adjoining a previously constructed lane and mechanical equipment will be operated upon the existing lane, that previously constructed lane shall have attained the strength for fourteen (14) day concrete. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three (3) days.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.

Concrete shall be deposited as near as possible to the expansion and contraction joints without disturbing them, but shall not be dumped from the discharge bucket or hopper into a joint assembly unless the hopper is well centered on the joint assembly. Should any concrete material fall on or be worked into the surface of a complete slab, it shall be removed immediately.

J. TEST SPECIMENS

As work progresses, at least one (1) set consisting of three (3) concrete beam test specimens, 150 mm x 150 mm x 525 mm or 900 mm shall be taken from each 330 m2 of pavement, 230 mm depth, or fraction thereof placed each day. Test specimens shall be made under the supervision of the PolWD PIU representative, and the Contractor shall provide all concrete and other facilities necessary in making the test specimens and shall protect them from damage by construction operations. Cylinder samples shall not be used as substitute for determining the adequacy of the strength of concrete.

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

K. STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT

Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two (2) layers, the bottom layer shall be struck off and consolidated to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be firmly positioned in advance of concrete, after spreading by mechanical or vibratory means.

Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale and loose or thick rust which could impair bond of the steel with the concrete.

L. JOINTS

Joints shall be constructed of the type and dimensions, and at the locations required by the Plans or Special Provisions. All joints shall be protected from the intrusion of injurious foreign material until sealed.

1. Longitudinal Joint

Deformed steel tie bars of specified length, size, spacing and materials shall be placed perpendicular to the longitudinal joints, they shall be placed by approved mechanical equipment or rigidly secured by chair or other approved supports to prevent displacement. Tie bars shall not be painted or coated with asphalt or other materials or enclosed in tubes or sleeves. When shown on the Plans and when adjacent lanes of pavement are constructed separately, steel side forms shall be used which will form a keyway along the construction joint. Tie bars, except those made of rail steel, may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed, or in lieu of bent tie bars, approved two-piece connectors may be used.

Longitudinal formed joints shall consist of a groove or cleft, extending downward from and normal to, the surface of the pavement. These joints shall be effected or formed by an approved mechanically or manually operated device to the dimensions and line indicated on the Plans and while the concrete is in a plastic state. The groove or cleft shall be filled with either a premolded strip or poured material as required.

The longitudinal joints shall be continuous; there shall be no gaps in either transverse or longitudinal joints at the intersection of the joints.

Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width and line shown on the Plans. Suitable guide lines or devices shall be used to assure cutting the longitudinal joint on the true line. The longitudinal joint shall be sawed before the end of the curing period or shortly thereafter and before any equipment or vehicles are allowed on the pavement. The sawed area shall be thoroughly cleaned and, if required, the joint shall immediately be filled with sealer.

Longitudinal pavement insert type joints shall be formed by placing a continuous strip of plastic materials which will not react adversely with the chemical constituent of the concrete.

2. Transverse Expansion Joint

The expansion joint filler shall be continuous from form to form, shaped to subgrade and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used.

The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joint shall not deviate more than 6 mm from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

3. Transverse Contraction Joint / Weakened Joint

When shown on the Plans, it shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement and shall include load transfer assemblies. The depth of the weakened plane joint should at all times not be less than 50 mm, while the width should not be more than 6 mm.

- Transverse Strip Contraction Joint. It shall be formed by installing a parting strip to be left in place as shown on the Plans.
- b. Formed Groove. It shall be made by depressing an approved tool or device into the plastic concrete. The tool or device shall remain in place at least until the concrete has attained its initial set and shall then be removed without disturbing the adjacent concrete, unless the device is designed to remain in the joint.
- c. Sawed Contraction Joint. It shall be created by sawing grooves in the surface of the pavement of the width not more than 6 mm, depth should at all times not be less than 50 mm, and at the spacing and lines shown on the Plans, with an approved concrete saw. After each joint is sawed, it shall be thoroughly cleaned including the adjacent concrete surface.

Sawing of the joint shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive ravelling, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on during the day or night, regardless of weather conditions. The sawing of any joint shall be omitted if crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discounted when a crack develops ahead of the saw. In general, all joints should be sawed in sequence. If extreme condition exist which make it impractical to prevent erratic cracking by early sawing, the contraction joint groove shall be formed prior to initial set of concrete as provided above.

4. Transverse Construction Joint

It shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 1.50 m of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has been mixed at the time of interruption to form a slab of at least 1.5 m long, the excess concrete from the last preceding joint shall be removed and disposed off as directed.

5. Load Transfer Device

Dowel, when used, shall be held in position parallel to the surface and center line of the slab by a metal device that is left in the pavement.

The portion of each dowel painted with one coat of lead or tar, in conformance with the requirements of **Item 404**, **Reinforcing Steel (DPWH Standard Specifications, 2004 edition)**, shall be thoroughly coated with approved bituminous materials, e.g., MC-70, or an approved lubricant, to prevent the concrete from binding to that portion of the dowel. The sleeves for dowels shall be metal designed to cover

50 mm plus or minus 5 mm (1/4 inch), of the dowel, with a watertight closed end and with a suitable stop to hold the end of the sleeves at least 25 mm (1 inch) from the end of the dowel.

In lieu of using dowel assemblies at contraction joints, dowel may be placed in the full thickness of pavement by a mechanical device approved by the PoIWD PIU representative.

M. FINAL STRIKE-OFF (CONSOLIDATION AND FINISHING)

1. Sequence

The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging and final surface finish. Work bridges or other devices necessary to provide access to the pavement surface for the purpose of finishing straight-edging, and make corrections as hereinafter specified, shall be provided by the Contractor.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as fog spray by means of an approved spray equipment.

2. Finishing Joints

The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material assembly, also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in Subsection for Placing Concrete.

After the concrete has been placed and vibrated adjacent to the joints as required in Subsection I, Placing Concrete, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to over and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 20 cm (8 inches) from the joint. Segregated concrete shall be removed from in front of and off the joint. The front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

3. Machine Finishing

a. Non-vibratory Method. The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without wobbling or other variation tending to affect the precision finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed in its entire length.

b. Vibratory Method. When vibration is specified, vibrators for full width vibration of concrete paving slabs, shall meet the requirements in Subsection 9.5b, Equipment. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and method which will produce pavement conforming to the Specifications. All provisions in item (a) above not in conflict with the provisions for the vibratory method shall govern.

4. Hand Finishing

Hand finishing methods may only be used under the following conditions:

- a. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade.
- b. In narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical, hand methods may be used.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used.

The screed for the surface shall be at least 60 cm (2 feet) longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its

shape, and constructed either of metal or other suitable material shod with metal.

Consolidation shall be attained by the use of suitable vibrator or other approved equipment.

In operation, the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

5. Floating

After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, either by hand or mechanical method.

a. Hand Method. The hand-operated longitudinal float shall be not less than 365 cm (12 feet) in length and 15 cm (6 inches) in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete, shall be worked with a sawing motion while held in a floating position parallel to the road center line, and moving gradually from one side of the pavement to the other. Movement ahead along the center line of the pavement shall be in successive advances of not more than one-half the length of the float.

Any excess water or soupy material shall be wasted over the side forms on each pass.

- b. Mechanical Method. The mechanical longitudinal float shall be of a design approved by the PoIWD PIU representative, and shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustment of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward screed shall be adjusted so that the float will lap the distance specified by the PoIWD PIU representative on each transverse trip. The float shall pass over each areas of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.
- c. Alternative Mechanical Method. As an alternative, the Contractor may use a machine composed of a cutting and smoothing float or floats suspended from and guided by a rigid

frame. The frame shall be carried by four or more visible wheels riding on, and constantly in contact with the side forms. If necessary, following one of the preceding method of floating, long handled floats having blades not less than 150 cm (5 feet) in length and 15 cm (6 inches) in width may be used to smooth and fill in open-textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike off and consolidations are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a 3-m straight-edge or more in length. Successive drags shall be lapped one-half the length of the blade.

6. Straight-Edge Testing and Surface Correction

After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 300 cm long straight-edge. For this purpose, the Contractor shall furnish and use an accurate 300-cm straight-edge swung from handles 100 cm (3 feet) longer than one-half the width of the slab. The straight-edge shall be held in contact with the surface in successive positions parallel to the road center line and the whole area gone over from one side of the slab to the other as necessary. Advances along the road shall be in successive stages of not more than one-half the length of the straight-edge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straight-edge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straight-edge and the slab conforms to the required grade and crosssection.

7. Final Finish

If the surface texture is broom finished, it shall applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation should be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than 1.5 mm in depth. Brooming shall be completed before the concrete is in such condition that the surface will be unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom. Brooms shall be of the quality size and construction and be operated so as to produce a surface finish meeting the approval of the PoIWD PIU representative. Subject to satisfactory results being obtained and approval of the PoIWD PIU representative, the Contractor will be permitted to substitute mechanical brooming in lieu of the manual brooming herein described.

If the surface texture is belt finished, when straight-edging is complete and water sheen has practically disappeared and just before the concrete becomes non-plastic, the surface shall be belted with 2-ply canvass belt not less than 20 cm wide and at least 100 cm longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the center line and with a rapid advances parallel to the center line.

If the surface texture is drag finished, a drag shall be used which consists of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform of gritty texture after dragging it longitudinally along the full width of pavement. For pavement 5 m or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 100 cm wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 15 cm wider than the layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1.5 mm in depth. Drag shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags be substituted.

Regardless of the method used for final finish, the hardened surface of pavement shall have a coefficient of friction of 0.25 or more. Completed pavement that is found to have a coefficient of friction less than 0.25 shall be grounded or scored by the Contractor at his expense to provide the required coefficient of friction.

8. Edging at Forms and Joints

After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints, shall be worked with an approved tool and rounded to the radius required by the Plans. A well – defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during the use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed. All joints shall be tested with a straight-edge before the concrete has set and correction made if one edge of the joint is higher than the other.

N. SURFACE TEST

As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 3-m straight-edge or other specified device. Areas showing high spots of more than 3 mm but not exceeding 12 mm in 3 m shall be marked and immediately ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 3 mm when tested with 3 m straight-edge. Where the departure from correct cross-section exceeds 12 mm, the pavement shall be removed and replaced by and at the expense of the Contractor.

Any area or section so removed shall be not less than 1.5 m in length and not less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 1.5 m in length, shall also be removed and replaced.

O. CURING

Immediately after the finishing operations have been completed and the concrete has sufficiently set, the entire surface of the newly placed concrete shall be cured in accordance with either one of the methods described herein. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or the lack of water to adequately take care of both curing and other requirements, shall be a cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than $\frac{1}{2}$ hour between stages of curing or during the curing period.

In all congested places, concrete works should be designed so that the designed strength is attained.

1. Cotton of Burlap Mats

The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that as laid they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mat shall be placed so that the entire surface and the edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mat shall be so placed and weighted down so as to cause them to remain in intimate contact with the covered surface. The mat shall be maintained fully wetted and in position for 72 hours after the concrete has been placed unless otherwise specified.

2. Waterproof Paper

The top surface and sides of the pavement shall be entirely covered with waterproof paper, the units shall be lapped at least 45 cm. The paper shall be so placed and weighted down so as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimension but each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement, or at pavement width and 60 cm strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

3. Straw Curing

When this type of curing is used, the pavement shall be cured initially with burlap or cotton mats, until after final set of the concrete or, in any case, for 12 hours after placing the concrete. As soon as the mats are removed, the surface and sides of the pavement shall be thoroughly wetted and covered with at least 20 cm of straw or hay, thickness of which is to be measured after wetting. If the straw or hay covering becomes displaced during the curing period, it shall be replaced to the original depth and saturated. It shall be kept thoroughly saturated with water for 72 hours and thoroughly wetted down during the morning of the fourth day, and the cover shall remain in place until the concrete has attained the required strength.

4. Impervious Membrane Method

The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it may be applied upon removal of the mass. The curing compound shall not be applied during rain.

Curing compound shall be applied under pressure at the rate 4 L to not more than 14 m2 by mechanical sprayers. The spraying equipment shall be equipped with a wind guard. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surface exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed, but approved means shall be used to insure proper curing at least 72 hours and to prevent the intrusion of foreign material into the joint before sealing has been completed. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film be damaged from any cause within the 72 hour curing period, the damaged portions shall be repaired immediately with additional compound.

5. White Polyethylene Sheet

The top surface and sides of the pavement or lean concrete of the reservoir shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 45 cm. The sheeting shall be so placed and weighted down so as to cause it to remain intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

P. REMOVAL OF FORMS

After forms for concrete shall remain in place undisturbed for not less than twenty four (24) hours after concrete pouring. In the removal of forms, crowbars should be used in pulling out nails and pins. Care should be taken so as not to break the edges of the pavement. In case portions of the concrete are spalled, they shall be immediately repaired with fresh mortar mixed in the proportion of one part of Portland Cement and two parts fine aggregates. Major honeycomb areas will be considered as defective work and shall be removed and replaced at the expense of the Contractor. Any area or section so removed shall not be less than the distance between weakened plane joint nor less than the full width of the lane involved.

Q. SEALING JOINTS

Joints shall be sealed with asphalt sealant soon after completion of the curing period and before the pavement is opened to traffic, including the Contractor's equipment. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign materials including membrane curing compound and the joint faces shall be clean and surface dry when the seal is applied.

The sealing material shall be applied to each joint opening to conform to the details shown on the Plans or as directed by the PolWD PIU representative. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. The use of sand or similar material as a cover for the seal will not be permitted.

Preformed elastomeric gaskets for sealing joints shall be of the cross-sectional dimensions shown on the Plans. Seals shall be installed by suitable tools, without elongation and secured in placed with an approved lubricant adhesive which shall cover both sides of the concrete joints. The seals shall be installed in a compressive condition and shall at time of placement be below the level of the pavement surface by approximately 6 mm.

The seals shall be in one piece for the full width of each transverse joint.

R. PROTECTION OF PAVEMENT

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection of and maintenance of warning signs, lights, pavement bridges or cross-overs, etc. The Plans or Special Provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic.

All boreholes after thickness and/or strength determinations of newly constructed asphalt and concrete pavements shall be immediately filled/restored with the prescribed concrete/asphalt mix after completion of the drilling works.

Any damage to the pavement, occurring prior to final acceptance, shall be repaired or the pavement be replaced.

S. ACCEPTANCE OF CONCRETE

The strength level of the concrete will be considered satisfactory if the averages of all sets of three (3) consecutive strength test results equal or exceed the specified strength, fc' and no individual strength test result is deficient by more than 15% of the specified strength, fc'.

Concrete deemed to be not acceptable using the above criteria may be rejected unless the Contractor can provide evidence, by means of core tests, that the quality of concrete represented by failed test results is acceptable in place. At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered deficient. The location of cores shall be determined by the PoIWD PIU representative so that there will be at least impairment of strength of the structure. The obtaining and testing of drilled cores shall be in accordance with AASHTO T 24.

Concrete in the area represented by the cores will be considered adequate if the average strength of the cores is equal to at least 85% of, and if no single core is less than 75% of, the specified strength, fc'.

If the strength of control specimens does not meet the requirements of this Subsection, and it is not feasible or not advisable to obtain cores from the structure due to structural considerations, payment of the concrete will be made at an adjusted price due to strength deficiency of concrete specimens as specified hereunder:

Deficiency in Strength of Concrete	Percent (%) of Contract Price
Specimens, Percent (%)	Allowed
Less than 5	100
5 to less than 10	80
10 to less than 15	70
15 to less than 20	60
20 to less than 25	50
25 or more	0

T. OPENING TO TRAFFIC

The PoIWD PIU representative will decide when the pavement may be opened to traffic. The road will not be opened to traffic until test specimens molded and cured in accordance with AASHTO T 23 have attained the minimum strength requirements in Subsection 10.2. If such tests are not conducted prior to the specified age the pavement shall not be operated to traffic until 7 days after the concrete was placed. Before opening to traffic, the pavement shall be cleaned and joint sealing completed.

6. READY-MIXED CONCRETE

- a. At the Contractor's option, ready-mixed concrete may be used in meeting the requirements as to materials, batching, mixing, transporting and placing as specified herein and in the requirements of the "Specifications for Ready-Mixed Concrete" (ASTM C-94), including the supplementary requirements specified in Subsections (b) through (g) herein.
- b. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one (1) hour after the addition of the cement to the aggregates or before the drum has been resolved to 250 revolutions, whichever is first. In hot weather, other conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 29.44°C (85°F) or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed forty-five (45) minutes.
- c. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the re-settable, recording type and shall be mounted in the driver's cab. The counter shall be actuated at the time of starting mixers at mixing speeds.
- d. Each batch of concrete be mixed in a truck mixer for not less than seventy (70) revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
- e. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the ¼ and ¾ points of the load during discharge give slumps differing by more than 25 mm (1 in.) when specified slump is 76 mm (3 in.) or less, or if they differ by more than 50 mm (2 in.) when the specified slump is more than 76 mm (3 in.), the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump test. All mechanical details of the mixer, such as water measuring and discharge

apparatus, condition of the blades, speed rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

- f. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a ticket furnished to the PolWD PIU representative showing volume of concrete, the weight of cement in kilograms (pounds), and total weight of all ingredients in kilograms (pounds). The ticket shall also show the time of day at which the materials were batched.
- g. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batched aggregates shall be subject to continuous inspection at the batching plant by the PolWD PIU representative.

7. PLACING REINFORCEMENT (other than pavement reinforcing steel)

- a. All reinforcement shall be placed in accordance with the plans furnished by the PoIWD PIU representative, in case of any doubt or ambiguity in placing of steel, the Contractor shall consult with the PoIWD PIU representative whose decision shall be final in such cases.
- b. All loose rust or scale, all adhering materials, and all oil or other materials which tend to destroy bond between the concrete and the reinforcement shall be removed before placing the steel and before concreting begins.
- c. Metal reinforcement shall be accurately placed and adequately secured by using annealed iron wire ties or suitable clips at intersections and shall be supported by concrete or metal support, spacers, or metal hangers. The minimum clear distance between parallel bars shall be 1-1/2 times the diameter for round bars and twice the side dimension for square bars. In no case shall the clear distance be less than 25 mm (1 in.) nor less than 1-1/3 times the maximum size of the course aggregates. Where bars are used in 2 or more layers at a clear distance of not less than 25 mm (1 in.).
- d. Reinforcement steel shall not be straightened or re-bent in a manner that will injure the material. Bars with kinds or bends not shown on the drawings shall not be used. Heating of the reinforcement will be permitted only when approved by the PolWD PIU representative.

8 OFFSETS AND SPLICES IN REINFORCEMENT

a. In splices of reinforcement at points of maximum stress shall be generally avoided, and maybe allowed only upon written approval of splice details by the PoIWD PIU representative. Splices shall provide sufficient lap to transfer stress between bars by bonding shear or by butt-welding to develop in tension at least one hundred twenty five percent (125%) of the specified yield strength of the reinforcing bar. Splices in adjacent bars shall be generally staggered.

b. Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion of the bat with the axis of the column shall not be more than one in six; in the case of the tied columns, the ties shall be spaced not over 76 mm (3 in.) on center for a distance of 300 mm (12 in.) below the actual point of offset unless otherwise shown on the plans.

9 LIQUIDATED DAMAGES

For failure to meet the specified strengths of concrete which has been designed, prepared and deposited by the Contractor, the Contractor shall pay the PolWD as liquidated damages, not as penalty or forfeiture, the following schedule applied on the amount of concrete represented by the samples:

- a. For concrete less than one hundred percent (100%) but greater than or equal to ninety percent (90%) of specified strengths, payment of ten percent (10%) of the unit bid cost per cubic meter of concrete;
- For concrete less than ninety percent (90%) but greater than or equal to eighty-five percent (85%) of specified strength, payment of fifteen (15%) percent of the unit bid cost per cubic meter of concrete;
- c. For concrete less than eighty-five percent (85%) of the specified strength, removal of the concrete so deposited and the replacement of same at the expense of the Contractor;
 - 1. In any case of failure to meet specified strength, the Contractor concrete and the compressive strength of same, as determined by a competent testing authority, shall be taken as conclusive evidence of its strength and integrity, provided the curing will not impair the safety of the structure and can be satisfactory replaced.

To determine adequacy of affected parts, the PolWD shall have the option to order load test on parts of the structure where concrete strength tests are below eighty percent (80%) of specified. These tests shall be in accordance with an ACI-318, Latest Revision; recommendations and their costs shall be borne by the Contractor.

3. In case of failure of samples to meet specified strengths to the extent mentioned in (a) or (b) or (c) above, the Contractor shall be required to prolong the curing of the poured concrete as directed by the PolWD PIU representative, in addition to payment of the liquidated damages mentioned above.

3.10 MISCELLANEOUS METALWORKS

1. SCOPE OF WORK

The Contractor shall furnish, fabricate, and install all the miscellaneous metalwork as specified and shown. Miscellaneous metalwork is defined as all items required to be fabricated from structural steel shapes, plates, bars, and their products.

2. WELDING

All welding shall be by the shielded arc method and shall conform to the "AWS Code for Arc and Gas Welding in Building Construction". Qualification of welders shall be in accordance with the "Specifications for Standard Qualification Procedure" of the AWS.

3. BOLTS

- The Contractor shall furnish and set all bolts and anchor bolts. Except a. where otherwise shown or specified, all bolts, anchor bolts, washers, and nuts shall be steel, galvanized after fabrication in accordance with "Specification for Zinc (HotGalvanized) Coating on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip" (ASTM A123). Except as otherwise provided herein, steel for bolts, anchor bolts, and cap screws shall be in accordance with "Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners", Grade B (ASTM Designation A-307), or "Specifications for Carbon Steel Bars Subject to Mechanical Property Requirements" (ASTM Designation A-306) or threaded parts of ASTM A-36 and shall meet the following additional requirements: (1) the nut material shall be free-cutting steel, and (2) the nuts shall be capable of developing the full strength of the bolts. Thread shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads, and nuts shall be Heavy Hexagon Series.
- b. Threads on galvanized bolts and nut shall be formed with suitable taps and dies such that they retain the normal clearance after hot dip galvanizing.
- c. Unless otherwise shown, all bolts, anchor bolts, and nuts which are buried, submerged, or inside a covered hydraulic structure shall be Hot-Dip galvanized and then coated with two coats of coal tar epoxy, after installation.

3.11 REINFORCING STEEL (ITEM 404)

1. DESCRIPTION

This Item shall consist of furnishing, bending, fabricating and placing of steel reinforcement of the type, size, shape and grade required in accordance with

this Specification and in conformity with the requirements shown on the Plans or as directed by the PolWD PIU representative.

2. MATERIALS REQUIREMENTS

Reinforcing steel shall meet the requirements of item 710, Reinforcing Steel and Wire Rope.

3. CONSTRUCTION REQUIREMENTS

a. ORDER LISTS

Before materials are ordered, all order lists and bending diagrams shall be furnished by the Contractor, for approval of the PoIWD PIU representative. The approval of order lists and bending diagrams by the PoIWD PIU representative shall in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Any expense incident to the revisions of materials furnished in accordance with such lists and diagrams to make them comply with the Plans shall be borne by the Contractor.

b. PROTECTION OF MATERIAL

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, detrimental rust, loose scale, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

c. BENDING

All reinforcing bars requiring bending shall be cold-bent to the shapes shown on the Plans or required by the PolWD PIU representative. Bars shall be bent around a circular pin having the following diameters (D) in relation to the diameter of the bar (d):

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

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

d. PLACING AND FASTENING

All steel reinforcement shall be accurately placed in the position shown on the Plans or required by the PolWD PlU representative and firmly held there during the placing and setting of the concrete. Bars shall be tied at all intersections except where spacing is less than 300mm in each directions, in which case, alternate intersections shall be tied. Ties shall be fastened on the inside.

Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports, so that it does not vary from the position indicated on the Plans by more than 6mm. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shapes and dimensions. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick. metal pipe and wooden blocks shall not be permitted. Unless otherwise shown on the Plans or required by the PolWD PIU representative, the minimum distance between bars shall be 40mm. Reinforcement in any member shall be placed and then inspected and approved by the PolWD PIU representative before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal may be required. If fabric reinforcement is shipped in rolls, it shall be straightened before being placed. Bundled bars shall be tied together at not more than 1.8m intervals.

e. SPLICING

All reinforcement shall be furnished in the full lengths indicated on the Plans. Splicing of bars, except where shown on the Plans, will not be permitted without the written approval of the PolWD PIU representative. Splices shall be staggered as far as possible and with a minimum separation of not less than 40 bar diameters. Not more than one-third of the bars may be spliced in the same cross-section, except where shown in the Plans.

Unless otherwise shown on the Plans, bars shall be lapped a minimum distance of:

Splice Type	lice Type Grade 40 min. lap		But not less than	
Tension	24 bar dia.	36 bar dia.	300 mm	
Compression	20 bar dia.	24 bar dia.	300 mm	

In lapped splices, the bars shall be placed in contact and wired together. Lapped splices will not be permitted at locations where the concrete section is insufficient to provide minimum clear distance of one and one-third the maximum size of coarse aggregate between the splice and the nearest adjacent bar. Welding of reinforcing steel shall be done only if detailed on the Plans or if authorized by the PolWD PlU representative in writing. Spiral reinforcement shall be spliced by

lapping at least one and a half turns or by butt welding unless otherwise shown on the Plans.

f. LAPPING OF BAR MAT

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The overlap shall not be less than one mesh in width.

3.12 STRUCTURAL CONCRETE (ITEM 405)

1. DESCRIPTION

a. SCOPE

This Item shall consist of furnishing, bending, placing and finishing concrete in all structures except pavements in accordance with this Specification and conforming to the lines, grades, and dimensions shown on the Plans. Concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, admixture when specified, and water mixed in the proportions specified or approved by the PolWD PIU representative.

b. CLASSES AND USES OF CONCRETE

Five classes of concrete are provided for in this Item, namely: A, B, C, P and Seal. Each class shall be used in that part of the structure as called for on the Plans.

The classes of concrete will generally be used as follows:

Class A – All superstructures and heavily reinforced substructures. The important parts of the structure included are slabs, beams, girders, columns, arch ribs, box culverts, reinforced abutments, retaining walls, and reinforced footings.

Class B – Footings, pedestals, massive pier shafts, pipe bedding, and gravity walls, unreinforced or with only a small amount of reinforcement.

Class C - Thin reinforced sections, railings, precast R.C. piles and cribbing and for filler in steel grid floors.

Class P – Pre-stressed concrete structures and members.

Seal – Concrete deposited in water.

2. MATERIALS REQUIREMENTS

a. PORTLAND CEMENT

It shall conform to the applicable requirements of Item 700, Hydraulic Cement (DPWH Standard Specifications for Public Works and Highways, Republic of the Philippines). Only Type I Portland Cement shall be used unless otherwise provided for in the Special Provisions. Different brands or the same brands from different mills shall not be mixed nor shall they be used alternately unless the mix is approved by the PolWD PIU representative. However, the use of Portland Pozzolan Cement Type IP meeting the requirements of AASHTO M 240/ASTM C 695, Specifications for Blended Hydraulic Cement shall be allowed, provided that trial mixes shall be done and that the mixes meet the concrete strength requirements, the AASHTO/ASTM provisions pertinent to the use of Portland Pozzolan Type IP shall be adopted.

Cement which for any reason, has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used.

Samples of Cement shall be obtained in accordance with AASHTO T 127.

b. FINE AGGREGATE

It shall conform to all the requirements of Subsection J.2 (b)(1).

c. COARSE AGGREGATE

It shall conform all the requirements of Subsection J.2 (b)(2) except that gradation shall conform to Table 405.1

Table 405.1 – Grading Requirements for Coarse Aggregate							
Sieve De	signation	Mass Percent Passing					
Standard	Alternate	Class	Class Class Class Class				
Mm	US	Α	В	С	Р	Seal	
	Standard						
63.00	2-1/2"		100				
50.00	2"	100	95-100				
37.50	1-1/2"	95-100	-			100	
25.00	1"	-	35-70		100	95-100	
19.00	3⁄4"	35-70	-	100	95-100	100	
12.50	1⁄2"	-	10-30	90-100	100	-	
9.50	3/8"	10-30	-	100	-	25-60	
4.75	No. 4	0-5	0-5	40-70	20-55	-	
				0-15*	0-10*	0-10*	

* The measured cement content shall be within plus (+) or minus (-) 2 mass percent of the design cement content.

d. WATER

It shall conform to the requirements of Subsection J.2 (c).

e. REINFORCING STEEL

It shall conform to the requirements of Item 710, Reinforcing Steel and Wire Rope (DPWH Standard Specifications for Public Works and Highways, Republic of the Philippines).

f. ADMIXTURES

Admixtures shall conform to the requirements of Subsection J.2 (f).

g. CURING MATERIALS

Curing materials shall conform to the requirements of Subsection J.2 (g).

h. EXPANSION JOINT MATERIALS

Expansion joint materials shall be:

Preformed Sponge Rubber and Cork, conforming to AASHTO M 153. Hot-Poured Elastic Type, conforming to AASHTO M 173. Preformed Fillers, conforming to AASHTO M 213.

i. ELASTOMERIC COMPRESSION JOINT SEALS

These shall conform to AASHTO M 220.

j. ELASTOMERIC BEARING PADS

These shall conform to AASHTO M 251 or Item 412 – Elastomeric Bearing Pads (DPWH Standard Specifications for Public Works and Highways, Republic of the Philippines).

k. STORAGE OF CEMENT AND AGGREGATES

Storage of cement and aggregates shall conform to all the requirements of Subsection J.3.

3. SAMPLING AND TESTING OF STRUCTURAL CONCRETE

As work progresses, at least one (1) sample consisting of three (3) concrete cylinder test specimens, 150×300 mm (6 x 12 inches), shall be taken from each seventy five (75) cubic meters of each class of concrete or fraction thereof placed each day.

Compliance with the requirements of this Section shall be determined in accordance with the following standard methods of AASHTO:

Sampling of fresh concrete T 141 Weight per cubic metre and air content (gravi-

Metric) of concrete	T 121
Sieve analysis of fine and coarse aggregates	T 27
Slump of Portland Cement Concrete	T 119
Specific gravity and absorption of fine aggregate	T 84

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

Making and curing concrete compressive and	
flexural tests specimens in the field	T 23
Compressive strength of molded concrete	
Cylinders	T 22

4. PRODUCTION REQUIREMENTS

a. PROPORTIONING AND STRENGTH OF STRUCTURAL CONCRETE

The concrete materials shall be proportioned in accordance with the requirements for each class of concrete as specified in Table 405.2, using the absolute volume method as outlined in the American Concrete Institute (ACI) Standard 211.1. "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete". Other methods of proportioning may be employed in the mix design with prior approval of the PolWD PIU representative. The mix shall either be designed or approved by the PolWD PIU representative. A change in the source of materials during the progress of work may necessitate a new mix design.

The strength requirements for each class of concrete shall be as specified in Table 405.2.

Table 405.2 – Composition and Strength of Concrete for Use in Structures						
Class of Concrete	Minimum Cement Content Per m3 kg (bag**)	Maximum Water / Cement Ratio kg/kg	Consistency Range in Slump Mm (inch)	Designated Size of Coarse Aggregate Square Opening Std. mm	Minimum Compressive Strength of 150x300mm Concrete Cylinder Specimen at 28 days,	
				37.5 1.75	ww/mz (psi)	
Α	480 (9 bags)	0.57	50 - 100 (2 - 4)	(1-1/2" – No. 4)	27.58 (4000)	
B	320	0.58	50 – 100	50 - 4.75	16.5	
D	(8 bags)	0.00	(2 – 4)	(2" – No. 4)	(2400)	
С	380	0.55	50 – 100	12.5 – 4.75	20.7	
	(9.5 bags)	0.00	(2 – 4)	(1/2'' – No.4)	(3000)	
Р	440	0.49	100 max.	19.0 – 4.75	37.7	
-	(11 bags)	0.43	(4 max.)	(3/4" – No.4)	(5000)	
Seal	380	0.58	100 – 200	19.0 – 4.75	20.7	
U UU	(9.5 bags)	0.00	(4 – 8)	(3/4" – No.4)	(3000)	

		25 – 4.75	
		(1" – No. 4)	
		1 1	

* The measured cement content shall be within plus or minus 2 mass percent of the design cement content.

** Based on 40 kg/bag

b. CONSISTENCY

Concrete shall have a consistency such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcing steel but individual particles of the coarse aggregate when isolated shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be gauged by the ability of the equipment to properly place it and not by the difficulty in mixing and transporting. The quantity of mixing water shall be determined by the PolWD PIU representative and shall not be varied without his consent. Concrete as dry as it is practical to place with the equipment specified shall be used.

c. BATCHING

Measuring and batching of materials shall be done at a batching plant.

c.1 Portland Cement

Either sacked or bulk cement may be used. No fraction of a sack of cement shall be used in a batch of concrete unless the cement is weighed. All bulk cement shall be weighed on an approved weighing device. The bulk cement weighing hopper shall be properly sealed and vented to preclude dusting operation. The discharge chute shall not be suspended from the weighing hopper and shall be so arranged that cement will neither be lodged in it nor leak from it.Accuracy of batching shall be within plus (+) or minus (-) 1 mass percent.

c.2 Water

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not more than 1 percent.

c.3 Aggregates

Stockpiling of aggregates shall be in accordance with Subsection J.2 (b). All aggregates whether produced or handled by hydraulic methods or washed, shall be stockpiled or binned for draining for at least 12 hours prior to batching. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. If the aggregates contain high or non-uniform moisture content, storage or stockpile period in excess of 12 hours may be required by the PolWD PIU representative.

Batching shall be conducted as to result in a 2 mass percent maximum tolerance for the required materials.

c.4 Bins and Scales

The batching plant shall include separate bins for bulk cement, fine aggregate and for each size of coarse aggregate, a weighing hopper, and scales capable of determining accurately the mass of each component of the batch.

Scales shall be accurate to one-half (0.5) percent throughout the range used.

c.5 Batching

When batches are hauled to the mixer, bulk cement shall be transported either in waterproof compartments or between the fine and coarse aggregate. When cement is placed in contact with moist aggregates, batches will be rejected unless mixed within 1-1/2 hours of such contact. Sacked cement may be transported on top of the aggregates.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped cleanly into the mixer without loss, and, when more than one batch is carried on the truck, without spilling of material from one batch compartment into another.

c.6 Admixtures

The Contractor shall follow an approved procedure for adding the specified amount of admixture to each batch and will be responsible for its uniform operation during the progress of the work. He shall provide separate scales for the admixtures which are to be proportioned by weight, and accurate measures for those to be proportioned by volume. Admixtures shall be measured into the mixer with an accuracy of plus or minus three (3) percent.

The use of Calcium Chloride as an admixture will not be permitted.

5. MIXING AND DELIVERY

Concrete may be mixed at the site of construction, at a central point or by a combination of central point and truck mixing or by a combination of central point mixing and truck agitating. Mixing and delivery of concrete shall be in accordance with the appropriate requirements of AASHTO M 157/ASTM C94 except as modified in the following paragraphs of this section, for truck mixing

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

In exceptional cases and when volumetric measurements are authorized, for small project requiring less than 75 cu.m. per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.

Concrete mixing, by chute is allowed provided that a weighing scale for determining the batch weight will be used.

For batch mixing at the site of construction or at a central point, a batch mixer of an approved type shall be used. Mixer having a rated capacity of less than a one-bag batch shall not be used. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer except that an overload up to 10 percent above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory and provided no spillage of concrete takes place. The batch shall be so charge into the drum that a portion of the water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Mixing time shall be measured from the time all materials, except water, are in the drum. Mixing time shall not be less than 60 seconds for mixers having a capacity of 1.5m3 or less. For mixers having a capacity greater than 1.5m3, the mixing time shall not be less than 90 seconds. If timing starts, the instant the skip reaches its maximum raised position, 4 seconds shall be added to the specified mixing time. Mixing time ends when the discharge chute opens.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his own expenses.

The timing device on stationary mixers shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the Contractor will be permitted to continue operations while it is being repaired, provided he furnishes an approved timepiece equipped with minute and second hands. If the timing device is not placed in good working order within 24 hours, further use of the mixer will be prohibited until repairs are made.

Re-tempering concrete will not be permitted. Admixtures for increasing the workability, for retarding the set, or for accelerating the set or improving the pumping characteristics of the concrete will be permitted only when specifically provided for in the Contract, or authorized in writing by the PolWD PIU representative.

a. Mixing Concrete: General

Concrete shall be thoroughly mixed in a mixer of an approved size and type that will insure a uniform distribution of the materials throughout the mass.

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

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

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

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

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the PoIWD PIU representative more than one mass percent for cement, 1-1/2 mass percent for any size of aggregate, or one (1) mass percent for the total aggregate in any batch.

b. Mixing Concrete at Site

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixers shall be restored or replaced when any part or section is worn 20mm or more below the original height of the manufacturer's design. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used. When bulk cement is used and volume of the batch is 0.5m3 or more, the scale and weigh hopper for Portland Cement shall be separate and distinct from the aggregate hopper or hoppers. The discharge mechanism of the bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall also be interlocked against opening when the amount of cement in the hopper is underweight by more than one (1) mass percent or overweight by more than 3 mass percent of the amount specified.

When the aggregate contains more water than the quantity necessary to produce a saturated surface dry condition, representative samples shall be taken and the moisture content determined for each kind of aggregate.

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

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

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

All concrete shall be mixed for a period of not less than 1-1/2 minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed. Mixers shall be operated with an automatic timing device that can be locked by the PolWD PIU representative. The time device and discharge mechanics shall be so interlocked that during normal operation no part of the batch will be charged until the specified mixing time has elapsed.

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

- c. Mixing at central plant shall conform to the requirements for mixing at the site.
- d. Mixing Concrete in Truck

Truck mixers, unless otherwise authorized by the PoIWD PIU representative, shall be of the revolving drum type, water-tight, and so

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

The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing, shall, unless otherwise directed be continued for not less than 100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

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

When a truck mixer is used for transportation, the mixing time specified in Subsection 405.4.4 (3) at a stationary mixer may be reduced to 30 seconds and the mixing completed in a truck mixer. The mixing time in the truck mixer shall be as specified for truck mixing.

e. Transporting Mixed Concrete

Mixed concrete may only be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturers of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable point for adequate placement and consolidation in place.

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixers or agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.
When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within one hour, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 30°C, or above, a time less than one hour will be required.

f. Delivery of Mixed Concrete

The Contractor shall have sufficient plant capacity and transportation apparatus to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing of the minimum handling.

3.13 AGGREGATE SUBBASE COURSE (ITEM 200)

1. 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 PolWD PIU representative.

2. MATERIALS REQUIREMENTS

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

The subbase material shall conform to Table 200.1, Grading Requirements

Grading Requirements

Sieve Designation		Mass Percent		
Standard, mm	Alternate US Standard	Passing		
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.

3. CONSTRUCTION REQUIREMENTS

a. PREPARATION OF EXISTING SURFACE

The existing surface shall be graded and finished as provided under Item 105, Subgrade Preparation, "DPWH Standard Specifications for Public Works and Highways, Republic of the Philippines" before placing the subbase material.

b. 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 PolWD PIU representative. 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.

c. SPREADING AND COMPACTING

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

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

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

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

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

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

d. TRIAL SECTIONS

Before subbase construction is started, the Contractor shall spread and compact trial sections as directed by the PolWD PIU representative. 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 m2 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 PolWD PIU representative.

If a trial section shows that the proposed materials, equipment or procedures in the PolWD PIU representative'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.

e. TOLERANCES

Aggregate subbase shall be spread with equipment that will provide a uniform layer which when compacted will conform to the designed level and transverse slopes as shown on the Plans. The allowable tolerances shall be as specified hereunder:

Permitted variation from design THICKNESS OF LAYER	± 20 mm
Permitted variation from design LEVEL OF SURFACE	+ 10 mm - 20 mm
Permitted 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%

4. SITE DEVELOPMENT

4.1 CONCRETE PAVEMENT AND DRAINAGE SYSTEM

A. DESCRIPTION

The work to be done under this section shall include the furnishing of all labor, materials, equipment, and all satisfactory performance of all works necessary to complete as shown in the Drawings and specified herein for the construction of guardhouse and drainage system. All works included shall be subject to the General Conditions accompanying these specifications

The Concrete Pavement shall be composed on unreinforced 4 inch (100 mm) thk. concrete with a dimension of 5.00 meters width and 18.00 meters length from the perimeter fence gate. Concrete ramp should be provided before the gate to give access way to the vehicles. The rail of existing perimeter gate should be replaced with a new material after or during the placing of concrete for the pavement.

Construction of drainage system are as shown in the contract drawings and to be constructed in accordance with the Part G (DRAINAGE AND SLOPE PROTECTION STRUCTURES) of DPWH STANDARD SPECIFICATIONS FOR HIGHWAYS, BRIDGES AND AIRPORTS.

B. CONCRETE AND REINFORCED CONCRETE WORKS

a. SCOPE

All concrete and reinforced concrete works shall be done in accordance with the standard specifications for concrete and reinforced concrete works, as adopted by the government, in so far as it does not conflict with the revised proportioning of concrete as specified hereinafter.

b. GENERAL

b.1 STANDARDS SPECIFICATIONS AND CODES

The works covered by this Section unless otherwise noted on detailed, shall be governed by the Building Code requirements for Reinforced Concrete (ACI 318), Standard Code or Arc Welding in Building Construction of the American Welding Society. The latest edition of all specifications or codes will be used.

b.2 COORDINATION

The concrete work shall be coordinated with the work of other trades to allow reasonable time to set sleeves, inserts and other accessories which must be in position before concrete bases and pads of mechanical equipment shall be adjusted to comply with the approved shop drawings for the equipment.

b.3 WORKMANSHIP

The Contractor shall be responsible for any additional cost which may result from concrete surfaces which are not finished to the required profile or elevation.

b.4 SAMPLES

Submit sample of cement and aggregate proposed in the concrete work for approval, enumerating names, sources and descriptions of materials.

c. CONCRETE

The concrete shall consist of Portland cement, fine aggregates, coarse aggregates, water, and where specified, admixtures, proportioned, mixed placed, cured and finished as hereinafter specified.

d. MATERIALS

d.1 PORTLAND CEMENT

ASTM C – 150 Type I for normal Portland cement; Type III for high early strength Portland cement. The same brands for Portland from the same mill shall be used for concrete, throughout the job. Cement shall be any standard commercial brand in 40-kilogram.

d.2 FINE AGGREGATES

It shall be clean, hard, coarse river sand or crushed sand free from injurious amount of clay loam and vegetable matter.

d.3 COARSE AGGREGATES

It shall be river run gravel or broken stones. The maximum size shall be 1/5 of the nearest dimension between sides of forms of the concrete of ³/₄ of the minimum clear spacing between reinforcing bars, or between rebars and forms whichever is smaller.

d.4 MIXING OF WATER

Water used in mixture of concrete shall be clean and free from injurious amount of oils, acids, alkali, organic materials or other deleterious substances.

d.5 ADMIXTURES

Admixture used in concrete shall be produced by a reputable manufacturer and used in accordance with manufacturer's printed directions and are subject to approval by the PolWD PIU representative or his duly authorized representative.

(1) Plasticizing Admixtures

Concrete admixtures shall be free from chlorides and shall conform to ASTM C-494-651. The admixtures shall be used in all concrete mixes in accordance with the manufacturer's specifications.

(2) Calcium Chloride shall not be used under any circumstances.

d.6 TIE WIRES

Tie wires shall be standard commercial G.I. wire Gauge No. 16.

e. **PROPORTIONING**

e.1 The Contractor shall employ at his own expense an approved testing laboratory which shall design the mix for each type of concrete required by the specifications and draiwngs to obtain strength, as determined by the test cylinder, at least 15% higher than required. Strength requirements shall be as noted on the drawings or as specified in this specifications.

The adequacy of the design mix shall be verified by a test on a minimum of three (3) cylinders, 1 tested at 7 days, 1 at 14 days and 1 at 28 days, in accordance with ASTM C-192 and G - 39 and by the slump test in accordance with ASTM C - 143.

The testing laboratory shall submit 5 copies of the design mix and the test results to the PolWD PIU representative or his duly authorized representative for approval before any concrete is placed.

If, at any time during construction, the concrete resulting from the approved design mix proven to be unsatisfactory for any reason such as too much water, lack of sufficient plasticity to prevent segregation, honeycomb, etc., or insufficient strength, the contractor shall immediately notify the testing laboratory and the PolWD PIU representative. The laboratory shall modify the design, subject to the approval of the PolWD PIU representative or his duly authorized representative until satisfactory concrete is obtained.

- e.2 Controlled Strength of Concrete shall be as follows;
 - Concrete for structural elements shall develop minimum 7-day compressive cylinder strength of 20.68 MPa (3,000 psi), unless otherwise specified in the plans.
 - (2) Concrete for non-structural elements shall develop minimum 28-day cylinder strength of 20.68 MPa (3,000 psi), unless otherwise specified in the plans.
 - (3) The minimum cement content for 20.68 MPa (3,000 psi), concrete shall be 9 sacks per cubic meter of concrete.
 - (4) Maintain concrete cover for reinforcing steel as follows:

1. Slab	on Grade	1.5" (38mm)
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- 2. Slab on Fill 3" (75mm)
- 3. Wall Footing 3" (75mm)

- e.3 The water shall in no case exceed 19.00 liters, and 25.67 liters (5.62 and 6.79 US gallons) per bag of cement for all concrete with specified strength of fc=27.58 MPa (4,000 psi) and 20.68 MPa (3,000 psi), respectively. Slumps shall not exceed 100 mm in all cases unless otherwise changed by the PoIWD PIU representative and shall be according to "Test of Slump for Portland Cement Concrete" (ASTM C-143).
- e.4 Lean Concrete Lean concrete mix to be designated to produce concrete with 28-day strength of 13.79 MPa, slump and size shall be subject to approval depending on where it is mixed.
- e.5 Testing-The Contractor shall employ, at his own expense, an approved testing laboratory which shall make compression and slump tests and immediately submit 5 copies of test reports to the PolWD PIU representative. Ready mixed concrete companies may use their own laboratories provided that testing is done with the supervision of the PolWD PIU representatives.

Compression and slump tests shall be made for every 50 cu.m of concrete or fraction thereof, but not less than 1 set of tests shall be made from any one batch of concrete and all 3 tests shall be made from the same batch.

- e.6 Compression Tests Make 3 standard 150 mm x 300 mm cylinder and test in accordance with ASTM C-31 and C- 39. Test one (1) cylinder at the age 28 days, one (1) at age 14 days and one (1) at age 7 days. Make additional cylinder as required to check strength of concrete in the construction. These cylinders are to be cured in the field in the same manner as to the concrete in the construction is cured.
- e.7 Slump Tests For each representative quantity of concrete mentioned above, two slump tests shall be made in accordance with ASTM C-143.
- e.8 Test Reports The testing laboratory shall submit 4 copies of its test cylinder reports which are to include, as far as applicable, the following information: location of the structure where the concrete is used, design number, concrete design strength, type and manufacturer of Portland cement, amount of any admixtures used, slump tests, date of sampling, cylinder application number, days cured in the field, days cured in the laboratory, age at time of testing, crushing stress, type of failure, who made the cylinders, who shipped the cylinders to the laboratory and whether concrete strength meets the specifications.

- e.9 Inspection of Batch Plant operation on a "Spot Check" basis as required to insure the concrete delivered to the job complies with the specifications and the design mix. The testing laboratory shall provide this service as directed by the PoIWD PIU representative.
- e.10 Additional Tests If, in the opinion of the PoIWD PIU representative, based on cylinder strengths below specifications requirements or visual defects, concrete of poor quality has been placed, additional tests shall be made as directed by the PoIWD PIU representative or his authorized representative and at the expense of the Contractor. Test may be compression test on cored cylinder per ASTM C 42, and/or load tests as outlined in ACI, Section 202, or as specified.

f. MIXING CONCRETE

f.1 Site Mixed Concrete – Provide a batch mixer type equipped with accurate timing and measuring devices and operate in accordance with the manufacturer's recommendation.

> The mixing time for each batch, after all solid materials are in the mixing drum, and provided that water is introduced before ¼ of the mixing time has elapsed, shall not be less than 1 minute for mixers having a capacity of 1 cu.m or a fraction thereof of additional concrete.

- f.2 No hand mixing shall be allowed except in emergency such as mixer breakdown during concreting operations and this shall stop as soon as the pour is completed, at a construction joint shown or otherwise designated by the PoIWD PIU representative. All concrete shall be machine mixed for at least 2 minutes after all materials, including water, are in the mixing drum.
- f.3 The mixer shall be of an approved size and type that will insure a uniform distribution of materials throughout the mass. It shall be equipped with a device for accurately measuring and controlling the amount of mixing water in each batch.
- f.4 The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat the inside of the drum without reducing the cement of the mix to be discharged.
- f.5 Re-tampering i.e., remixing with the addition of water to concrete that has been partially hardened will not be permitted.

g. READY MIXED CONCRETE

All ready mixed concrete shall conform with the requirements of ASTM C - 94 be placed in forms within one hour after adding water or not more than $\frac{1}{2}$ hours if a retarder is used. It shall be kept constantly agitated during the transit period.

h. PLACING OF CONCRETE

- h.1 Do not start the placing of concrete until the forms and the reinforcement for the whole unit are properly laid and installed, cleaned, inspected and approved.
- h.2 Roughen and clean construction joints and just before any pouring starts, wet and slush with cement mortar.

i. RETEMPERING

The Contractor shall mix only such quantities that are required for immediate use and mixture, which has developed set, shall not be used. Concrete, which has partially hardened, shall not be retempered nor used.

j. HANDLING AND PLACING CONCRETE

- j.1 After the concrete is mixed, it shall be immediately conveyed in approved pushcarts or buggies (kept temporary runways built so that runway supports will not bear reinforcement of fresh concrete) to desired locations, and carefully deposited in such manner as to prevent the separation of ingredient or displacement of reinforcements. Conveying or hauling of concrete by the use of long inclined chuted or pipes will not be permitted.
- j.2 Dumping concrete into carts or buggies with a free fall of more than one meter will not be permitted. Hardened splashes or accumulation of concrete on forms or reinforcements shall be moved before the work proceeds.
- j.3 When placing operations would involve dropping the concrete more than 1 ½ meters, it shall be deposited through sheet metal or other approved conveyors. As for practicability, the conveyors shall be kept full of concrete during the placing and their lower ends shall be kept buried in the newly placed concrete. After the initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of the reinforcing bar, which it projects.
- j.4 Concrete in columns shall be placed in one continuous operation and allow to set 12 hours before caps are placed. Concrete in beams and slabs in superstructures shall be placed in one continuous operation. Construction joints shall be placed as directed by the PolWD PIU representative. Foundation shall be free from water during concreting.

k. CURING AND PROTECTION

Protect all concrete work from drying out after removal of forms by covering with waterproof of paper, polyethylene, burlap, at a coating of approved membrane curing compound with moisture retention property equal to 90% based on ASTM C – 309 and C 156, applied in accordance with manufacturer's instruction. Membrane curing compound shall not be used where floor hardener, membrane waterproofing, dam-proofing, resilient floor tile or other floor or wall covering set in adhesive, concrete-fill or setting beds, paint, plaster or other applied finishes, or surfaces treatment are to be subsequently applied. Wet burlap as often as required to keep concrete wet throughout each day for a period of at least 7 days where normal Portland cement is used and 3 days where high early strength cement is used.

I. REINFORCING AND ACCESSORIES

- I.1 All steel for columns, shear wall, footings and footing beams shall be high grade deformed bars with Fy = 275.90 MPa (40,000 psi) for bars larger than 16 mmØ.
- I.2 For 16 mmØ and smaller bars use deformed bars; Fy = 275.90 MPa (40,000 psi).
- I.3 For 5 mm bars plain ones may be used unless otherwise specified.
- I.4 Accessories Provide bar supports and other accessories necessary to hold bars in the proper positions while concrete is being placed. Bar supports which come in contact with forms for concrete exposed to view in the finishes structure shall be galvanized. Bar supports are subject to approval.
- I.5 Mill Certificate and Test Furnish two (2) copies of manufacturer's certificate of mill tests of all reinforcing steel. The Contractor shall employ at his own expense, an approved testing laboratory which shall test, at the supervision of the PolWD PIU representative or his authorized representative, all sizes of reinforcement of each bulk.
- I.6 Shop Drawings Each reinforcing steel detail and placement drawings shall be submitted for approval. Any material fabricated before the final approval of the shop drawings will be done at the Contractor's risk but no material shall be installed until final approval of the "Shop Drawing". Shop drawings hall be in accordance with the "Manual of Standard Practice for Detailing Reinforced Concrete Structure" (ACI – 315).

- I.7 Labeling Bars shall be properly labeled with weatherproof tags to facilitate identification.
- I.8 Storage of Materials Store steel reinforcing bars on supports above ground level. Keep covered with tarpaulins, required, due to a delay in use.
- I.9 Placing Place all reinforcement according to the approved placement drawings. Use sufficient bar supports, ties, anchors and other accessories to hold all bars securely in place. All stirrups shall be held in place by spacer bars unless otherwise shown in the detailed drawings.

Reinforcing steel shall be cleaned of oil, grease, scale, rust or other coatings which will impair bond, and shall be without kinks and bends. Otherwise the same will be rejected.

All welded splices shall be made by certified welders. Certification shall be submitted, approved by the Government PolWD PIU representative of his duly authorized representative before any welding works shall be started. The welding of bars shall conform to AWS D 1.4 Recommended Practices for Welding Reinforcing Steel. All bars shall be bent cold.

I.10 Bars of reinforced concrete member exposed to the weather shall be protected with at least $3.1 \text{ cm} (1 - 1/2^{\circ})$ and in no case less than $2.54 \text{ cm} (1^{\circ})$ concrete.

Reinforcing bars shall be deformed conforming to ASTM - A - 615 as follows:

- (1) 16mmØ Bars and larger bars shall be high grade with minimum Fy = 414 MPa (60,000 psi).
- (2) 12mmØ Bars and lower bars shall be intermediate grade with minimum Fy = 276 Mpa (40,000 psi).
- (3) If bending and welding are important, deformed bar shall conform to STM A706 low alloy grade 414 reinforcing steel bar.

m. FORMS

m.1 General

Forms shall conform to shape, lines and dimensions shown on the drawings. They shall be substantial and designed to resist the pressure and weight of the concrete and shall be properly tied and braced or shored to maintain their position and shape. The forms shall be sufficiently tight to prevent leakage of mortar.

- (1) Shop drawings of formwork, where required by the PolWD PIU representative, shall be submitted for approval before the fabrication and erection of such formwork.
- (2) Provide temporary openings where necessary to facilitate cleaning and inspection immediately before depositing concrete.
- (3) All form materials are subject to approval before construction.
- (4) The type of form used shall be in accordance with the finish requirement as specified or as shown on the detailed drawings.
- (5) Start forming at the first floor level with new materials. Forms for exposed concrete may be reused only if the surface has not absorbed moisture and has not splintered, warped or peeled, subject to the PolWD PIU representative's approval or his designated representative.
- (6) Coat forms with non-staining form oil before setting reinforcement. The form oil shall not contain chemical that will impair the strengths of the concrete.
- (7) Side forms of footings may be omitted, and concrete placed against the neat excavation only when approved by the PolWD PIU representative/or his authorized representative and when appropriate credit is allowed.
- (8) All exposed corners shall be square. Exercise due care while stripping forms and protect corners subsequently against chipping or other damage by approved means.
- (9) Removal of forms or shoring is subject to approval by the PolWD PIU representative and under no circumstances shall the bottom forms and shoring be removed until the members have acquired sufficient strength to support their weight and load thereon. Forms shall remain in place for minimum time as follows.

Columns, shear and bearing walls ------ 3 days

C. CONCRETE MASONRY WORKS

a. GENERAL

The work includes all labor, materials, tools and equipment necessary to install concrete masonry and all appurtenant work in connection with the work as shown on the Drawings and Specifications.

- a.1 The Contractor shall examine all drawings, specifications and note all conditions that may affect his work and performance in execution of the contract.
- a.2 Where any deviation on the plans and specifications are to be made, the PoIWD PIU representative shall be notified and his written approval shall be obtained before proceeding with the work.

b. SCOPE OF WORK

The work covered in this section shall include the following:

- b.1 The furnishing of all necessary labor, materials and appliance necessary to complete the execution of the concrete masonry construction as shown on the Drawings.
- b.2 All preparations and all masonry work necessary to receive and adjoin other work including provision for inserts and attachments as noted in the plans and specifications, which shall be installed under this section.
- b.3 Coordination with all other trades in laying out and execution of the concrete masonry work.
- b.4 Giving the work his personal supervision and keeping a competent project supervisor on the job at all times.
- b.5 Arranging for adequate bracing, forming and shoring required in conjunction with and in the course of constructing the concrete masonry although not provided for under the other sections.
- b.6 Placing of all reinforcement including furnishing of all reinforcing steel for concrete masonry, which is not provided under the other sections but found to be necessary for proper prosecution of the work.
- b.7 Arrange for the necessary storage space and protection of materials in the jobsite.
- b.8 Providing assistance and facilities for all inspections by the PoIWD PIU representative as required in the course of execution of the work.

b.9 Arrange for furnishing test specimens and samples of materials as maybe required in the course of work implementation.

c. MATERIALS REQUIREMENTS

Concrete masonry unit work of the type indicated shall be provided and shall be properly coordinated with the work of their trades. The source of supply of materials, which will affect the appearance of the finished work, shall be changed after the work has started. The following has to be considered in concrete masonry work:

- c.1 Cement to conform to ASTM C-150, Type I.
- c.2 Sand or fine aggregate shall be clear, sharp and well graded, and free from injurious amount of dust, lumps, shale, alkali, surface coating and organic matter.
- c.3 All load bearing masonry units shall have a minimum compressive strength of not less than 5.5 MPa (800 psi) based on five (5) individual units when tested in accordance with the methods set forth in ASTM C -140-70.

Masonry units shall have been cured for not less than 14 days if steam-cured, or 28 days if air-cured when placed in the structure.

c.4 Concrete hollow blocks shall be standard machine fabricated and shall have fine and even texture and well defined edges. CHB shall conform to the requirements of ASTM Specifications C 90, grade with minimum compressive strength of 2.45 MPa (350 psi) (average of 5 specimens). Samples shall be tested and submitted to the PolWD PIU representative. Dimensions and tolerances shall be as individually specified on the Plans.

d. MORTAR AND GROUT

Cement shall be type I Portland cement conforming to ASTM C-150.

- d.1 Plastic cement shall have less than 12% of the total volumes in approved types of plasticizing agents and shall conform to all of the requirements for Portland cement per ASTM C – 150, except in respect to the limitations in insoluble residue, airentrainment, and addition subsequent to calcination.
- d.2 Mortar shall be freshly prepared and uniformly mixed in the proportion of 1 part Portland cement, ¼ part maximum lime putty or hydrated lime, fine aggregate/loose sand not less the 1 and 1 ½ and not more than 3 times the sum of the volume of cement and lime used, and shall conform to ASTM C 270.

- d.3 Grout for pouring shall be of fluid consistency and mixed in the proportion by volume, 1 part Portland cement, 2 and ½-part minimum 3 parts maximum fine aggregate where the grout space is less than 75 mm in its least dimension.
- d.4 Grout for pouring shall be fluid consistency and mixed in the ratio by volume, 1 part Portland cement, 2 parts minimum to 3 parts maximum fine aggregates, 2 parts coarse aggregate where the grout space is 75 mm or more in its dimension.
- d.5 Grout for pumping shall be of fluid consistency and shall have not less than 7 bags of cement in each cubic meters of grout. The mix design shall be approved by the PolWD PIU representative.
- d.6 Fluid consistency shall mean that consistency as fluid as possible for pouring without segregation of the constituent parts.
- d.7 Aggregate for mortar shall conform to ASTM C-144.
- d.8 Aggregate for grout shall conform to ASTM C-404.
- d.9 Admixtures: The use of admixtures shall not be permitted in mortar or grout unless substantiating data is submitted to and approved by the PoIWD PIU representative.
- d.10 The use of admixture shall not be permitted in mortar without reducing the lime content.
- d.11 Insert coloring pigments maybe added but not to exceed 6 % by weight of the cement.
- d.12 The use of uncontrolled fire clay, dirt and other deleterious materials is prohibited.
- d.13 Water shall be free from deleterious quantities of acids alkalis and organic materials.

e. REINFORCING STEEL

- e.1 Vertical and horizontal reinforcements for CHB shall are as shown in the Plans.
- e.2 Minimum requirements for deformed steel reinforcement shall conform to ASTM A-305.
- e.3 Wire reinforcement shall conform to ASTM A-82.
- e.4 Reinforcement shall be clear and free from loose rust scale and any coatings that reduce bond and kinks.

f. CONSTRUCTION

f.1 Workmanship

Masonry work shall not be started when the horizontal and vertical alignment of the foundation is a maximum of 25 mm total in error.

- (1) All masonry shall be laid true, level plumb and neat in accordance with the plans.
- (2) Units shall be cut accurately to fit all plumbing ducts, openings of electrical works, etc., and all holes shall be neatly patched.
- (3) Extreme care shall be taken to prevent visible grout mortar stain.
- (4) No construction supports shall be attached to the wall except where specifically permitted by the PolWD PIU representative.
- f.2 Masonry Units

Masonry units shall be sound, dry, clean and free from cracks when placed in the structure.

- (1) All masonry units shall be stored on the job so that they are kept off the ground and protected from the rain. Wetting the units shall not be permitted except when hot dry weather exists causing the units to be warm to the touch, and then the surface only may be wet with a light fog spray.
- (2) Where a masonry unit cutting is necessary, all cuts shall be neat and true.
- f.3 Mixing of Mortar and Grout

Mortar shall be mixed by placing $\frac{1}{2}$ of the water and sand in the operating mixer. Then add the cement, lime and the remainder of the sand and water.

- (1) Mortar once mixed to optimum plasticity shall not be re-tempered with water. Re-tempering decreases the strength of the mortar. Any mortar, which is unused after 1 ½ hours from the initial mixing time, shall not be used.
- (2) After all ingredients are in the batch mixer, they shall be mechanically mixed for not less than 3 minutes.

Hand mixing shall not be employed unless specifically approved.

f.4 Bonding

Concrete masonry units should be laid with the thicker edge of the shell up, to provide a wider mortar bed.

- (1) Both face shell and ends of all blocks should receive a full bed of mortar.
- (2) Cross webs should be mortared.
- (3) For bonding the masonry of the foundation, the top surface of the concrete foundation shall be clean and with laitance removed and aggregate exposed before starting the masonry construction.
- (4) Where no bond pattern is shown, the wall shall be laid up in straight, uniform coarses with regular running bond.
- (5) Intersecting masonry walls and partitions shall be handed by the use of steel ties with spacing and other details are shown on the Plans. Corners shall have a standard masonry bond by overlapping units and shall be solidly grouted.
- (6) Where stack bond is indicated on the plans, approved horizontal reinforcement shall be provided at 600 mm on center maximum.
- f.5 Joints

The starting joint on foundation shall be laid with the full mortar coverage on the bed point except at the area where grout occurs free from mortar so that the grout will contact the foundation.

- (1) Mortar joints shall be straight, clean and uniform in the thickness and shall be tooled as shown on the plans.
- (2) All walls shall have joints tooled with a round bat (or V-shaped bar) to produce a dense, slightly concave surface well bonded to the block at the edges, unless specifically detailed.
- (3) Tooling shall be done when the mortar is partially set bury still sufficiently plastic to bond. All tooling shall be done with a tool, which compact the mortar, pressing the excess mortar cut of the joint rather than dragging out.

- (4) Raked joints shall be not more than 13 mm deep and where exposed to the weather shall be tooled.
- (5) Where walls are to receive plaster, the joints shall be stuck flush.
- (6) Where joints are to concealed under paint, these joints shall be filled flush and then socked to produce a dense without sheen.
- (7) Joints which are not tight at the time of tooling shall be raked out, painted and then tooled.
- (8) Unless otherwise specified or detailed on the plans, in hollow unit masonry, the horizontal and vertical mortar joints shall be 10 mm thick full mortar coverage on the face shells and on the webs surrounding cells to be filled.
- (9) Vertical head joints shall be buttered well for a thickness equal to the face shell of the unit and these joints shall be shoved tightly so that the mortar bonds well to both units. Joints shall be solidly filled from the face of the block to at least the depth of the face shell.
- (10) It is necessary to move a unit after it have been once set in place, the unit shell be removed from the wall, cleaned and set in fresh mortar.
- (11) Concrete building bricks shall be laid with full head and bed joints.
- (12) Lintels, capping units and all bearing plates set by the mason shall be set in full bed of mortar.
- (13) When control joints are required, they shall be as detailed on the plans.
- f.6 Grouting / General

Reinforcing steel shall be secured in place and inspected before grouting starts cured in place and inspected before grouting starts.

- (1) Mortar dropping should be kept out of the grout space.
- (2) All grout shall be puddle or vibrated in place.
- (3) Vertical cells to be filled with grout shall have vertical alignment to maintain a continuous unobstructed core space.

- (4) Cells containing reinforcement shall be solidly filled with grout and pours shall be stopped 38 mm below the top of a course to form a key at pour joints.
- (5) Grouting of beams over openings shall be done in continuous operation.
- (6) The tops of unfilled cell columns under a horizontal masonry beam shall be covered with metal latch of special units used to confine the front fill to the beam section.
- (7) All bolts, anchors, or inserts in the wall shall be solidly grouted in place.
- (8) Spaces around metal door frames and other built-in items shall be filled solidly with grout or mortar.

g. **REJECTION**

- g.1 In case the shipment fails to conform to the specified requirements, the contractor may sort it, and new specimen shall be selected by the PoIWD PIU representative from the retained lot and tested at the expense of the contractor. In case the second set of specimen failed to conform to the test requirements, the entire lot shall be rejected.
- g.2 Sample of masonry block representing one (1) unit in every 1000 blocks shall be selected and tested in accordance with "Standard Method of Testing Masonry Units" (ASTM 410). No blocks shall be used unless the results of the tests are approved by the PoIWD PIU representative. The Contractor shall provide the samples and convey them to the approved government accredited laboratory for testing. The cost of providing the samples and transporting them to the testing laboratory shall be borne by the contractor.

h. SAMPLING OF MASONRY BLOCKS

h.1 Samples of masonry block representing one (1) unit in every 1000 blocks shall be selected and tested in accordance with "Standard Method of Testing Masonry Units" (ASTM 410). No blocks shall be used unless the results of the tests are approved by the PolWD PIU representative. The Contractor shall provide the samples and convey them to the approved Laboratory to be nominated by the Contractor. The cost of providing the samples, transporting them to the testing laboratory and payment for the testing shall be borne by the Contractor. h.2 Re-tempering: The mortar shall be mixed only in such quantities, as are required for immediate use and any mixture, which has developed initial set or partially hardened shall not be tempered or remixed.

i. PROTECTION AND CLEANING

Corners shall be protected from damage, with substantial board covers. Mortar or grout stains on masonry work shall be removed immediately. Any masonry work showing stains from mortar or concrete, or grout at completion of work, shall be replaced or the entire masonry surface sandblasted to provide uniform approved appearance. In cleaning the block, only stiff fiber brushes and wooden scrapers shall be used. Metal implements or acids shall not be used for cleaning blocks. All imperfect joining, nail holes, chipped edges of corners, and similar defects shall be corrected or replaced as directed.

4.2 LANDSCAPING AND GRASS PLANTING

A. GENERAL

The Contractor shall place or plant the grass as shown in the drawings so that the area is neat and green. The area should be filled with a specified soil and graded to attain a uniform level inside the pump station.

B. MATERIAL REQUIREMENTS

a. Grass

Frog or Bermuda grass should be planted in the area.

b. Soil

Soil should have the following properties:

(1) Loam

Loam, a mix of sand, silt, and clay in roughly equal proportions, is considered the best soil type for grass.

(2) pH

Slightly Acidic to Neutral: The ideal pH range for most grass types is between 6.0 and 7.0.

(3) Nutrient Content

Soil should be rich in essential nutrients for plant growth, including nitrogen, phosphorus, and potassium.

(4) Drainage & Aeration

Proper aeration allows oxygen to reach the roots, which is essential for healthy root growth and overall plant health.

(5) Soil Texture

The soil should be friable, meaning it's easily crumbled and not compacted.

(6) Topsoil

Depth of good topsoil should be at least 6 inches (150 mm).

c. Outdoor Plant Box and plants around Reservoir

Outside wall of proposed reservoir should be installed with a concrete hollow blocks plant box plastered with at least 16mm thickness. Choice of outdoor plants should be approved by the PolWD PIU representative.

5. SHOP DRAWINGS

5.1 INTENT OF SPECIFICATIONS AND DRAWINGS

- a. The intent of the Specifications and Drawings is that the Contractor shall furnish all the required plan, labor materials, equipment and services unless otherwise specifically provided.
- b. The Specifications and Drawings are complementary and what is called for in one shall be as binding as if called for in both.
- c. Any discrepancies, errors, or omissions found in the Specification or Drawings shall be reported in writing with ten (10) days from discovery to the PolWD PIU representative who will issue the correction in writing within the same period. The Contractor shall not take advantage of any such discrepancies, errors, or missions, but shall comply with any corrective measures regarding the same prescribed by the PolWD PIU representative.
- d. In case of conflict between the Specification and the Drawings, inform the PoIWD PIU representative and the PoIWD for clarifications.

5.2 SHOP DRAWING

a. Whenever called for in these Specifications or on the Drawings, or where required by the PoIWD PIU representative, the Contractor shall furnish the PoIWD for review three (3) prints of each shop drawing. The term "Shop drawing" as used herein shall be understood to include detail design calculations, fabrications and installation drawings, list, graphs, operation instruction, etc. Shop drawings shall be submitted to the PoIWD for review / approval within fifteen (15) days from receipt of the Notice of Award, unless otherwise extended in writing by the PoIWD.

- b. All shop drawings submittals shall be accompanied by a transmittal from using the format bound with the Contract Documents, if one is included. Any shop drawing submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for re-submittal. The Contractor may authorized a material or equipment supplier to deal directly with the PolWD with regard to shop drawings, however, ultimate responsibility for the accuracy and completeness of the information contained in the submittal shall remain with the Contractor.
- c. A separate transmitted form shall be used for each specific item or class material or equipment for which a submittal is required. Transmitted of shop drawings on various items using a single transmittal form will be permitted only when items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. At his option, the Contractor or Supplier may obtain from the PolWD qualities of the shop drawings transmittal form at reproduction cost.
- d. Within five (5) calendar days after receipt of said prints, the PolWD will return prints of each drawing to the Concrete to the Contractor with his comments noted thereon. Whenever a re-submittal is required, the Contractor shall make a complete and acceptable submittal to the PolWD within ten (10) days from receipt of the returned shop drawings. Non-compliance hereof will gives rise to the PolWD's right to either (a) cancel the award; or (b) withhold the money due the Contractor to cover additional costs of the PolWD PIU representative's review beyond the second submission. Such failure may be considered a factor against the Contractor's competences in future bidding to be conducted by the PolWD.
- e. If three (3) prints of the drawings are returned to the Contractor marked "NO EXCEPTION TAKEN", formal revision of said drawings will not be required.
- f. If three (3) prints of the drawings are returned to the Contractor marked "MAKE CORRECTION NOTED", formal revision of said drawings will not be required.
- g. If one (1) print of the drawings is returned to the Contractor marked "AMEND-RESUBMIT", THE Contractor shall revise the said drawing and shall resubmit eight (8) copies of said revised drawing to the PolWD.
- h. If one (1) print of the drawings is returned to the Contractor marked "REJECTED-RESUBMIT", the Contractor shall revise the drawing and shall resubmit eight (8) copies of said revised drawing to the PolWD.
- i. Fabrication of an item shall not be commend before the PolWD has reviewed / examined the pertinent shop drawings and returned copies to the Supplier marked either "NO EXEPTION TAKEN" or "MAKE CORRECTIONS NOTED". Revisions indicated on shop drawings shall be considered as changes necessary to meet the requirements of the Contract Drawings and Specification and shall not be taken as the basis of claims for extra work. The Contractor shall have no claim for damages or extension of time due to any delay resulting from the Contractor having to make the required revisions to shop drawings (Unless reviewed by the PolWD of said drawings is delayed

beyond a reasonable period of time and unless the Contractor can established that the PolWD's delay in review actually resulted in the delay in the Contractor's Construction Schedule). The review of said drawings by the PolWD will be limited to checking for general agreement with the specifications and drawings, and shall in no way relieve the Contractor of the responsibility for errors or omissions contained therein nor shall review operate to waive or modify and provision contained in Specifications or Contractor Drawings. Fabricating dimensions, quantities of material, applicable code requirements shall be the Contractor's responsibility.

5.3 REFERENCE TO STANDARDS OR PUBLICATIONS

Any reference in the Specifications or Drawings to any specification, standard or publication of any organization shall, in the absence of a specific designation to the contrary, be understood to refer to the latest edition of the specification, standard or publication in effect as of the date of advertising the work. Internationally accepted standards equal to or better than specified standards or specifications are acceptable.

5.4 REFERENCE TO PROPRIETARY PRODUCTS

Where references to proprietary products appear in the Specifications or Drawings, it in for the purpose of establishing an acceptable standard of quality or design but no guarantee is given that said referenced manufacturer's products will meet all contact requirements without modifications. Unless a substitute is expressly prohibited, the Contractor may request approval of a substitute for any such proprietary product. Such request must be in writing and must include descriptive literature, specifications, test reports of samples, as appropriate, to enable the PolWD to determine the acceptability of the product proposed for substitution. No substitute product shall be used in the work until written approval has been received from the PolWD. All costs involved in making laboratory test of the sample submitted as substitute for the specified materials shall be borne by the Contractor.

5.5 SPECIFICATIONS AND DRAWINGS FURNISHED TO CONTRACTOR

The PolWD will furnish the Contractor with two (2) sets of Specifications together with reduced drawings (if any) and two (2) sets full-scale Drawings. Additional quantities of Specifications and Drawings will be furnished at reproduction cost.

5.6 AS-BUILT DRAWINGS

The Contractor shall maintain at least three (3) set with softcopy (AutoCAD File) of approved with sign and seal blueprints (printed in A3 size of paper) for all works at the job site. These prints shall be marked and updated to indicate current job-progress and shall show deviations from the construction drawings. After final inspection, the Contractor shall transfer all as-built information to a set of reproducible tracings that shall be delivered to the PoIWD PIU representative prior to acceptance of the project.

Section VII. Drawings

1. INTENT OF SPECIFICATIONS AND DRAWINGS

- **a.** The intent of the Specifications and Drawings is that the Contractor shall furnish all the required plant, labor, materials, equipment and services, unless otherwise specifically provided.
- **b.** The Specifications and Drawings are complementary and what is called for in one shall be as binding as if called for in both.
- **c.** Any discrepancies, errors, or omissions found in the Specifications or Drawings shall be reported in writing within ten (10) days from discovery to the Project Engineer who will issue the correction in writing within the same period. The Contractor shall not take advantage of any such discrepancies, errors, or omissions, but shall comply with any corrective measures regarding the same prescribed by the Project Engineer.
- **d.** In case of conflict among the specifications, drawings, general conditions, special conditions, special provisions, the matter shall be resolved by the PolWD through the Project Engineer.

2. SHOP DRAWINGS

- **a.** Whenever called for in these Specifications or on the Drawings, or when required by the Project Engineer, the Contractor shall furnish the PolWD for review three (3) prints of each shop drawing. The term "shop drawing" as used herein shall be understood to include detail design calculations, fabrications and installation drawings, lists, graphs, operating instructions, etc. Shop drawings shall be submitted to the PolWD for review/approval within fifteen (15) days from receipt of the Notice of Award, unless otherwise extended in writing by the PolWD.
- **b.** All shop drawing submittals shall be accompanied by a transmittal form using the format bound with the Contract Documents, if one is included. Any shop drawing submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for re-submittal. The Contractor may authorize a materials or equipment supplier to deal directly with the PolWD with regard to shop drawings, however, ultimate responsibility for the accuracy and completeness of the information contained in the submittal shall remain with the Contractor.
- **c.** A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of shop drawings on various items using a single transmittal form will be permitted only when items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. At his option, the Contractor or Supplier may obtain from the PolWD quantities of the shop drawing transmittal form at reproduction cost.
- **d.** Within five (5) calendar days after receipt of said prints, the PolWD will return prints of each drawing to the Contractor with his comments noted thereon. Whenever a re submittal is required, the Contractor shall make a complete and acceptable submittal to the PolWD within ten (10) days from receipt of the

returned shop drawings. Non-compliance hereof will give rise to the PolWD's right to either

- (a) cancel the award; or
- (b) Withhold the money due the Contractor to cover additional costs of the Project Engineer's review beyond the second submission. Such failure may be considered a factor against the Contractor's competence in future biddings to be conducted by the PolWD.
- **e.** If three (3) prints of the drawings are returned to the Contractor marked "NO EXCEPTIONS TAKEN", formal revision of said drawings will not be required.
- **f.** If three (3) prints of the drawings are returned to the Contractor marked "MAKE CORRECTIONS NOTED", formal revision of said drawings will not be required.
- **g.** If one (1) print of the drawings is returned to the Contractor marked "AMEND RESUBMIT", the Contractor shall revise the said drawing and shall resubmit eight (8) copies of said revised drawing to the PolWD.
- **h.** If one (1) print of the drawings is returned to the Contractor marked "REJECTED RESUBMIT", the Contractor shall revise the said drawings and shall resubmit eight (8) copies of said revised drawing to the PolWD.
- Fabrication of an item shall not be commenced before the PolWD has i. reviewed/examined the pertinent shop drawings and returned copies to the "NO EXCEPTIONS marked either TAKEN" **"MAKE** Supplier or CORRECTIONS NOTED". Revisions indicated on shop drawings shall be considered as changes necessary to meet the requirements of the Contract Drawings and Specifications and shall not be taken as the basis of claims for extra work. The Contractor shall have no claim for damages or extension of time due to any delay resulting from the Contractor having to make the required revisions to shop drawings (unless reviewed by the PolWD of said drawings is delayed beyond a reasonable period of time and unless the Contractor can establish that the PolWD's delay in review actually resulted in a delay in the Contractor's Construction Schedule). The review of said drawings by the PolWD will be limited to checking for general agreement with the specifications and drawings, and shall in no way relieve the Contractor of the responsibility for errors or omissions contained therein nor shall review operate to waive or modify any provision contained in Specifications or Contract Drawings. Fabricating dimensions, quantities of material, applicable code requirements shall be the Contractor's responsibility.

3. REFERENCE TO STANDARDS OR PUBLICATIONS

Any reference in the Specifications or Drawings to any specification, standard or publication of any organization shall, in the absence of a specific designation to the contrary, be understood to refer to the latest edition of the specification, standard or publication in effect as of the date of advertising the work. Internationally accepted standards equal to or better than specified standards or specifications are acceptable.

4. REFERENCE TO PROPRIETARY PRODUCTS

Where references to proprietary products appear in the Specifications or Drawings, it is for the purpose of establishing an acceptable standard of quality or design but no guarantee is given that said referenced manufacturer's products will meet all contract requirements without modifications. Unless a substitute is expressly prohibited, the Contractor may request approval of a substitute for any such proprietary product. Such request must be in writing and must include descriptive literature, specifications, test reports of samples, as appropriate, to enable the PolWD to determine the acceptability of the product proposed for substitution. No substitute product shall be used in the work until written approval has been received from the PolWD. All costs involved in making laboratory tests of the sample submitted as substitute for the specified materials shall be borne by the Contractor.

5. SPECIFICATIONS AND DRAWINGS FURNISHED TO CONTRACTOR

The PolWD will furnish the Contractor with one (1) set of Specifications attached in the Contract Documents together with reduced drawings (if any) and two (2) sets full-scale Drawings.

6. CONSTRUCTION DRAWINGS

The Contractor shall maintain at least one (1) set of blue prints of the construction drawings on the job site. These prints shall be marked and updated to indicate current job progress and shall show deviations from the Contract. These drawings shall show the actual location and depth of all mains, fittings, thrust blocks, valves, fire hydrants, service connections (if any) and all other items shown and specified. Valve locations shall be tied-in by reference to two or three existing permanent or semi-permanent ground features. Before final inspection, the Contractor shall transfer all as-built information from these construction drawings to a set of reproducible tracings and drawn in AutoCad latest version, which shall be delivered to the Project Engineer within 30 days after the date of physical completion of the project.

Please see attached separate documents for the plans.

Section VIII. Bill of Quantities

Notes on the Bill of Quantities

Objectives

The objectives of the Bill of Quantities are:

- a. to provide sufficient information on the quantities of Works to be performed to enable Bids to be prepared efficiently and accurately; and
- b. when a Contract has been entered into, to provide a priced Bill of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bill of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bill of Quantities should be as simple and brief as possible.

Daywork Schedule

A Daywork Schedule should be included only if the probability of unforeseen work, outside the items included in the Bill of Quantities, is high. To facilitate checking by the Entity of the realism of rates quoted by the Bidders, the Daywork Schedule should normally comprise the following:

- a. A list of the various classes of labor, materials, and Constructional Plant for which basic daywork rates or prices are to be inserted by the Bidder, together with a statement of the conditions under which the Contractor will be paid for work executed on a daywork basis.
- b. Nominal quantities for each item of Daywork, to be priced by each Bidder at Daywork rates as Bid. The rate to be entered by the Bidder against each basic Daywork item should include the Contractor's profit, overheads, supervision, and other charges.

Provisional Sums

A general provision for physical contingencies (quantity overruns) may be made by including a provisional sum in the Summary Bill of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a provisional sum in the Summary Bill of Quantities. The inclusion of such provisional sums often facilitates budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises. Where such provisional sums or contingency allowances are used, the

SCC should state the manner in which they will be used, and under whose authority (usually the Procuring Entity's Representative's).

The estimated cost of specialized work to be carried out, or of special goods to be supplied, by other contractors should be indicated in the relevant part of the Bill of Quantities as a particular provisional sum with an appropriate brief description. A separate procurement procedure is normally carried out by the Procuring Entity to select such specialized contractors. To provide an element of competition among the Bidders in respect of any facilities, amenities, attendance, etc., to be provided by the successful Bidder as prime Contractor for the use and convenience of the specialist contractors, each related provisional sum should be followed by an item in the Bill of Quantities inviting the Bidder to quote a sum for such amenities, facilities, attendance, etc.

Signature Box

A signature box shall be added at the bottom of each page of the Bill of Quantities where the authorized representative of the Bidder shall affix his signature. Failure of the authorized representative to sign each and every page of the Bill of Quantities shall be a cause for rejection of his bid.

These Notes for Preparing a Bill of Quantities are intended only as information for the Procuring Entity or the person drafting the Bidding Documents. They should not be included in the final documents.

Bill of Quantities

CONSTRUCTION OF 300 CU.M. REINFORCED CONCRETE GROUND RESERVOIR AT ANTIPORTA

ITEM			
NO.	WORK DESCRIPTION	QUANTITY	UNIT
А	Temporary Site Facilities	1	lot
В	Occupational Safety and Health Program	1	Lot
С	Mobilization and Demolition	1	Lot
D	Site Clearing and Grubbing	500	Sq.m.
E	Excavation	228	Cu.m
F	Embankment	50	Cu.m.
G	Forms and Falseworks	519	Sq.m.
н	Reinforcement Bars	10069	Kgs.
I	Concrete Works	106	Cu.m.
J	Water Level Indicator	1	Lot
к	Moisture Control and Leak Prevention	1	Lot
L	Valve Chamber and Manhole	1	Lot
м	Pipelines	1	Lot
N	Ladders, Air Vent, and Steel Handle	1	Lot
0	Painting Works	178	Lot
Р	Disinfection and Chlorination	1	Sq.m.
Q	Landscaping and Grass Planting	1	Sq.m.

Section IX. Checklist of Technical and Financial Documents

Notes on the Checklist of Technical and Financial Documents

The prescribed documents in the checklist are mandatory to be submitted in the Bid, but shall be subject to the following:

- a. GPPB Resolution No. 09-2020 on the efficient procurement measures during a State of Calamity or other similar issuances that shall allow the use of alternate documents in lieu of the mandated requirements; or
- b. Any subsequent GPPB issuances adjusting the documentary requirements after the effectivity of the adoption of the PBDs.

The BAC shall be checking the submitted documents of each Bidder against this checklist to ascertain if they are all present, using a non-discretionary "pass/fail" criterion pursuant to Section 30 of the 2016 revised IRR of RA No. 9184.

Checklist of Technical and Financial Documents

I. TECHNICAL COMPONENT ENVELOPE

Class "A" Documents

Legal Documents

□ (a) Valid PhilGEPS Registration Certificate (Platinum Membership) (all pages) in accordance with Section 8.5.2 of the IRR;

Technical Documents

- □ (b) Statement of the prospective bidder of all its ongoing government and private contracts, including contracts awarded but not yet started, if any, whether similar or not similar in nature and complexity to the contract to be bid; and
- □ (c) Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid, except under conditions provided under the rules; and
- □ (d) Special PCAB License in case of Joint Ventures <u>and</u> registration for the type and cost of the contract to be bid; <u>and</u>
- □ (e) Original copy of Bid Security. If in the form of a Surety Bond, submit also a certification issued by the Insurance Commission <u>or</u> original copy of Notarized Bid Securing Declaration; <u>and</u>
 - (f) Project Requirements, which shall include the following:

- a. Organizational chart for the contract to be bid;
 - b. List of contractor's key personnel (*e.g.*, Project Engineer, Project Engineers, Materials Engineers, and Foremen), to be assigned to the contract to be bid, with their complete qualification and experience data;
 - c. List of contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of PolWDship or certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be; <u>and</u>
- □ (g) Original duly signed Omnibus Sworn Statement (OSS) <u>and</u> if applicable, Original Notarized Secretary's Certificate in case of a corporation, partnership, or cooperative; or Original Special Power of Attorney of all members of the joint venture giving full power and authority to its officer to sign the OSS and do acts to represent the Bidder.

Financial Documents

□ (h) The prospective bidder's computation of Net Financial Contracting Capacity (NFCC).

Class "B" Documents

□ (i) If applicable, duly signed joint venture agreement (JVA) in accordance with RA No. 4566 and its IRR in case the joint venture is already in existence <u>or</u> duly notarized statements from all the potential joint venture partners stating that they will enter into and abide by the provisions of the JVA in the instance that the bid is successful.

II. FINANCIAL COMPONENT ENVELOPE

(j) Original of duly signed and accomplished Financial Bid Form; and

Other documentary requirements under RA No. 9184

- \Box (k) Original of duly signed Bid Prices in the Bill of Quantities; and
- □ (1) Duly accomplished Detailed Estimates Form, including a summary shee indicating the unit prices of construction materials, labor rates, and equipmen rentals used in coming up with the Bid; <u>and</u>
- \Box (m) Cash Flow by Quarter.

