Republic of the Philippines
DEPARTMENT OF AGRICULTURE
NATIONAL IRRIGATION ADMINISTRATION
REGIONAL OFFICE NO. VII (CENTRAL VISAYAS)

TANJAY-BAIS RIVER IP, PACKAGE 2
(Construction of Canal Structures at Main Canal), TANJAY CITY, NEGROS ORIENTAL

NOSO-LMC-TANJAY-BAIS-02-2024

06 March 2024

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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

Republic of the Philippines
DEPARTMENT OF AGRICULTURE
NATIONAL IRRIGATION ADMINISTRATION
REGIONAL OFFICE NO. VII (CENTRAL VISAYAS)

Invitation to Bid

FOR TANJAY-BAIS RIVER IP, PACKAGE 2 (CONSTRUCTION OF CANAL STRUCTURES AT MAIN CANAL), NEGROS ORIENTAL

1. National Irrigation Administration – Regional Office VII (NIA-RO VII), through the General Appropriation Act – LINE Project for Fiscal Year 2024 (GAA-LINE FY 2024) intends to apply the sum of **Forty-Six Million Seven Hundred Fifty-Seven Thousand Five Hundred Sixty-Two Pesos and 00/100 (₱ 46,757,562.00) only** being the Approved Budget for the Contract (ABC) to payment under contract for **TANJAY-BAIS RIVER IP, PACKAGE 2 (CONSTRUCTION OF CANAL STRUCTURES AT MAIN CANAL), TANJAY CITY, NEGROS ORIENTAL** with Contract No. **NOSO-LMC-TANJAY-BAIS-02-2024.** Bids received in excess of the ABC shall be automatically rejected at bid opening.

2. The NIA-RO7 now invites bid for the above Procurement Project. Completion of the Work is required **Three Hundred Sixty (360) calendar days**. Bidders should have completed a contract similar to the project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II. Instruction to Bidders.

3. Bidding will be conducted through open competitive bidding procedures using non-discretionary "pass/fail" criterion as specified in the 2016 revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184.

4. Interested Bidders may obtain further information from the NIA-RO7 and inspect Bidding Documents at the address given below from 8:00 A.M. to 5:00 P.M. except during declared (special & regular) holidays and weekends.

5. A complete set of Bidding Documents may be acquired by interested Bidders who were able to log-in in the Philippine Government Electronic Procurement System (PhilGEPS) wherein the name of the company will be reflected in the Documents Request List of the Bid Notice Abstract of the Procuring Entity, from **March 06, 2024, 8:00 A.M. to April 04, 2024, 2:15 P.M.** during office hour from the given address and website(s) below and upon presentation of the payment from NIA - Negros Oriental Satellite Office Cashier of nonrefundable fee of **Twenty-five Thousand pesos (₱ 25,000.00) only** its proof of payment for the fees in person, by facsimile, or through electronic means.

   Interested Bidders' representatives must also present a letter duly signed by the General Manager/Owner, if Sole Proprietorship, or authorized Signatory if Corporation, authorizing him/her to acquire the Bidding Documents.

6. The NIA-RO7 will hold a Pre-Bid Conference on **March 14, 2024, 2:15 P.M.** at the **Conference Room, NIA Negros Oriental Satellite Office, Osmeña St., Poblacion, Sibulan, Negros Oriental,** and/or through videoconferencing/webcasting via Google Meet, which shall be open to prospective bidders.

7. Bids must be duly received by the BAC Secretariat through manual submission at the **Conference Room, NIA Negros Oriental Satellite Office, Osmeña St., Poblacion, Sibulan, Negros Oriental** on or before **April 04, 2024, 2:15 P.M.** 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 15.

9. Bid opening shall be on **April 04, 2024, 2:15 P.M. at Conference Room, NIA Negros Oriental Satellite Office, Osmeña St., Poblacion, Sibulan, Negros Oriental** and/or through videoconferencing/webcasting via Google Meet. Bids will be opened in the presence of the bidders' representatives who choose to attend the activity.

10. The NIA-RO VII reserves the right to reject any and all bids, declare a failure of bidding, or not award the contract at any time prior to contract award in accordance with sections 35.6 and 41 of the 2016 revised Implementing Rules and Regulations (IRR) of RA No. 9184, without thereby incurring any liability to the affected bidder or bidders.

11. For further information, please refer to:
    NIA-Negros Oriental Satellite Office
    C/O The BAC Secretariat
    Osmeña St., Poblacion, Sibulan
    Negros Oriental
    Telephone No. (035) 419-9590
    Email Address: nianegrosoriental@gmail.com

12. You may visit the websites (region7.nia.gov.ph and PhilGEPS) for downloading of Bidding of Documents.

March 06, 2024

Sgd. **ENGR. ORENCIO M. APALE**
BAC Chairperson

Section II. Instructions to Bidders

1. Scope of Bid

The Procuring Entity, *National Irrigation Administration - Regional Office 7 (NIA-RO7)* invites Bids for the **TANJAY-BAIS RIVER IP, PACKAGE 2 (CONSTRUCTION OF CANAL A STRUCTURES AT MAIN CANAL), TANJAY CITY, NEGROS ORIENTAL,** with Project Identification Number **NOSO-LMC-TANJAY-BAIS-02-2024**.

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 **₱ 46,757,562.00.**

2.2. The source of funding is:

a. NGA, the General Appropriations Act or Special Appropriations.

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/webcasting} as indicated in paragraph 6 of the **IB.**

9. Clarification and Amendment of Bidding Documents

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

10. Documents Comprising the Bid: Eligibility and Technical Components

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

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

10.3. A valid 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 Manager, Project Engineers, Materials Engineers, and Foremen) assigned to the contract to be bid, with their complete qualification and experience data shall be provided. These key personnel must meet the required minimum years of experience set in the **BDS**.

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

11. Documents Comprising the Bid: Financial Component

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

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

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

12. Alternative Bids

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

13. Bid Prices

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

14. Bid and Payment Currencies

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

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

a. Philippine Pesos.

15. Bid Security

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

15.2. The Bid and bid security shall be valid for a period of 120 calendar 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**.

Section III. Bid Data Sheet

Bid Data Sheet

<table>
<tr><td>ITB Clause</td><td></td></tr>
<tr><td>5.2</td><td>For this purpose, contracts similar to the Project refer to contracts which have the same major categories of work, which shall be:
Construction of Lined Canal and appurtenent Structures</td></tr>
<tr><td>7.1</td><td>Sub-contracting is not allowed</td></tr>
<tr><td>10.3</td><td>None</td></tr>
<tr><td>10.4</td><td>The key personnel must meet the required minimum years of experience set below:
<table>
<tr><td><u>Key Personnel</u></td><td><u>Relevant Experience</u></td></tr>
<tr><td>1 – Project Manager</td><td>– Preferably Technical individual with at least three (3) years’ experience as Project Manager;</td></tr>
<tr><td>1 – Project Engineer</td><td>– A licensed Civil Engineer with at least two (2) years’ experience as Project Engineer in similar works;</td></tr>
<tr><td>1 – Safety/Health Officer</td><td>– With Training Certificate and with at least two (2) years’ experience as Safety Officer.</td></tr>
<tr><td>1 - Foreman</td><td>– with at least two (2) years’ experience as Foreman for Earthworks, concreting and/or other related works;</td></tr>
<tr><td>1 - Materials Engineer</td><td>- With at least two (2) years’ experience as Materials Engineer duly accredited by the DPWH provided that the limits of</td></tr>
</table>
<table>
<tr><th>Classification</th><th>Max. No. of Projects</th><th>Max. Projects/ Aggregate Cost (Php)</th></tr>
<tr><td rowspan="5">Materials Engineer I</td><td>1</td><td><500Million</td></tr>
<tr><td>2</td><td><450Million</td></tr>
<tr><td>3</td><td><400Million</td></tr>
<tr><td>4</td><td><350Million</td></tr>
<tr><td>5</td><td><300Million</td></tr>
<tr><td rowspan="5">Materials Engineer II</td><td>1</td><td>No limit</td></tr>
<tr><td>2</td><td><500Million</td></tr>
<tr><td>3</td><td><450Million</td></tr>
<tr><td>4</td><td><400Million</td></tr>
<tr><td>5</td><td><350Million</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>Provisional Materials Engineers may be assigned to a maximum of three (3) Projects simultaneously with individual project cost of Php 3 Million to Php20Million and an aggregate amount of not more than Php60Million</td></tr>
<tr><td>10.5</td><td>The minimum major equipment requirements are the following:

<table><tr><th colspan="2">Equipment</th><th>Capacity</th><th>Number of Units</th></tr><tr><td>1.</td><td>Dump Truck</td><td></td><td>1</td></tr><tr><td>2.</td><td>Cargo Truck</td><td></td><td>1</td></tr><tr><td>3.</td><td>Backhoe</td><td>1 cu.m</td><td>1</td></tr><tr><td>4.</td><td>Concrete Mixer</td><td>1 bagger</td><td>2</td></tr><tr><td>5.</td><td>Concrete Vibrator</td><td></td><td>2</td></tr><tr><td>6.</td><td>Plate Compactor</td><td></td><td>1</td></tr><tr><td>7.</td><td>Survey Instrument (set)</td><td></td><td>1</td></tr><tr><td>8.</td><td>Bar Cutter</td><td></td><td>2</td></tr><tr><td>9.</td><td>Water pump (4”Ø)</td><td></td><td>2</td></tr></table></td></tr>
<tr><td>12</td><td>None</td></tr>
<tr><td>15.1</td><td>The bid security shall be in the form of a Bid Securing Declaration or any of the following forms and amounts:
a. The amount of not less than two percent (2%) of ABC, if bid security is in cash, cashier’s/manager’s check, bank draft/guarantee or irrevocable letter of credit;

b. The amount of not less than five percent (5%) of ABC if bid security is in Surety Bond.</td></tr>
<tr><td>19.2</td><td>Partial bids are not allowed.</td></tr>
<tr><td>20</td><td>None</td></tr>
<tr><td>21</td><td>Additional contract documents relevant to the Project that may be required by existing laws and/or the Procuring Entity, such as construction schedule and S-curve, manpower schedule, construction methods, equipment utilization schedule, construction safety and health program approved by the DOLE, and other acceptable tools of project scheduling.</td></tr>
</table>

Section IV. General Conditions of Contract

1. Scope of Contract

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

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

2. Sectional Completion of Works

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

3. Possession of Site

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

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

4. The Contractor's Obligations

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

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

5. Performance Security

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

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

6. Site Investigation Reports

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

7. Warranty

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

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

8. Liability of the Contractor

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

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

9. Termination for Other Causes

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

10. Dayworks

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

11. Program of Work

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

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

12. Instructions, Inspections and Audits

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

13. Advance Payment

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

14. Progress Payments

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

15. Operating and Maintenance Manuals

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

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

Section V. Special Conditions of Contract

Special Conditions of Contract

GCC Clause	
2	Mobilization of Equipment - within 7 calendar days after receipt of Notice to Proceed
4.1	As per construction program submitted
6	The site investigation reports are: none
7.2	*[In case of semi-permanent structures, such as buildings of types 1, 2, and 3 as classified under the National Building Code of the Philippines, concrete/asphalt roads, concrete river control, drainage, irrigation lined canals, river landing, deep wells, rock causeway, pedestrian overpass, and other similar semi-permanent structures:]* Five (5) years.
10	a. 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 7 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 none.
13	The amount of the advance payment is 15% of the Contract Price and to be recouped every progress billing, to be made as per herein schedule: a. First (1st) Installment – 7.5% of the Contract Price – upon submission to and acceptance by NIA of an Irrevocable Standby Letter of Credit of equivalent value issued by a commercial bank, a bank guarantee or surety bond, callable upon demand, issued by a surety or insurance company duly accredited by the Insurance Commission and confirmed by NIA. b. Second (2nd) Installment – 7.5% of the Contract Price – upon submission to and acceptance by NIA of an Irrevocable Standby Letter of Credit of equivalent value issued by a commercial bank, a bank guarantee or surety bond, callable upon demand, issued by a surety or insurance company duly accredited by the Insurance Commission and confirmed by NIA (if amount is not included in the first Installment), and after Contractor has fully mobilized the minimum equipment requirement and Key Personnel indicated in its Manpower Utilization Schedule..
14	*[If allowed by the Procuring Entity, state:]* 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 operating and maintenance manuals are required is *(None)* The date by which "as built" drawings are required is upon submission Final Billing.
15.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is not required.

Section VI. Specifications

TEMPORARY WORKS, CONSTRUCTION PLANT, MOBILIZATION OF CONSTRUCTION EQUIPMENT AND DEMOBILIZATION WORK

SCOPE

(a) **Temporary Works**

The Contractor shall furnish all materials, labor, equipment, tools and install such temporary works as are necessary for the successful completion of the Contract Work. The Contractor shall negotiate the site for his construction camp, office and work areas.

These temporary works and construction plant shall include but will not be limited to the following:

1) Construction camp for housing, feeding and accommodating of all the Contractor's employees. The Contractor shall also, within close proximity of his camp, provide an office and sleeping quarter for NIA employees, complete with facilities (specified in item 2 below) and shall have a minimum floor area of 80 square meters.

2) Facilities such as potable water, drainage, lighting, sewage, disposal, sanitation, first aid and fire protection facilities.

3) Workshops, warehouses, site offices, stockpile areas, storage areas for materials, equipment, spare parts, fuel and oil.

4) All other temporary facilities not specifically listed but nevertheless required for the proper functioning of the camp set-up and construction activities.

Temporary works shall conform to all government standards and codes and shall meet the sanitary requirements of the Department of Health.

Contractor shall submit to the Deputy Administrator for Engineering and Operations for approval layout drawings, program of erection and specifications for the Temporary Works within 30 calendar days following the date of receipt of the Notice to Proceed. No construction or erection of Temporary Works shall be started without the approved layout drawings, program of erections & specifications.

(b) **Mobilization of Equipment**

The Contractor shall mobilize and move into the Project Temp. Works, Const. Plant, Mob. of Const. Equip. and Demobilization Work Site within 20 calendar days after receipt of Notice to Proceed the required initial equipment requirement as listed in Section V-A, Local Conditions and Supplemental Information, of the Bid Documents.

Notwithstanding the mobilization of the initial equipment requirements, the Contractor shall mobilize to the Site the additional equipment requirement within 20 calendar days upon receipt of the approved Equipment Moving-in and Utilization Schedule.

If for the reasons or causes other than "major calamities", the Contractor fails to mobilize fully the initial equipment required within said period, and all other equipment listed in his approved Equipment Moving-in and Utilization Schedule, at the discretion of the Administrator, he may be given an extension of time to mobilize them fully but in no case shall it exceed 30 calendar days. Failure to fully mobilize the required construction equipment within said period will be a ground for contract rescission. During said extension period liquidated damages equivalent to the daily operated ACEL rental rate of eight hours of the undelivered equipment per day of delay shall be imposed and collectible from any subsequent payment due the Contractor. If delays are caused by "major calamities', the corresponding number of calendar days caused by such calamities will not be counted. Delays shall be reckoned starting at 12:00 o'clock noon of the succeeding day after the date scheduled for the mobilization of the programmed equipment. The Engineer shall certify to the date of actual mobilization of the programmed equipment to the site.

The Engineer shall check and verify the number, type and actual condition of the equipment moved into the Project Site. The NIA reserves the right to order the removal of such equipment that are not in good working condition from the Project Site at the Contractor's expense and said equipment are not to be counted for as mobilized.

Construction equipment once moved into the Project Site, checked and accounted for by the Engineer shall not be permitted, prior to the completion of the Contract Work, to be moved out or transferred by the Contractor to another Project Site without the written approval of the Engineer.

Periodic check-up of the Contractor's equipment moved-in for the Contract Work shall be conducted by NIA. The Contractor will pay to NIA the amount equivalent to the ACEL Rental Rate of any equipment not accounted for during said check-up for the number of calendar days the equipment have been removed (without the written consent of the Engineer) from the Project Site until said equipment have been returned. Such cases are grounds for disapproval of claims by the Contractor for time extensions.

(c) **Demobilization**

Demobilization shall include dismantling and removal from the site of Contractor's Construction Plant, materials and equipment and all Temporary Facilities with the exception of some facilities which NIA shall consider to remain and which shall be handed over to NIA at the time of demobilization in a fully operational condition. Demobilization shall also include cleanup of the site after completion of the Contract Work as approved and accepted by NIA and transportation of Contractor's employees from the site.

BASIS OF PAYMENT

Payment for furnishing of all materials, equipment and labor for the temporary works, mobilization of construction equipment including demobilization work, shall be made at the fixed lump sum price or lump sum bid price whichever is stated in the Bill of Quantities which shall not be subject to price escalation and adjustment, in accordance with the following:

1. Twenty percent (20%) of the lump sum price will be paid upon complete mobilization of the initial equipment requirement and submission of certificate of joint inspection conducted by Central Office and Field Office personnel.

2. Ten percent (10%) of the lump sum price will be paid upon submittal and approval by the NIA of the Contractor's plan for the temporary works including list of equipment requirement based on his work schedule as approved by NIA.

3. Twenty percent (20%) of the lump sum price will be paid upon completion of the Contractor's temporary Works.

4. Thirty percent (30%) of the lump sum price will be paid upon completion of moving-in of all the construction equipment approved under Equipment Moving-in and Utilization Schedule, duly certified by the Engineer, Project Auditor or their duly authorized representatives. Partial payment of this 30% may be given on a pro-rata basis after fifty percent (50%) of the approved equipment has been moved-in to the Project Site.

   For purposes of computing the percentage of equipment moved-in, corresponding number of points for each equipment listed in the Equipment Moving-In Utilization Schedule shall be provided by NIA to serve as the basis for any partial payment

Description of Equipment	No. of Points
Crane	10
D-8 or equivalent	10
Concrete Batching Plant	10
D-7 or equivalent	9
Motorized Scraper	9
D-6 or equivalent	8
Aggregate Processing Plant	8
Towed Scraper	7

Road Grader	6
Backhoe	6
Front End Loader	5
Self-Propelled Roller	5
Road Roller	5
Concrete Mixer, 3-4 bagger	4
10"∅ Pump	4
8"∅ Pump	3
Welding Equipment	2
Lathe Machine	2
Transit Mixer	2
Concrete Mixer, 2 bagger	2
Generator, 10KV	2
Compressors and Jack Hammers	2
Pile Driving Equipment	2
Farm Tractor	2
Water Truck	1
Sheepsfoot Roller	1
Generator, 5KV	1
Concrete Mixer, 1 bagger	1
4" ∅ Pump	1
3" ∅ Pump	1
Dump/Stake Truck	1
Aggregate Scale	1
6"∅ Pump	2

5. The remaining twenty percent (20%) of the lump sum price will be paid to the Contractor upon final acceptance of the Contract Work.

CLEARING AND GRUBBING

SCOPE

The work under this Section shall include clearing, grubbing and disposal, in a manner approved by the Engineer of all vegetation such as trees, stumps, roots, brush; rubbish and all objectionable matters within the entire right-of-way for canals, farm ditches, drainage ditches, diversion work and over borrow areas, road surfacing materials sources, stockpile areas and elsewhere mutually agreed upon by the Engineer and the Contractor all in accordance with the Drawings and these Specifications

METHOD OF CONSTRUCTIONS

(a) **Clearing on Lightly Vegetated Areas**

The areas over which diversion works shall be constructed, the entire right-of-way for canals, farm ditches and drainage ditches, side borrow areas, borrow haul areas, aggregate sources and stockpile areas shall be cleared of all vegetation, trees and all other matters, except such trees or shrubs which the Engineer may order to be preserved. All trees and shrubs ordered to be preserved including all existing adjacent facilities, properties and utilities, if any, shall be protected from injury or damage resulting from the Contractor's operations. All combustible materials from clearing operations shall be burned thoroughly or removed from the site of work or otherwise disposed to designated areas as directed by the Engineer.

All materials to be burned shall be piled neatly and when in a suitable condition shall be burned thoroughly. Piling for burning shall be done in such a manner and in such locations as to cause the least fire risk. The Contractor shall at all times take special precautions to prevent fire from spreading and shall have available at all times suitable equipment and supplies for use in preventing and fighting fires. In this connection, the Contractor shall be liable for all costs and damages resulting from such incidents.

No clearing shall be done on any areas where there are standing crops until such crops have been harvested or unless the Contractor shall have secured written permission from NIA.

(b) **Clearing on Swampy Areas and/or Second Growth Forested Areas**

Clearing on swampy areas and/or second growth forested areas where canals are passing thru shall only be started when said areas are suitably dry or when directed by the Engineer. Clearing includes felling and bucking of trees using chain saws and cutting of tree branches extending over the entire right-of-way. Felled trees shall be cut into the longest usable lengths and shall be hauled and neatly stocked at designated stockpile areas. Small trees and stumps, branches, grass and litters shall be burned in accordance with the preceding paragraph (a).

(c) **Grubbing**

Grubbing shall consist of the removal of all trees, stumps, roots, brush and rubbish from the above mentioned work areas. No roots shall be left within 50 cm. from the ground surface. It shall include necessary stripping of the natural ground surface to a depth not more than 10 centimeters by effective means to remove all objectionable materials or organic matters from the said work areas, except for dam site where stripping shall be in accordance with sub-section 403(b) of Section IV of these Technical Specifications. Stripping beyond the limit of 10 centimeters shall be subject to the approval of the Engineer and payment thereof shall be considered included under Section IV, Canal Excavation.

If required by the Engineer, stripped top soil shall be temporarily stored at the edges of the right-of-way for subsequent use on slopes to encourage vegetative growth and minimize erosion.

METHOD OF MEASUREMENT

The area to be measured for payment shall be within the limit of the entire right-of-way as shown on the Drawings or as staked by the Engineer during Construction Operations.

All clearing and grubbing operations for side borrow areas, borrow haul areas, aggregate sources, stockpile areas and elsewhere are considered subsidiary works required for other pay items in the Bill of Quantities and will not be measured for payment under this Section. The costs of such works shall be considered included in the contract unit price for the various items in the Bill of Quantities where clearing and grubbing are required.

BASIS OF PAYMENT

The cleared and grubbed areas measured as provided above shall be paid at the contract unit price per square meter in the Bill of Quantities which price and payment shall constitute full compensation for furnishing all labor, tools, equipment, supplies and all incidentals or subsidiary works (including stripping within the 10 centimeters limit) necessary for the successful completion of the work. No payment shall be made on cleared and grubbed areas where no excavation or embankment construction have been undertaken.

STRUCTURE EXCAVATION

SCOPE

Structure Excavation includes the removal of all materials within the structure lines including necessary dewatering operations not otherwise specified. It shall also include additional excavations within the vicinity of the structure in order to shape the ground as shown on the Drawings or as directed by the Engineer.

CLASSIFICATION

Structure excavation shall be classified in accordance with paragraph 402.

CONSTRUCTION REQUIREMENTS

All excavation requirements described in paragraph 403 are applicable under this Section.

METHOD OF CONSTRUCTION

All structures, where practicable shall be constructed in open excavation. The method of construction or excavations shall be in accordance with the applicable provisions of paragraph 404 and the following requirements.

Foundations shall be excavated according to the outline of the footings and floors of structure as shown on the Drawings or as directed by the Engineer, and shall be of sufficient size to permit free movement of workers.

On excavation of common materials the foundation bed upon which structures are to be placed shall be finished accurately to the established lines and grades after a thorough compaction and trimming of the foundation with the use of suitable tools and equipment. As soon as the foundation excavations have been trimmed to their final level, it should be protected from degradation by weathering. Should the foundation material soften through exposure then the soft material shall be removed and replaced at the Contractor's expense. If at any point, material is excavated beyond the lines and grades of any part of the structure, the over-excavation shall be filled with selected materials approved by the Engineer and shall be placed in layers of not more than 20 centimeters thick, moistened and thoroughly compacted by special roller, mechanical tampers or by other approved methods. A density not less than 90% of the maximum dry density determined by ASTM test D-698 is required. The cost of filling over-excavation ordered by the Engineer shall be borne by the Contractor.

On excavation of rock materials, the bottom and side surfaces of excavated rock excavation upon or against which concrete and weep holes are to be placed shall conform to the required grades and dimensions as shown on the drawings or as established by the Engineer. If at any point, materials are excavated beyond the required limits, the over-excavation shall be filled with concrete at the expense of the Contractor including the cost of all materials required.

When concrete is to be placed upon or against rock, the excavation shall be of sufficient depth to provide for the minimum thickness of concrete at all points and any deviation from the required minimum thickness of concrete shall be avoided as much as possible. The surface on which concrete will be laid shall be trimmed and thoroughly cleaned as directed by the Engineer.

When excavation of rock materials reaches the surface upon or against which concrete is to be placed, blasting shall be stopped and the remaining mass of rock shall be carefully removed by means of jack-hammer or any appropriate hand tool. The point beyond which blasting will not be allowed shall be determined by the Engineer. All damages to the rock foundation caused by improper blasting operation shall be repaired by the Contractor at his own expense in a manner acceptable to the Engineer.

All foundations for bridge pier footings shall be excavated to such depths as may be necessary to secure stable bearing for the structure. Whenever the safe bearing power of the soil as uncovered is less than that called for on the Drawings, pilings or appropriate spread footings will be used. The elevations of the bottoms of footings, as shown in the Drawings shall be considered as approximate, and the Engineer may order, in writing, such changes in elevations and dimensions of footings as may be necessary to ensure a satisfactory foundation. Bearing tests, upon written order of the Engineer, shall be taken to determine the supporting power of the soil. Cost of bearing test will be paid as "Extra Work".

If, in the opinion of the Engineer, the material at the base of the excavation is unsuitable for foundation he shall instruct the Contractor to either a) Carry out additional excavation to a depth of 50 cm. below the proposed bottom of concrete shown on the Drawings and to maximum depth of 60 cm. outside of the outermost lines of said base and replace with backfill compacted to at least 90% of the maximum dry density or b) strengthen the soft material by ramming in gravel and cobbles until a firm foundation is obtained. Measurement and payment for the backfill shall be made under Section XII, "Structure Backfill".

METHOD OF MEASUREMENT

Structure Excavation shall be measured by the cubic meter in its original position before being excavated in accordance with the Drawings, or as may be ordered by the Engineer. No excavation beyond the paylines shown on the Drawings will be measured for payment. For canal structures, the limit of measurement along the lines perpendicular to the flow of water shall be the vertical planes at the outer edges of the inlet cut-off walls. The upper limits of the solid measured for payment shall be the canal bottom for canal structures or the original ground surface in case of diversion

structures. The lower limit shall be the bottom of the required excavation. Excavated materials not vertically above the boundaries as specified above shall not be measured for payment. The volume measured shall not include water and other liquids removable by pumping. Such materials as mud, muck, quagmire and other similar semi-solids not removable by ordinary pumping shall be considered pay quantities and shall be measured and paid for as "Structure Excavation".

However, in case structure excavation for canal structures is done before canal excavation, the upper limit of the solid measured for payment shall be the original ground surface in accordance with the structure excavation paylines.

BASIS OF PAYMENT

The volume measured as provided above will be paid per cubic meter, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, equipment, tools and incidentals and subsidiary works necessary to complete the work described under this Section.

For diversion works, canal siphons and bridge structure excavations, the cost of dewatering operation unless otherwise specified in the Bill of Quantities shall be paid under a separate item in the Bill of Quantities. For all other structure excavations, dewatering operations involved are considered subsidiary works and the cost thereof shall be considered included in the unit price of structure excavation.

The Contractor shall be paid sixty percent (60%) of the pay quantities of the actual excavation acceptably accomplished in accordance with the paylines as shown on the Drawings or as directed by the Engineer. The remaining forty percent (40%) will be paid upon pouring of concrete for the foundation or upon placing of riprap, gravel blanket or grouted riprap in accordance with the Drawings and Specifications.

CONCRETE

SCOPE

This Section covers all the materials as cement, aggregates, water, admixtures and proportioning, mixing, transporting, placing, finishing, curing and protecting of concrete, including supplies, equipment, tools and all other incidentals necessary for concrete works.

All the applicable provisions of the latest revision of the ACI Building Code (ACI-318-63) and American Society for Testing Materials (ASTM) shall govern in all cases not specifically provided for herein.

CONCRETE COMPOSITION

Concrete shall be composed of portland cement, fine and coarse aggregates, water, and if necessary, admixtures or agents approved by NIA. The design of concrete mixtures and consistency shall be as specified in this Section.

CEMENT

a) **General**. The cement shall conform to the requirements of the standard specifications for Portland Cement (ASTM: C-150 Type 1). Special Cement may be used subject to the approval of the Engineer provided it meets the requirements of Portland Cement with regards to strength, soundness and setting time.

b) **Storage**. Contractor shall, immediately upon delivery of cement to the jobsite, store the same in a dry, weathertight and properly ventilated structure with adequate provisions for the prevention of absorption of moisture. All storage facilities shall be subject to the approval of the Engineer and shall be such as to permit easy access for the inspection and identification. In order that cement may not become unduly aged after delivery, the Contractor shall use any cement of the same type, which has been stored at the site for 60 days or more before using cement of lesser storage age. Any cement stored at the project site over four months shall not be used unless retest proves it to be satisfactory. Sacked cement shall not be stocked

higher than 14 sacks for storage for a period of not longer than 30 days and not higher than seven sacks for longer period.

c) **Payment**. Payment for cement shall be considered included in the contract unit price for the various items of concrete in the Bill of Quantities for which cement is used.

ADMIXTURES

In order to reduce the cement content and/or the amount of mixing water, and to improve the concrete workability, the Contractor may be allowed to use Admixtures and as such he shall submit to NIA for approval such Admixture he proposes to use. The Contractor shall be required to submit manufacturer's brochures and data sheets for review together with detailed proposals on how the admixtures will be used in the works. This information should be supported with mix designs and the results of trial mixes. All admixtures shall be used strictly in accordance with the manufacturer's recommendations. However no additional payment will be made by NIA to the Contractor in view of this as the cost thereof is considered included in the contract unit price for the different classes of concrete.

The following type of admixtures will be given consideration by the NIA provided that they conform to the provisions of this Paragraph:

1. Air entraining agent
2. Water reducing admixtures
3. Water reducing and retarding admixtures
4. Water reducing and accelerating admixtures

Admixtures shall be furnished in a powder or liquid form. If furnished in a solution it shall contain at least 50% solids and a mold inhibitor. The admixtures effect on the properties of Portland cement concrete mixtures shall meet the requirements of ASTM: C-494.

Admixtures will be accepted on manufacturer's certification of conformance with the specifications but permission to slip on certification shall in no way relieve the Contractor of responsibility for furnishing an admixture not meeting specification requirements. Where the Engineer has reason to believe that testing is necessary to prove compliance with the requirements of these specifications, it may order these admixtures to be sampled and tested anytime. The Contractor shall provide facilities satisfactory to the Engineer for readily procuring samples for test.

Air Entraining Agent. Concrete produced with water reducing agents shall contain four to six per cent of air entraining agent by volume. The air entraining agent shall conform to the requirements of ASTM: C 260, and shall be tested in accordance with ASTM: C 233. The total calculated air content of the concrete as discharged from the mixer shall be as follows:

Coarse Aggregates Maximum Size	Total Air - Per cent by Volume of Concrete
2 cm.	5 + 1
3.8 cm.	4 + 1

The agent in solution shall be maintained at uniform strength and shall be added to the batch in a portion of the mixing water. This solution shall be batched by means of a mechanical batcher capable of accurate measurement. When a retarder dispersing agent is used in the concrete, the portion of the mixing water containing the air-entraining agent shall be introduced separately into the mixer.

Water Reducing Agent or Water Reducing and Set Retarding Agent. The Contractor may be allowed to use an approved water reducing agent, or water-reducing and set retarding agent in concrete. The ASTM designations for these admixtures are Type A and Type D, respectively. The agent used shall be either suitable calcium, sodium or ammonium salts of lignosulfonic acids or of the nonlignin, hydroxylated carboxylic and acid groups. The agent shall be of uniform consistency and quality within each container and from shipment to shipment.

The amount of water reducing, or water reducing and set retarding agent to be used in each concrete mix shall in general be within the following limits:

Lignosulfonic Acid Type	-	0.27 to 0.37 percent of solid rystalline ligning, by weight, of cement.
Hydroxylated Carboxylic Acid Type	-	0.25 to 0.50 percent of liquid, by weight of cement.

Water Reducing and Accelerating Admixture. The ASTM designation for this admixture is Type E. Water reducing and accelerating admixture may be used by the Contractor for speeding up pre-casting and post-tensioning operations for precast and pre-stressed beams, girders, slabs and bearing pads, if approved.

WATER

The water used in concrete, mortar and grout shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities. The recommendation of the seventh edition of the U.S. Bureau of Reclamation Concrete Manual for mixing water shall be followed.

FINE AGGREGATES

a) General. The term "Fine Aggregates" is used to designate aggregates in which the maximum size of particles is 5 millimeters. Fine aggregates for concrete, mortar and grout shall be provided by the Contractor and shall consist of natural sand, manufactured sand, or a combination of both. The different components shall be batched separately, or subject to the written approval of the Engineer, or blended prior to delivery to the batching plant.

As a means of providing moisture control, the Contractor may be required to stockpile the fine aggregates over porous storage to drain excessive water and to stabilize moisture content.

b) Quality. Fine aggregates shall conform to the requirements of ASTM C-33 and shall consist of hard, tough, durable, uncoated rock particles. The Contractor shall exercise every possible precaution in transporting, washing and screening operations to prevent contamination of sand particles. Fine aggregates shall conform to the following requirements:

1. **Grading** -It is assumed that the sand available in natural deposits will require processing to provide a suitable gradation. Regardless of the source, the fine aggregates shall be well graded from fine to coarse and the gradation as delivered to the mixers shall conform to the following requirements unless otherwise approved:

Sieve Designation	Percent by Weight
US Standard Square	Passing Individual
. Mesh .	. Sizes .
3/8" (9.50mm)	100
No. 4 (4.75mm)	95-100
No. 8 (2.36mm)	85- 95
No. 16 (1.18mm)	60- 85
No. 30 (600um)	25- 60
No. 50 (300um)	10- 30
No. 100 (150um)	2- 10

In addition to the grading limits shown above, the fine aggregates as delivered to the mixer shall have the fineness modulus of not less than 2.30 or more than 3.00. The grading of the fine aggregates also shall be controlled so that the fineness moduli of at least 9 to 10 test samples of the fine aggregates as delivered to the mixer shall not vary more than 0.10 from the average fineness modulus of all samples previously taken. The fineness modulus shall be determined by dividing by 100, the sum of the cumulative percentages retained on US standard sieves No. 4, 8, 16, 30, 50 and 100. At the option of the Contractor fine aggregates may be separated into two or more sizes or classifications, but the resulting sand when combined before entering the concrete mixer shall be of uniform grading within the limits specified above.

2. **Particle Shape**. The shape of the particles shall be generally spherical or cubical and reasonably free from flat or elongated particles. A flat or elongated particle is defined as a particle having a maximum dimension in excess

of five times the minimum dimension. Rocks which breaks down into such shape, regardless of the type of processing equipment used, will not be approved for use in the production of fine aggregates.

3. **Deleterious Substances**.the maximum percentages of deleterious substances in the fine aggregates as delivered to the mixer shall not exceed the following values:

Percent by

	. Weight.
Materials passing no. 200 Screen (Designation 16)*	3
Shale (Designation 17)	1
Clay (designation 13)	1
Total of other deleterious substances (Such as alkali, mica, and soft, flaky Particles and loam)	2

* The designation in parenthesis refers to methods of testing described in the seventh (7th) edition of the US Bureau of Reclamation Concrete Manual and ASTM.

The sum of the percentages of all deleterious substances shall not exceed 5% by weight. Fine aggregates producing a color darker than the standard in the colometric test for organic impurity (USBR designation 14 or ASTM C-40) may be rejected. Fine aggregate having specific gravity (USBR Designation 9 or ASTM C-128, saturated surface dry basis) of less than 2.60 may be rejected. The fine aggregate may be rejected if the portion retained on No. 50 (300 um) screen, when subjected to five cycles of sodium sulphate test for soundness (USBR designation 19 or ASTM C-88) shows an average loss of more than 18% by weight. Fine aggregates delivered to the batching plant may be rejected if it contains more than 0.10% soluble sulphate for any one sample or more than 0.10 for an average of at least 9 out of 10 consecutive test samples of finished sand, when samples are taken hourly. The percent soluble sulphate in fine aggregates shall be determined in accordance with the method of test prescribed in subparagraph 4.below.

4. **Sampling** - Sampling of fine and coarse aggregates shall be done in accordance with paragraph 1509. The source from which fine and coarse aggregates is to be obtained shall be selected well in advance of the time when the materials will be required in the work. Unless otherwise specified, all test samples shall be taken under the supervision of the Engineer in sufficient time as approved to permit adequate testing and examination of results sufficiently in advance of the time for use in concrete. Routine control test and analysis of the fine and coarse aggregates at various stages in the processing operation shall be made. The approval of a source shall not be construed as containing approval of all materials from the source, and the Contractor will be held responsible for the specified quality of all such materials used in the work.

(c) Storage - Fine aggregates shall be stored in such a manner as to avoid the inclusion of any foreign materials in the concrete. The storage or stockpile shall be constructed so as to prevent segregation. Depositing of materials in storage and its removal therefrom shall be done in such a manner as to result in increasing the uniformity of the grading insofar as this is practicable. All fine aggregates shall remain in free drainage storage for at least seventy-two (72) hours prior to use. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete.

(d) Measurement and Payment - Fine aggregates will not be measured for payment. The cost of excavation, stockpiling, transporting, processing, blending, handling and other costs for providing fine aggregates shall be considered included in the unit price bid for the various items in the Bill of Quantities for which fine aggregates are used.

COARSE AGGREGATES

(a) General - The term "Coarse Aggregate" is used to designate aggregates of such sizes as to fall within the range of 0.5 cm. to 7.5 cm or any size or range of sizes within such limits. The coarse aggregates shall be reasonably well graded within the nominal size ranges hereinafter specified. Coarse aggregate for concrete shall be furnished by the Contractor and shall consists of crushed rock or mixture of natural gravel and crushed rock as provided in paragraph 1508. Coarse aggregate, as delivered to the batching plant shall have a uniform and stable moisture content. Any rewashing found necessary to provide clean aggregates shall be done prior to finish screening. Rewashing shall not be performed in finish screen.

(b) Quality - Coarse aggregates shall conform to the requirement of ASTM C-33 and shall consist of hard, dense, uncoated durable rock fragments.

1. **Grading** - The coarse aggregates shall be well graded from fine to coarse. It shall be separated into the following specific size groups. The grading of the aggregates within the separated size groups as delivered to the mixer shall be as follows:

S I Z E G R O U P S

Sieve Sizes US Std. Sq. Mesh		Per Cent by Weight Passing Individual Sizes 12.5 mm	18 mm	37.5mm	50mm	75mm
6"	(150 mm)	-		-	-	-
3"	(75mm)	-		-	-	100
2-1/2"	(63 mm)	-		-	100	90-100
2"	(50 mm)	-		100	95-100	35-70
1-1/2"	(37.5mm)	-		90-100	-	0-15
1"	(25 mm)	-	100	20-55	35-7	-
3/4"	(19 mm)	100	90-100	0-15	-	0-5
1/2"	(12.5mm)	90-100	-	-	10-30	-
3/8"	(9.5 mm)	40-70	20-55	0-5	-	-
No. 4	(4.75mm)	0-15	0-10	-	0-5	

Coarse aggregates shall contain not more than 1.5 per cent of materials passing the No. 200 sieve by meshing, nor more than 5% of soft fragments.

It shall have an abrasion loss of not more than 45 per cent at 500 revolutions.

Unless otherwise directed, the maximum sizes of aggregates to be used in concrete for the various parts of the work shall be in accordance with the following:

General Use	Maximum Aggregate Diameter
Lean Concrete to control water Intrusion and other miscellaneous uses	37.5 mm
Concrete for Footings, Walls, Slabs Beams, 0.22 to 0.75 meters thick	37.5 mm
Concrete for thin walls, slabs, beams, less than 0.22 meters thick	19 mm
Concrete for reinforced concrete pipes	12.5 mm

In all cases, the diameter of the aggregate shall not exceed 1/2 the distance between the reinforcing steel bars of the members being placed.

2. **Particle Shape** - The particle shape of the crushed coarse aggregate shall be generally spherical or cubical and reasonably free from flat or elongated particles. A flat or elongated particle is defined as a particle having a maximum dimension in excess of five times the minimum dimensions. Rocks which breaks down into such shape will not be approved for the production of aggregate.

3. **Deleterious Substances** - The deleterious substances in any size of coarse aggregate, as delivered to the mixer, shall not exceed the following values:

	Per Cent

	By Weight
Material Passing No. 200 (Screen Designation 16)*	1/2
Shale (Designation 18)	1
Clay Lumps (Designation 13)	1/2
Other deleterious substances	1

* The designations in parenthesis refers to methods of Testing described in the seventh edition of the U.S. Bureau of Reclamation Concrete Manual and ASTM

The sum of the percentages of all deleterious substances in any size, as delivered to the mixer, shall not exceed 3% by weight. Coarse aggregate may be rejected if it fails to meet the following requirements:

1) **Petrographic Examination** - If more than 10% of poor aggregate particles can be identified in physical quality test and in case 20% of the particles would be classified with respect to the chemical quality (USBR Desig. 7 or ASTM C-295).

2) **Sodium-sulphate Test for soundness** (USBR Desig. 9 or ASTM C-88)- If the weighted average loss, after 5 cycles is more than 10% by weight.

3) **Specific Gravity** (USBR Desig. 10 or ASTM C-127) - If the specific gravity (saturated surface-dry basis) is less than 2.60.

4) **Sampling** - All sampling of coarse aggregates shall be in accordance with Paragraph 1509.

c) Storage - Course aggregate storage or stockpiles shall be built in such a manner as to avoid the inclusion of any foreign materials in the concrete and to prevent segregation and excessive breakage. Water sprayers shall be installed to keep that portion of the coarse aggregate stockpiles saturated which is intended for immediate use in the concrete. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete.

d) Measurement and Payment - Coarse aggregates will not be measured for payment. The cost of excavation, stockpiling, processing, blending, handling and other cost for providing coarse aggregates shall be considered included in the unit price bid for the various items in the Bill of Quantities for which coarse aggregates are used.

PRODUCTION OF FINE AND COARSE AGGREGATES

(a) **Source of Aggregates** - Fine and coarse aggregates for concrete, and fine aggregate for mortar and grout may be obtained by the Contractor from any approved source. Approval of deposit shall not be construed as constituting approval of all materials taken from the deposit, and the Contractor shall maintain the specified quality of all such materials used in concrete works. If the aggregates are to be obtained from deposits or quarry sources not previously tested and approved by NIA, Contractor shall submit, for preliminary test and approval, a representative, 90 kilograms (approximately 200 pounds) sample of the fine aggregate and of the 0.5 centimeters to 2 centimeter size of coarse aggregate and a 45 kilograms (approximately 100 pounds) sample of each of the other sizes of coarse aggregate proposed for use in the work, at least 90 days before the materials are required for use.

(b) **Developing Aggregate Deposit.** The Contractor shall carefully clear the area, from which aggregates are to be taken, of trees, roots, brush, sod, soil, unsuitable sand and gravel or aggregates, and other objectionable matter. The portion of the deposit used shall be located and operated so as not to detract from the usefulness of the deposit or of any adjacent property and so as to preserve, insofar as practicable, the future usefulness or value of the deposit. Waste materials removed from aggregate borrow areas shall be disposed of in approved locations.

(c) **Processing Raw Materials.** The Contractor shall employ processing equipment which will ensure well-shaped particle in all aggregate sizes and a minimum of particle which are flat or elongated. Processing of raw materials shall include screening, washing, and blending if necessary to produce fine and coarse aggregate meeting the requirements of Paragraphs 1506 and 1507. Processing of aggregates produced from any source shall be done at an approved site. Water used for washing aggregates shall conform to Paragraph 1505. To utilize the greatest practicable yield of suitable materials in the portion of the deposit being worked, the Contractor may crush oversize material and any excess materials of the size of coarse aggregate to be furnished, until the required quantity of each size has been

secured, provided, that the crushed aggregates shall be blended uniformly with the uncrushed aggregates. Crushing and blending operations shall at all times be subject to approval by the Engineer.

Aggregates, as delivered to the mixers, shall consist of clean, hard and uncoated particles. When required, dust shall be removed from the coarse aggregate by adequate washing.

(d) **Moisture Control.** The free moisture control of the fine aggregate and smallest size group of coarse aggregate as delivered to the mixers shall be controlled so as not to exceed the value of 6.0 and 1.5, respectively, expressed as a percentage by weight of the saturated, surface dry aggregates. The percent variation of free moisture content in fine aggregate and the smallest size of coarse aggregate shall not exceed 0.5% and 2.0%, respectively, during any one hour of mixing plant operation. The free moisture of the other sizes of coarse aggregates shall be the least amount when delivered to mixers and variations shall be the least practicable under all job conditions. Sand shall have a uniform and stable moisture content. Under no conditions shall the other sizes of coarse aggregates be delivered to the mixing plant bins dripping wet. The Contractor may accomplish the required moisture control by use of free drainage storage, mechanical dewatering devices, or any other satisfactory means of dewatering.

AGGREGATE SAMPLING AND TESTING

Sampling of the aggregate materials approved for use in the work shall be done by the contractor in accordance with ASTM Sampling Method at 10 days in advance of the time when placing of concrete is expected to begin. Aggregate studies and tests will be made by the contractor at its own expense. It shall be the responsibility of the Contractor to designate the source(s) of aggregates early enough to give NIA sufficient time to obtain the necessary samples and have them subjected to tests.

The samples of aggregates shall be obtained and tested in accordance with the following ASTM standard methods:

Sampling aggregate	- C 75
Sieve Analysis	- C 136
Amount of material finer than 200 sieve	- C 117
Organic impurities	- C 40
Mortar Strength	- C 87
Soundness	- C 88
Soft Particles	- C 235
Abrasion	- C 131
Clay lumps	- C 142

No aggregate shall be used until official advice has been received that it has satisfactorily passed all tests, at which time written authority shall be given for its use. Material from source which has been previously tested and shown satisfactory compliance with all the requirements given herein may be used without further testing upon written permission of NIA. Test reports for previous tests must be available before approval can be given.

During construction, aggregates will be sampled as delivered to the mixer to determine compliance with specification provisions. Test shall be made in accordance with the applicable ASTM Standards. Routine control test and analysis of aggregates at various stages in processing, transporting, stockpiling, redraining, and batching, if used will be made by the contractor. The Contractor shall provide such facilities as may be considered necessary for the ready procurement of representative test samples. All test will be made by the contractor under the supervision of NIA.

CLASSIFICATION AND PROPORTIONING OF CONCRETE MIXTURES

(a) **Classification and Design Mixtures**. The mixture for all classes of concrete shall be designed by the Contractor and approved by NIA to obtain the compressive strength at the age of 28 days as specified below:

Class	Minimum Strength (kg/cm2)	Maximum Aggregate Size (mm)	Minimum Cement (kg/m3)	Maximum Water/Cement Ratio
X	300	19	375	0.55
Y	210	12.5	350	0.60
AA	210	19	325	0.60
A	210	37.5	300	0.60
B	170	50	250	0.70
C	170	75	225	0.70
Z	140	75	200	0.85
Blinding (Concrete)	70	37.5	150	no limit

(b) **Aggregate Content.** - Concrete mixtures shall be designed to use the largest size and the maximum amount of coarse aggregate as practicable for the intended use of the concrete.

(c) **Consistency.** - The amount of water to be used in the concrete shall be regulated as required to secure concrete of the proper consistency and to adjust for any variation in the moisture content or grading of the aggregates as they enter the mixer.

It shall be such consistency that it will flow around reinforcing steel bar but individual particles of the coarse aggregate when isolated shall have coating of mortar containing its proportionate amount of sand. The consistency shall be gauged by the ability of the equipment to properly place it and not by the difficulty in mixing or transporting. Addition of water to compensate for stiffening of the concrete before placing will not be permitted. Uniformity in concrete consistency from batch to batch will be required.

The slump of the concrete at the time of placing shall not exceed 5 centimeters in heavy concrete sections and at top of walls, piers and parapets, 10 centimeters for pumped or air placed concrete, and 7.5 centimeters for concrete elsewhere.

The Engineer reserves the right to require a lesser slump whenever concrete of lesser slump can be consolidated readily into place by means of the vibration specified in Paragraph 1517.

(d) Notwithstanding the approval by NIA of the design mixtures and the above specified minimum cement content for different classes or gradation of aggregates, the Contractor shall be responsible that all the concrete meet the desired strength.

MEASUREMENT OF MATERIALS

All materials from which the concrete will be manufactured shall be mechanically measured by weight, except as otherwise specified and/or authorized by the Engineer and admixture solutions which may be measured by volume.

Measuring devices shall be suitably designed and constructed for the purpose and shall be weighing separately the cement, fine and coarse aggregates. The accuracy of all weighing devices shall be such that successive quantities can be measured to one per cent of the desired weights. Cement in standard bags (40 kilograms) need not be weighed. The water measuring devices shall be of such type and make to be readily controlled to obtain an accuracy of one-half per cent of the desired quantity of water.

Whenever volumetric proportioning and measurement is permitted due to failure or malfunction of weighing devices the equivalent volumetric proportions of weighed representative samples of the concrete ingredients shall be computed taking into consideration bulking effect of cement and variations of moisture content of the aggregates.

When sack or bag cement is used, the quantities of aggregates for each batch shall be for one or more full sack of cement. No batch requiring a fractional sack of cement will be tolerated.

MIXING AND DELIVERY

Ready-mixed concrete shall be mixed and delivered to the point designated by the Engineer by means of one of the following combination of operations:

- Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in a truck mixer operating at agitator speed or in nonagitating equipment when approved by the Engineer. (Known as central-mixed concrete).

- Mixed completely in a truck mixer at the batching point or while in transit. (Known as transit-mixed concrete).

- Mixed completely in a truck mixer at the point of delivery following the addition of mixing water. (Known as truck-mixed concrete).

Truck mixers and truck agitators shall be operated within a capacity not to exceed 63 or 80 percent, respectively of the gross volume of the drum and at a speed of rotation for mixing or agitating as designated by the manufacturer of the equipment. A truck mixer or truck agitator used for transporting concrete that has been completely mixed in a stationary mixer shall be operated within the limits of capacity and speed of rotation designated by the manufacturer for agitating, except that the agitator capacity shall in no event exceed 80 percent of gross drum volume.

When a stationary mixer is used for the complete mixing of the concrete, the mixing time for mixers having a capacity of 10 cubic yards (7.6 m3) or less shall be not less than 60 seconds. For mixers of more than 10 cubic yards (7.6 m3) capacity, the mixing time shall be determined by the Engineer. The time is valid provided mixer efficiency tests prove the concrete is satisfactory for uniformity and strength. Mixing time shall be measured from the time all cement and aggregates are in the drum. The batch shall be so charged into the Mixer that some water will enter in advance of cement and aggregates, and all water shall be in the drum by the end of the first one-fourth of the specified mixing time.

When a truck mixer is used for complete mixing, each batch of concrete shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment on the metal plate on the mixer as mixing speed. 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 determination of the number of revolutions of mixing.

When a truck mixer or truck agitator is used for transporting concrete that has been completely mixed in a stationary mixer, mixing during transport shall be at the speed designated by the manufacturer of the equipment as agitating speed.

When a truck mixer or truck agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be completed within 1 hour after the addition of the cement to the aggregates. Each batch of concrete delivered at the job site shall be accompanied by a time slip issued at the batching plant, bearing the time of charging of the mixer drum with cement and aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 30°C (85°F) or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. When a truck mixer is used for the complete mixing of the concrete, the mixing operation shall begin within 30 m minutes after the cement has been added to the aggregate.

- The concrete when discharged from truck mixers or truck agitators, shall be of the consistency and workability required for the job. The rate of discharge of the plastic concrete from the mixer drum shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open. If additional mixing water is required to maintain the specified slump and is added with the permission of the Engineer, a minimum of 20 revolutions of the truck mixer drum at mixing speed shall be required before discharge of any concrete

When approved by the Engineer, central-mixed concrete which is designated for the purpose may be transported in suitable non-agitating equipment.

When non-agitating equipment is used for transportation of concrete the following requirements shall apply.

- Bodies of equipment shall be smooth, water-tight, metal containers equipped with gates that will permit control of the discharge of the concrete. Covers meeting the approval of the Engineer shall be provided for protection against the weather.

- The concrete shall be delivered to the site of the work in a thoroughly mixed and uniform mass and discharged with a satisfactory degree of uniformity. Slump tests of representative samples taken during the discharge shall not differ by more than 2 inches (50.8 mm). Discharge shall be completed within 30 min. after introduction of the mixing water to the cement and aggregates.

Concrete delivered in outdoor temperatures lower than 5°C (40°F) shall arrive at the work having a temperature not less than 15.6°C (60°F) nor greater than 32.2°C (90°F).

The volume of concrete mixed or transported shall not be less than 15 percent of the gross volume of the drum.

RE-TEMPERING

Concrete, mortar and grout mixers which have developed initial set shall not be used. Concrete, mortar and grout which have partially hardened shall not be retempered or remixed.

SAMPLING AND TESTING OF CONCRETE

The Contractor shall provide the required samples of Concrete to be furnished by the Contractor without cost to NIA. Sampling will, in all cases be performed by the contractor under the direct supervision of the Engineer and Contractor shall provide without cost to NIA all available tools and labor as may be required. Concrete sampling shall be carried on during concrete operations at the rate of one standard sample for each 75 cubic meters of concrete or fraction thereof placed during each continuous placing operations but in no case shall there be less than one sample for each day concreting. Each standard sample shall consist of three standard cylinders (6-inch diameter by 12-inches high.) The Contractor shall keep a record of the samples and the portion of the structures and volume represented which shall be available to NIA on demand.

Sampling shall conform to ASTM Designations C-172, preparation, storage and curing to ASTM Designation C-31 and testing to ASTM Designation C-39. NIA shall have the sample tested by an approved testing laboratory at the expense of the Contractor.

CONVEYING AND PLACING CONCRETE

(a) **General**. Approval of the Engineer shall be obtained before starting any concrete pour. Concrete placement will not be permitted when, in the opinion of the Engineer, conditions prevent proper placement and consolidation. Before concrete is placed, all saw dust, chips, and other construction debris and extraneous matters will be removed from the interior of forms, struts, stays, and braces, serving temporarily to hold the forms in correct shape and alignments, pending the placing of concrete at their location, shall be removed when the concrete placing has reached an elevation rendering their services unnecessary as may be. These temporary members shall be entirely removed from the forms and not to be buried in concrete. Surfaces of existing concrete left after partial demolition against which new concrete is to be placed, shall be cleared thoroughly of all loose concrete coatings or concrete dust by brushing or other effective means followed by thorough washing or jetting. Such surfaces shall be kept moist for at least 24 hours before pouring the new concrete.

Concrete shall be placed only in the presence of the Engineer or his duly authorized representatives. Any and all concrete placed in the absence of the Engineer or his duly authorized representatives will not be considered for measurement and payment, and shall be removed at the discretion of the Engineer with the Contractor assuming all losses.

Concrete shall be conveyed from mixer to forms, as rapidly as practicable, by methods which will prevent segregation, or loss of ingredients. In case of circular siphons, pumpcrete shall be used. There shall be no vertical drop greater than 1.50 meters except where suitable equipment is provided to prevent segregation and where specifically authorized by the Engineer. Belt conveyors, clutch or similar continuously exposed flow, will not be permitted.

(b) **Concrete on Earth Foundation**. All concrete shall be placed upon clean and dump surfaces free from standing or running water. Prior to placing concrete, the earth foundation shall be satisfactorily compacted in accordance with these Specifications.

(c) **Concrete on Rock or Other Concrete.** Rock surface or hardened concrete upon or against which concrete is to be placed shall be clean, free from oil, standing or running water, mud, drummy rock objectionable coatings, debris, loose and semi- detached or unsound fragments. Fault, fissures and seams in rock shall be cleaned to a satisfactory depth and to firm rock on the sides. Immediately before concrete is placed, all surfaces shall be cleaned thoroughly by the use of high velocity, air water jets, wet sand blasting or other satisfactory means. When required by the Engineer, roughening by grooving with pneumatic tool, of existing concrete surfaces against which concrete is to be placed may be required. All surfaces shall be wetted before placing concrete and approximately horizontal surface shall be covered immediately, before the concrete is placed, with a layer of mortar not to exceed 15 millimeters in thickness and of the same cement-sand ratio as used in the concrete.

(d) **Lift in Concrete**. The permissible depth of concrete placed in one lift will be as shown in the detailed Drawings or as directed for each structure by the Engineer. Unless otherwise authorized or shown, lifts of mass concrete shall not exceed 1.5 meters in height, and a minimum of 72 hours shall elapse between the placing of each successive lifts. Lifts of three meters will be permitted in piers and walls. Height of lift specified herein will not apply where the use of slip form has been approved. All concrete, when placed and vibrated shall be approximately horizontal layers not to exceed 50 centimeters in thickness unless otherwise specifically authorized. The placement of concrete surfaces shall not have reached their initial set before additional concrete is placed thereon. Slabs shall generally be placed in one lift unless the depth is so great that this procedure will produce objectionable results.

(e) **Consolidation of Concrete**. Consolidation of concrete shall be by the use of mechanical vibratory equipment. The vibrating equipment shall be of the internal type and shall at all times be adequate in number of units and the power of each unit shall be capable to properly consolidate all concrete. The frequency of vibration shall not be less than 6,000 revolutions per minute. Form or surface vibrators shall not be used, unless otherwise specified in other Sections of this Technical Specifications. The duration of vibration shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. In consolidating each layer of concrete the vibrating head shall be allowed to penetrate under the action of its own weight and revibrate the concrete in the upper portion of the underlying layer.

At least one spare vibrator in working order shall be available at any location where concrete is being placed.

(f) **Finishing of Concrete Lift Surfaces**. The manipulation of the concrete adjacent to the surface of the lift in connection with completing lift placement shall be the minimum necessary to produce not only the degree of consolidation desired in the surface layer of concrete but also a surface with the desired degree of roughness for bond with the next lift. Surface vibration or excessive surface working will not be permitted. All unfinished top surface not covered by forms and which are not to be covered by additional concrete or backfill, shall be carried slightly above grade, as directed, and struck offby board finish.

(g) **Placing Concrete through Reinforcement**. In placing concrete through reinforcement, care shall be taken so that no segregation of the coarse aggregate occurs. On the bottom of beams and slabs, where the congestion of steel near the forms makes placing difficult, a layer of mortar of the same cement-sand ratio as used in the concrete shall be first deposited to cover the surface.

(h) **Depositing Concrete in Water**. When specifically authorized, concrete may be deposited in water. The methods and equipment used shall be subject to approval of the Engineer.

FORMS

(a) **General**. Forms shall be used wherever necessary to confine the concrete during vibration and to shape it to the required lines. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in position. The strength and rigidity of the forms shall be such that formed surfaces will conform to specification requirements relating to surface irregularities and tolerances for concrete construction. Forms shall be tight to prevent loss of mortar from the concrete.

Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce beveled edges. Interior corners and edges of formed joints shall not be beveled unless the requirement therefore is shown on the Drawings.

The tolerance limits specified in Paragraph 1521 and the surface irregularity limits specified in Paragraph 1521 are the maximum permissive limits of misalignment or irregularity surface which may occur despite workmanlike effort to construct and maintain the forms to the specified surfaces. These limits pertain only to inadvertent and occasional irregularities, even though these irregularities are within the maximum permissive limits, will be rejected. Accordingly, these limits, shall not be construed to be tolerances for aligning forms or determining acceptability of form material

Stub walls shall not be used, except that stub walls shall be used for walls having fillets at the bottom.

Concrete in such stub walls shall be re-vibrated after adjacent floor concrete is placed.

Forms for finishes F2 and F3 shall be constructed with grade strips at the horizontal construction joints, unless the use of groove strips is specified on the Drawings. Such forms shall be removed and reset from lift to lift, they shall be continuous from lift to lift. Sheathing of reset forms shall overlap the previous lift by not less than 25 mm. Forms shall be tightened against the concrete so that the forms will not spread and permit abrupt irregularities or loss of mortar or paste. Supplementary bolts or form ties shall be used as necessary to hold the rested forms against the concrete.

Forms for all wall openings shall be constructed so as to facilitate loosening.

(b) **Form Sheathing and lining**. Wood sheathing or lining shall be of such kind of quality and shall be so treated or coated that there will be no chemical deterioration or discoloration of the formed concrete surfaces. The type and condition of form sheating and lining, and the fabrication of forms for finishes F2, F3 and F4 shall be such that the form surfaces will be even and uniform. The ability of forms to withstand distortion caused by placement and vibration of concrete shall be such that formed surfaces will conform with applicable requirements of these specifications pertaining to finish of formed surfaces. Where finish F3 is specified, the sheathing or lining shall be placed so that the joint marks on the concrete surfaces will be in general alignment, both horizontally and vertically.

Plywood used for sheathing or lining shall be high density overlaid plywood specially manufactured for use in construction concrete forms as approved. Materials used for form sheathing or lining shall conform with the following requirements, or other materials producing equivalent results as approved by the Engineer.

Req'd Finish of Formed Surface	Wood Sheathing or Lining*	Steel Sheathing or Lining**
F1	Any grade, surfaced on 2 edges (S2E) with no limits to defects except imposed by other requirements of these specifications.	Steel Sheathing permitted Steel Lining permitted
F2	Selected lumber, surfaced on side and two edges (SIS2E) or plywood sheathing or lining.	Steel Sheathing permitted Steel Lining permitted

F3	Selected lumber, surfaced on four sides (S4S) or plywood sheathing or lining.	Steel Sheathing permitted Steel lining not permitted
F4	For plane surfaces, selected lumber surfaced on four sides (S4S) T & G or plywood. For warped surfaces, the lumber shall be free from knots and other imperfections and which can be cut and bent accurately to the required curvatures without splintering or splitting.	Steel sheathing permitted.

* The lumber shall be free from warp and knotholes and shall have no knots larger than five centimeters in diameter. All knots shall be sound and tight. There will be no pitch pockets, barb or lack of wood on the face of the lumber against which concrete is to be placed.

** Steel sheathing denotes steel sheets not supported by a backing of wood boards.

(c) **Form Ties.** Embedded ties for holding forms shall remain embedded and, except for F1 finish, shall terminate within the concrete approximately two diameters or twice the minimum dimensions of the tie from the formed faces of the concrete. Embedded ties for F1 finish shall terminate within the concrete or shall be cut-off flush with the faces of the concrete, at the Contractor's option.

The ties shall be so constructed that ends and end fasteners can be removed by unskilled workmen without causing spalling at the faces of the concrete.

(d) **Cleaning and Oiling of Forms**. The surfaces of the forms in contact with the concrete shall be free from encrustations of mortar, grout or other foreign material when the concrete is placed. The surfaces of the forms to be in contact with the concrete shall be coated with an approved coating which will enable the ready release of the forms and will not contaminate the concrete surfaces. Except as provided below, forms for surfaces which are to be painted shall be coated with straight, refined, pale, paraffin mineral oil, or other approved coating, and the coating for steel forms shall consist of refined mineral oil suitably compounded for the purpose.

(e) **Forms of Curved Surfaces**. Curved surfaces have been dimensioned at several sections. The Contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form lumber shall be built up to laminated splines cut to make tight, smooth form surfaces. The forms shall be constructed so that the joint marks on the concrete surfaces generally will follow the line of water flow. After the forms have been constructed, all surface imperfections shall be corrected, and all surface irregularities at packing faces of form materials shall be dressed to the specified curvature.

(f) **Forms for Slopes or Battered Surfaces**. Forms for sloped or battered surfaces shall be built so that the sheathing can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration, and inspection of the concrete. The sheathing shall be built so that the sheathing can be removed board-by-board from the bottom to top.

(g) **Forms for Open Channel Transitions.** When warped surfaces of transitions are not backformed, natural or compacted earth shall be shaped to the specified surface and covered immediately with a plaster coat of cement-sand mortar at least 0.95 centimeter.

Forms for the warped surfaces shall be tied securely to the floor slab and braced against spreading. In the upper surface, forms shall be butt and removed as specified in sub-paragraph (j), so as to enable ready access for placement, vibration, inspection, and repair and finishing of the concrete.

(h) **Forms for Bridges**. Forms for girders and slabs shall be cambered as specified by the Engineer.

Forms shall be constructed so that form marks will conform to the general lines of the structure. Column form marks shall be spaced symmetrically.

Form bolts or clamps shall be used to fasten forms. The use of ties consisting of twisted wire loops will not be permitted. Bolts or clamps shall be positive in action and shall be of sufficient strength and number to prevent displacement of the forms. They shall be of such type that they can be entirely removed or cut back one inch or more below the finished surface of the concrete leaving no metal within one inch of the concrete surface. All forms for the outside surfaces shall be constructed with rigid wales at right angles to the studs and all form clamps shall extend through and fasten such wales.

Forms for exposed surfaces shall be constructed of plywood or material which will produce an equivalent surface. Form panels shall be furnished and placed in uniform widths of not less than 90 centimeters and in uniform lengths of not less than 1.8 meters, except where the dimensions of the member formed are less than the specified panel dimensions. Plywood panels shall be placed with the grain of the outer piles perpendicular to the studding of joists, unless otherwise permitted by the Engineer. Where form panels are attached directly to the studding or joists, the panels shall not be less than 1.6 centimeters thick, and the studding or joists, shall be spaced not more than 30 centimeters center to center. Form panels less than 1.6 centimeters thick, which otherwise conform to the requirements specified in this Paragraph, may be used with a continuous backing of surfaced material 1.9 centimeters thick. Form panels more than 1.6 centimeters thick attached to studding or joists spaced at 30 centimeters center to center may be used, provided the deflection of the panel between studding or joists does not exceed that of a 1.6 centimeters panel attached to a studding or joists spaced at 30 centimeters center to center. All form panels shall be placed in a neat, symmetrical pattern subject to the approval of the Engineer.

(i) **Falsework for Bridges and Other Superstructures**. False work for the support of a bridge or other superstructure shall be designed and constructed to support the loads that would be imposed where the entire structure placed at one time.

Suitable jacks, wedges or camber strips shall be used in connection with falsework or centering to set the forms to the required grade or camber and to take up any settlement in the formwork either before or during the placing of concrete

(j) **Forms for Large Circular Siphons**. The Contractor shall submit to NIA a detailed Drawings for a collapsible steel forms to be used as inner forms of the monolithic barrels. The length of one section of the barrels is at every 9.15 meters bar length intervals as shown on the Drawings. The outer forms intervals as shown on the Drawings. The outer forms of the concrete barrels shall be made with butt joints throughout and form surfaces to be in contact with concrete shall be smooth and true. All forms shall be sufficiently tight with suitable gaskets provided at all form joints and gates to prevent leakage of mortar. Forms shall be braced and sufficiently stiff to withstand, without detrimental deformation, all operations incidental to the proper placement of concrete within the forms. All forms shall be cleaned and oiled before pouring concrete.

(k) **Removal of Forms**. Forms shall be removed as soon as possible to enable the earliest practicable repair of surface imperfections, but in no case shall they be removed before approval of the Engineer. Any needed repair or treatment shall be performed at once, and be followed immediately by the specified curing. Forms shall be removed with care so as to avoid injuring of the concrete and any concrete so damage shall be repaired.

In field operation that are not controlled by beam or cylinder test the removal of forms and supports shall be governed by the following:

Type of Structure	Time of Removal After the Last Pouring
Arch, beam, girders and slabs	14 day
Slab in close span of less than three meters	7 days

Side forms for beams, railings parapets,	Not less than 12 hours
balustrade, walls and columns	and more than 48 hours

CONSTRUCTION JOINTS

(a) **General**. After the top surface of a lift is finally compacted, it shall be immediately and carefully protected from direct rays of the sun, pedestrian traffic, materials being placed thereon, running water, heavy rains, or any activity upon the surface that in any manner will affect the setting of the concrete. Unless otherwise specified, vertical and horizontal joints on exposed faces shall be chamfered as shown on standard detailed drawings and formed to produce a uniform and neat appearance.

(b) **Cleaning**. Horizontal construction joints on lifts with relatively open and accessible surfaces may be prepared for receiving the next lift by either wet sand blasting or by cutting with an all-water jet, as specified below. If the surface of the lift is congested with reinforcements, or is relatively inaccessible or, if for any other reason the Engineer considers it undesirable to disturb the surface of a lift before final set has taken place, surface cutting by means of air-water jets will not be permitted and the use of wet sand blasting or light brush hammering will be required. After approved cleaning, the surface of the construction joints shall be kept continuously wet for at least 12 hours immediately prior to placing concrete. A mortar coating of approximately one centimeter in thickness shall be applied to all approximately horizontal surfaces immediately prior to the placing of the next lift of concrete. The mortar shall have the same cement sand ratio as the concrete. Any free water on the joint surface shall be removed prior to placing the mortar. The Contractor shall ensure that the surface of any horizontal joints (and the formwork in general) is completely clean of any dust, weed, wood showings or other deleterious material prior to the placing of concrete.

1. **Air-Water Cutting** - Air-Water cutting of construction joint shall be performed after initial set has taken place but before the concrete has obtained its final set. The surface shall be cut with a high pressure air-water jet to remove all laitance and expose clean, sound aggregate, but not to undercut the edges of the larger particles of aggregate. After cutting, the surface shall be washed and rinsed as long as there is a trace of cloudiness of the wash water.

2. **Wet Sandblasting**. When employed in the preparation of construction joints, wet sandblasting shall be performed immediately before placing the following lift. The operation shall be continued until all unsatisfactory concrete and laitance, coatings, stain, debris, and other foreign materials are removed. The surface of the concrete shall then be washed thoroughly to remove all loose materials.

3. **Cleaning Vertical Construction Joint**. The vertical construction joints shall be cleaned by wet sand blasting or by brush manner.

REPAIR OF CONCRETE

No repair of work or plaster finish of formed concrete in structures will be permitted, unless otherwise provided in these Specifications or directed by the Engineer in writing. All defective concrete shall be removed and replaced with the Contractor assuming all expenses and losses. Plastering without permission will be assumed as defective works. If directed, the Contractor shall notify the Engineer of the start of the repair work at least 24 hours in advance thereof and shall repair concrete only in the presence of the Engineer or its authorized representative, unless inspection of such repair work is waived.

Drypack shall be used for filling holes having at least one surface dimension smaller, if any greater than the hole depth; for narrow slots cut for repair of cracks for grout pipe recesses; and for tie-rod fastener recesses as specified. Drypack shall not be used for filling behind reinforcement or for filling holes that extend completely through a concrete section. Mortar filling, placed under impost by use of a mortar gun, maybe used for repairing defects on surfaces designated to receive F1 and F2 finishes where the defects are too wide for drypack filling and too shallow for concrete filling and no deeper than the far side of the reinforcement that is nearest the surface. Concrete filling shall be used for holes extending entirely through concrete sections; for holes in which no reinforcement is encountered and which are greater in area than 900 square centimeters and deeper than 20 cm.; and for holes in reinforced concrete which are greater in area than 400 square centimeters and which extends beyond reinforcement.

Workmanship methods, preparation of concrete for repair, materials, and curing shall be as directed. Only workmen skilled in the repair of concrete shall perform such work. Repairs of defective concrete shall be made within 48 hours after removal of forms.

Surfaces to which concrete is to be bonded shall be clean and dry when coated with epoxy.

Surfaces of concrete to be repaired with sealing compound method shall be cured by the water curing method for one day before application of the sealing compound. All repair shall be sound and free from shrinkage cracks and drummy areas after they have been cured and have dried 30 days.

Surfaces of repairs which will be exposed to view shall blend inconspicuously with surrounding concrete surfaces.

Fins and encrustations shall be removed from surfaces which will be exposed to view.

FINISHES AND FINISHING

(a) **General**. Allowable deviations from established lines, grades and dimensions are set forth in Paragraph 1521. These allowable deviations are defined as "tolerance" and are to be distinguished from surface irregularities in finish as described herein. The class of finish and the requirements for finishing concrete shall be as specified in this Paragraph.

Finishing of concrete surfaces shall be performed only by skilled workmen. The Contractor shall advise the Engineer as to when concrete will be finished. Unless inspection is waived in each specific case, finishing of concrete shall be performed only in the presence of the Engineer. Concrete surfaces will be tested by the Engineer to determine that surface irregularities are within the limits hereinafter specified.

Surface irregularities are classified as "abrupt" or "gradual". Offsets caused by displaced or misplaced form sheathing or lining or form sections or by loose knots in forms or otherwise defective form lumber will be considered abrupt irregularities, and will be tested by direct measurements. All other irregularities will be considered to be gradual irregularities, and will be measured as the departure from the testing edge of an approved template held parallel to and in contact with the surface. The template shall consist of a straight-edge or the equivalent thereof for curved surfaces.

(b) **Formed Surfaces**. The classes of finish for formed concrete surfaces are referred to by symbols F1, F2, F3 and F4 faces. Grinding will not be required on formed surfaces except as necessary to reduce protrusions to specified limits. Recesses from removal of form ties shall be filled with dry pack or epoxy mortar at the Contractor's option: except that filling recesses in Finish F1 surfaces will be required only if the recesses are deeper than 2.5 centimeters in walls, less than 30 centimeters thick or if unfilled, recesses would reduce the required cover over reinforcements.

The filled recesses shall blend inconspicuously with the surrounding concrete surfaces or concrete that will be exposed to view.

The classes of finish and their application are as follows:

Finish F1 - Finish F1 applies to formed surfaces where fill material or concrete is to be placed. The surfaces require no treatment after form removal except for repair of defective concrete and specified curing. Correction of surface irregularities will be required only for depressions which exceed 2.5 centimeters, when measured as described in sub-paragraph (a)

Abrupt irregularities on surfaces to which pre-molded joint filler is to be applied shall not exceed 0.30 centimeter.

Finish F2 - Finish F2 applies to all formed surfaces not permanently concealed by fill materials or concrete, or not required to receive Finish F3. Surface irregularities, measured as described in sub-paragraph (a) shall not exceed 0.60 centimeter for abrupt irregularities and 1.20 centimeters for gradual irregularities.

Finish F3 - Finish F3 applies to formed surfaces of the stoplog guides, exposed faces of abutments, wing walls, girders, curbs, parapet railings, and decorative features on bridges. Surface irregularities, measured as described in sub-paragraph (a) above, shall not exceed 0.60 centimeter for gradual irregularities and 0.30 centimeter for abrupt irregularities, except that abrupt irregularities will not be permitted at construction joints.

Finish F4 - Finish F4 applies to formed surfaces for which accurate alignment and evenness of surfaces are of paramount importance from the standpoint of eliminating destructive effects of high velocity flows. Formed surfaces to receive an F4 finish includes formed surfaces exposed to high velocity flowing water.

Except as hereinafter provided, abrupt irregularities on surfaces to receive F4 finish, when measured as described in sub-paragraph (a), shall not exceed 0.60 centimeter for irregularities parallel to the direction of the flow and 0.30 centimeter for irregularities not parallel to the direction of the flow. Gradual irregularities on surfaces to receive an F4 finish shall not exceed 1.60 centimeters.

Abrupt irregularities on formed surfaces exposed to high velocity flows shall be eliminated by grinding on a bevel of 1:20 ratio of height to length.

The Contractor will not be entitled to any extra payment or compensation for reducing or eliminating irregularities on formed concrete surfaces which do not meet specification limits.

(c) Unformed Surfaces - The classes of finish for unformed concrete surfaces are referred to by symbols U1, U2, U3, or U4. Exterior surfaces will be sloped for drainage where shown on the Drawings or as directed by the Engineer. Exterior surfaces which otherwise would be level shall be sloped for drainage. Unless the use of other slopes or level surfaces is indicated on the Drawings or directed by the Engineer narrow surfaces, such as tops of walls and burbs, shall be sloped approximately 3 centimeters per meter of width; broader surfaces, such as walks, roadways, platforms, and decks shall be sloped approximately 2 centimeters per meter. These classes of finish and their applications are as follows:

Finish U1 - Finish U1 (screeded finish) applies to unformed surfaces that will be covered by fill material or by concrete. Finish U1 is also used as the first stage of finishes U2 and U3. Finishing shall consist of sufficient leveling and screening to produce even uniform surfaces. Surface irregularities, measured as described in sub- paragraph (a) shall not exceed 0.60 centimeter.

Finish U2 - Finish U2 (floated finish) applies to unformed surfaces not permanently concealed by fill material or concrete, or not required to receive finishes U3 and U4. Finish U2 is also used as the second stage of finish U3. Floating may be performed by use of hand or power driven equipment. Floating shall be started as soon as the screeded surface has stiffened sufficiently, and shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. If finish U3 is to be applied, floating shall be continued until a small amount of mortar without excess water is brought to the surface, so as to permit effective trowelling. Surface irregularities measured as described in sub-paragraph (a), shall not exceed 0.60 centimeter.

Finish U3 - Finish U3 (trowelled finish) applies to inside floors of buildings. When the floated surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel trowelling shall be started. Steel trowelling shall be performed with firm pressure, so as to flatten the sandy texture of the floated surface and produce a dense uniform surface, free from blemishes and trowel marks. Surface irregularities, measured as described in sub-paragraph (a), shall not exceed 0.60 centimeter.

Finish U4 - Finish U4 applies to canal lining. The finished surface shall be equivalent in evenness, smoothness and freedom from rock pockets and surface voids to that obtainable by effective use of a long-handled steel trowel. Light surface fitting and light trowel marks will not be considered objectionable. Surface irregularities measured as described in sub-paragraph (a), shall not exceed 0.60 centimeter for bottom slabs and 1.20 centimeter for side slopes.

(d) Moisture Control for Unformed Surfaces - In warm, dry or windy weather the moisture control measures specified herein shall be taken to inhibit loss of moisture from the surface of the concrete. Such surfaces shall be fog-sprayed, covered completely with white polyethylene sheet, or otherwise treated as approved. The curing specified in Paragraph 1520 shall be started as soon as the concrete hardens, however, the surface of the concrete shall be kept wet during the change in curing methods.

If surfaces are fog sprayed, the fog spray shall maintain a sheet of moisture on the concrete but shall not displace cement or create a wet surface during finishing operations. Surfaces shall be fog sprayed during and immediately following finishing operations, and fog spraying shall be interrupted only to enable finishing operations. Such interruptions shall be of minimum duration and shall occur only in the immediate area being finished.

Plastic shrinkage cracks which occur before the concrete hardens shall be closed. Shrinkage cracks shall be closed by working; cracks shall not be sealed by trowelling only.

CURING

(a) **General**

All concrete except interior surfaces, shall be cured for a period of not less than 14 consecutive days.

All horizontal slabs or surfaces shall be cured by water curing in accordance with sub-paragraph (c) and all inclined or vertical surfaces of concrete shall be applied with membrane curing immediately after removal of forms to prevent dehydration in accordance with sub-paragraph (b) except that membrane curing shall not be allowed for mass concrete and for construction joints. Contractor shall have all equipment needed for adequate curing and protection of the concrete on hand and ready for use before actual concrete placement begins. The curing medium and method or the combination of mediums and methods used shall be subject to the approval of the Engineers.

(i) Floors, stair threads, and horizontal construction joints shall be cured for 14 days by a covering of damp sand or curing mats, except that curing of construction joints surfaces may be discontinued in less than 14 days when the surfaces are to be covered with fresh concrete. The sand or curing mats shall not be kept so wet as to allow water to drain from it and stain concrete walls. The sand or curing mats shall be removed after the expiration of the curing period.

(ii) Interior Surfaces

Concrete surfaces of interior walls, including ceilings and surfaces of construction joints and vertical construction joints will require no curing other than resulting from forms being left in place for at least two days. Interior walls shall be washed during and after completion of concrete operations at higher elevations. The washing shall be sufficient to keep the walls free from drips or runs of material that would cause streaking or staining of the concrete. Stair risers and large repairs on interior walls shall be cured for at least four days by damp mats but the mats shall not be wet enough to cause dripping of water on completed concrete. Small repairs and filled core holes on interior walls shall be cured for at least four days by masking tape or similar covering.

(b) **Membrane Curing Method**.

The concrete shall be sprayed uniformly with sealing compound in accordance with the manufacturer's written recommendation, copies of which shall be furnished to the Engineer for approval in advance of the material being used. The sealing compound shall conform to AASHO Designation: M-148, Type II. The component shall be of uniform consistency and quality within each container of each shipment and from shipment to shipment. Sealing compound used in confined spaces shall not be toxic to workmen. The Contractor shall furnish a manufacturers certificate of compliance for the compound prior to its use on the work. The certificate shall identify the batch and include certified test results covering all requirements of the specifications for the sealing compound material.

Sealing compound shall be applied to unformed concrete surfaces immediately upon completion of moisture control measures taken as specified in Paragraph 1519 (d). Where such measures are not required, sealing compound shall be applied as soon as the concrete is hard enough to preclude damage from application of the sealing compound. The Engineer will require that the side slopes and bottom of the canal lining be sprayed separately unless the surfaces are ready, simultaneously, to receive the sealing compound.

Sealing compound shall be applied to formed concrete surfaces immediately upon removal of the forms as specified in Paragraph 1516. The moisture control measures shall be taken until the forms have been removed. Formed surfaces shall be sprayed with water immediately after the forms have been removed until the surfaces are saturated. The sealing compound shall be applied as soon as the surface film or water has disappeared but while the surface is still damp.

Sealing compound shall be applied in one coat to provide a continuous uniform membrane. Special care shall be taken to ensure coverage of edges, corners, and rough spots of formed surfaces. The compound shall be agitated continuously in the spray pressure tank.

Concrete repair work shall be performed after the sealing compound has been applied and is dry to touch. In the event that application of sealing compound is delayed or interrupted, water shall be applied as approved, until application of sealing compound is started or resumed.

Any membrane that is damaged or is determined to be defective within 28 days after application shall be repaired or replaced without delay, as approved. If the Contractor's operations require traffic on coated surfaces, the membrane shall be protected from damage.

Payment for membrane curing shall be included in the contract unit price for concrete in the Bill of Quantities where they are required.

(c) **Water Curing**

Water curing shall start as soon as practicable after placement of the concrete and shall continue until completion of the specified curing period or until covered with fresh concrete. Concrete, if cured by water, shall be kept wet by ponding method or by covering with an approved water saturated materials, or by a system of perforated pipes, mechanical sprinklers, porous hose, or by any other methods approved by the Engineer which will keep all surfaces to be cured continuously (not periodically) wet.

Water used for curing shall be free of chemicals which may have an adverse effect on the concrete. For example, water containing sulfates or chlorides is not acceptable.

TOLERANCES FOR CONCRETE CONSTRUCTION

a) **General**. Permissible surface irregularities for the various classes of concrete surface finish, specified in Paragraph 1519 are defined as "finishes", and are to be distinguished from tolerances that are consistent with modern construction practice, yet governed by the effect that permissible deviations will have upon the structural action or operational function of the structure. Deviations from the established lines, grades and dimensions will be permitted to the extent set forth herein.

Where tolerances are not stated in the Specifications or Drawings for any individual structure or feature thereof, permissible deviations will be interpreted in conformity with the provisions of this paragraph. Concrete work that exceeds the tolerance limits specified will be rejected and shall be corrected or removed and replaced, as ordered.

(b) Tolerance for Canal Structure

1. Concrete canal lining:

Departure from established alignment
- 5 cm. on tangents
- 10 cm. on curves

Departure from established profile grade
- 2.50 cm.

Reduction in thickness of lining:

10 per cent of the specified thickness; provided that the average of all thickness measurements made in 40 meters of lining shall be not less than the specified thickness, and provided further that the quantity of concrete actually used in 40 meters of lining shall be not less than the theoretical quantity, based on the lines shown on the Drawings.

Variation from specified width of section at any depth	-	3 cm.
Variation from established depth of lining	-	3.7 cm.
Variation in surface:		
Invert, in 3 meter	-	0.60 cm.
Side slopes, in 3 meter	-	1.20 cm.
2. Bridges, inlets, chutes and structures:		
Departure from established alignment	-	1.20 cm.
Departure from established grades	-	1.20 cm.
Variation from the plumb or the specified batter in the lines and surfaces of columns, piers, walls and in arises		
Exposed in 3 meters	-	1.20 cm.
Backfilled in 3 meters	-	2.00 cm.
Variation in cross-sectional dimensions of columns, walls, piers, slabs, beams and similar parts		
Minus	-	0.60 cm.
Plus	-	1.20 cm
3. Bridge Slabs:		
Variation in thickness of slab:		
Minus	-	0.30 cm.
Plus	-	0.60 cm.
Variations from specified width over curbs	-	0.60 cm.
Variations from specified grade of top of curb in cambered position	-	0.60 cm.
4. Foundations:		
Variations in dimensions in plan:		
Minus	-	2.50 cm.
Plus	-	5.00 cm.
Variations from established grade:		
Minus	-	1.20 cm.
Plus	-	2.00 cm.
Misplacement of eccentricity:		
2 percent of the footing width in the direction of misplacement but not more than	-	5.00 cm.
5. Bridge Seats:		
Variation of any one bearing from established elevation	-	0.30 cm.
Difference in elevations of bearings for adjacent spans, maximum	-	0.60 cm.
Difference in elevations of bearings for zone span on any one pier, maximum	-	0.30 cm.
Horizontal misplacement for any one bearing, maximum	-	0.70 cm.
Variation in the sizes and locations of slabs and wall openings	-	1.20 cm.
Skills and side walls for radial gates and similar watertight joints:		
Variation from the plump level	not greater than 0.30 cm. in 3 meters	
6. Stop Log Slots:		

Variation from a common plane between the sealing surfaces of each pair of related stop log slots shall be no greater than	-	0.15 cm.
Variation of widths of stop log guides:		
Minus	-	0.30 cm.
Plus	-	0.60 cm.

(c) Tolerances for Cast-In-Place Concrete Pipe:

Departure from established alignment or from established grade	-	2.50 cm.
Variation in thickness at any point:		Minus 2-1/2% or 0.60 cm. whichever is greater Plus 5% or 1.20 cm. whichever is greater
Variation from inside diameter	-	0.5%
Variation in surface invert	-	0.60 cm. in 3 meters

(d) Tolerances for Placing reinforcement steel:

Variation from indicated protective cover:

For 5 cm. cover	-	0.60 cm.
For 7.5 cm. cover	-	1.20 cm.
Variation from indicated spacing	-	2.50 cm.

FAILURE TO CURE

The Engineer shall have the authority to suspend the work whole or in part, by written order, for such period as he may deem necessary for failure on the part of the Contractor to perform proper curing of the concrete work and to withhold payment for the corresponding work pending results of test, that shall subsequently be made on these concrete works. The Contractor shall immediately secure core samples of such members and from parts of the structure as shall be designated by the Engineer and shall have them tested in a Testing Laboratory approved by the NIA. If the results of tests are found satisfactory, payment of the concrete in question shall be made and the work ordered resumed, but if the results of test are unsatisfactory to meet the structural requirements, the Contractor shall remove, wholly or partly, the concrete work in question at the discretion and upon written order of the Engineer and the Contractor shall replace such parts at his own expense

FAILURE TO MEET CONCRETE REQUIREMENTS

All concrete designed, prepared and placed by the Contractor for bridges that fails to meet the specified strengths shall be removed and replaced by the Contractor at his own expense. For other structures, concrete that fails to meet the specified strengths may be accepted provided the Contractor shall pay as liquidated damages the amount based on the following schedule:

Percent (%) lower than	Reduction in Price
the specified strength	per cu.m. of Concrete
Up to -5	less 10% of contract unit price
Above -5 to -10	less 20% of contract unit price
Above -10 to -20	less 30% of contract unit price

Concrete for all structures other than bridges which are more than twenty percent (20%) lower than the specified strength shall be removed and replaced by the Contractor at his own expense.

PROTECTION OF CONCRETE WORKS

The Contractor shall protect all concrete against injury until final acceptance by the NIA. Final acceptance shall be construed to mean acceptance of the whole work after the Contract has been completed or satisfactory terminated.

CONCRETE STRUCTURES

SCOPE

The Contractor shall construct all concrete structures shown on the Drawings.

Concrete shall be proportioned, mixed, placed, finished and cured as specified in Section XV, Concrete, except as modified herein. The sequence of construction of the structures shall be subject to the approval of the Engineer. Where the thickness of any portion of a concrete structure is variable, it shall vary uniformly between the dimensions shown. Cement mortar plastering is not allowed in the construction of structures, unless otherwise specified elsewhere in these Specifications.

CONCRETE CONSTRUCTION

All concrete construction shall conform to the provisions of Section XV, Concrete and the detailed requirements of the following paragraphs. Concrete finished shall conform to Paragraph 1519 and/or shall be as noted on the Drawings.

All structures shall be built to the specified lines, grades and dimensions. The location of all construction joints shall be shown on the Drawings or as approved by the Engineer. Construction joints shall be constructed as shown on the Drawings. The Contractor shall place and embed or attach to each structure all timber, metal or other accessories necessary for its completion as shown on the Drawings or as directed by the Engineer.

The dimensions of each structure shown on the Drawings will be subject to change as may be found necessary by the Engineer to adopt the structures to actual field conditions and conditions disclosed by excavation.

METHOD OF MEASUREMENT

Measurement for payment of any and all classes of concrete will be made by the number of cubic meter computed to the neat lines of the structure, unless otherwise specifically shown on the Drawings or specified in these Specifications. In the event cavities resulting from careless excavation or from excavation performed to facilitate the Contractor's operations, as determined by the Engineer, are required to be filled with concrete. Such refilling will be made by at the expense of the Contractor. In measuring concrete for payment, the volume of all openings, embedded pipes, woodwork and metal work within the concrete will be deducted.

BASIS OF PAYMENT

Payment for any and all classes of concrete in various parts of the work will be made at the applicable contract unit prices per cubic meter which price and payment shall include cost for furnishing all materials, equipment and labor, and all operations required in the construction as specified under Section XV, Concrete, except that payment for reinforcing bars and joint materials will be made at the applicable separate contract unit prices in the Bill of Quantities.

If during the implementation of the project, the sources of aggregates differ from those chosen by the Contractor considered in the derivation of his unit bid price for concrete, the Contractor shall not be entitled to any claim for unit price adjustment as a result of such alteration of sources.

CONCRETE FOR ALL STRUCTURES

(a) **General**

The item "Concrete for All Structures" in the Bill of Quantities include all concrete in diversion works (except Rubble Masonry), canal structures and road structures such as siphons, bridges, drainage culverts, road crossings, pipe crossings, ungated thresher crossings, control structures, drop structures, headgates and turnouts and all other structures not otherwise specified elsewhere in these Specifications.

Small concrete structures, at the option of the Contractor, may be installed as precast units provided that precast structures installed in place are equal in all respect to cast-in-place construction as specified in these specifications.

Concrete for diversion works, canal structures and other structures will be measured and paid for as specified in Paragraphs 1703 and 1704, respectively. Structures not fully and acceptably completed will not be measured for payment. Precast structures installed and acceptably completed in place shall be paid for as specified in Paragraph 1704.

All materials used like cement, admixtures, aggregates and steel reinforcing bars shall conform to the provisions of Section XV, Concrete and Section XXIII, Reinforcing Steel Bars, respectively. Classes of concrete to be used shall be those specified in the Drawings.

(b) **Curing and Joints**

All concrete shall be cured in accordance with paragraph 1522, except that concrete for canal siphon shall be cured until the concrete test cylinders shall have attained a strength of at least 210 kg. per square cm. (3,000 pounds per square inch).

The Contractor shall construct expansion and construction joints at sections specified on the drawings all in accordance with the provisions of paragraph 1517 and Section XXI, Concrete Joints and Joint Materials, and elsewhere in these Specifications.

PRE CAST CONSTRUCTION

(a) **Scope and Description**

Pre-casting of reinforced concrete may be resorted to as an alternative to poured-in-place concrete for certain structures such as headwalls and collars, parshall flumes, turnouts, division boxes, and other structures. Should the Contractor choose to employ pre-cast construction on these structures, he must so inform the Engineer in writing, submitting in detail his proposed design, modifications of concrete sections, concrete specifications, reinforcements and schemes of construction of all pre-cast units. The NIA may further required the Contractor to submit all other additional informations as may deemed necessary.

The NIA may approve the construction proposed on pre-casting of concrete with or without correction. The approval, however, does not relieve the Contractor of any responsibility if such work does not meet specified results.

Reinforced concrete pipes and concrete hollow blocks are not considered pre-cast construction, hence, are excluded under this Section.

(b) **Transporting and Placing**

Extreme care should be observed in handling, storing, moving and erecting to avoid cracking, twisting, or other distortions that would result to cracking or damage to the precast concrete. Pre-cast concrete members shall be handled, transported and erected in an upright position and the points of support and directions of the reactions with respect to the members shall be approximately the same as when the member is in final position.

(c) **Sampling and Testing**

The individual components of precast concrete structures, shall conform to the applicable provision of Section XV, Concrete and will be subject to the usual test for reinforced concrete.

(d) **Measurement and Payment**

Measurement of concrete in pre-cast structures will be measured by the number of cubic meter. It shall be computed to the neat lines as if these structures were constructed to the details shown on the Drawings.

The Contractor will be paid for all pre-cast structures acceptably installed or completed in place. He shall be paid for each pre-cast unit as if the units were constructed to the details shown on the Drawings, regardless of the actual dimensions of the pre-cast unit.

LEAN CONCRETE

In the construction of siphons, the bottom of the cast-in-place concrete barrels will be exposed to high velocity flow of seepage during pouring which will absorb or wash out the cement in the concrete poured. To minimize the effect of seepage, a blinding concrete with minimum strength of 70 kg/sq. cm. shall first be poured to the lines, grade and dimensions on which the barrels will be constructed as shown on the Drawings.

Lean concrete shall be measured and paid for as specified in paragraphs 1703 and 1704, respectively.

STAFF GAGES

The Contractor shall install two vertical staff gages, one upstream and one downstream, in all parshall flumes and turnouts with valve structures and in all check structures in the laterals as shown on the Drawings or as directed by the Engineer. The porcelain plated or enameled steel staff gages and other materials and accessories necessary for the installation shall be supplied by the Contractor.

Installation of staff gages will not be measured for payment including all the channels, anchors, anchor bolts and other metal materials necessary to install the staff gages at the parshall flumes and check structures. The cost of installation and other materials supplied by the Contractor shall be included in the contract unit price for concrete in the respective structure where gages are required.

RUBBLE MASONRY

SCOPE

The work under this Section shall include furnishing all materials, supplies, tools and equipment; construction of all necessary form work; placing rubble stone and concrete binder on an approved foundation and form work; the removal of forms and curing of the rubble masonry, all in accordance with the Drawings and these Specifications or as directed by the Engineer.

MATERIALS

Rubble stones shall consist of field stones that are clean, sound, durable, resistant to the action of water, and must have specific gravity of at least two and six tenths (2.6), and diameters ranging from 15 centimeters to 60 centimeters, sixty per cent (60%) which comprises the bigger sizes. Stones shall have the prior approval of the engineer before their use. Materials for concrete binder shall be in accordance with the applicable provisions of Section XV. Concrete binder shall be Class "A" concrete with 37.50 millimeters maximum size of aggregates.

METHOD OF CONSTRUCTION

Preparation and handling of the concrete binder shall be in accordance with Section XV. The stones shall be thoroughly wet before they are installed in place. The entire surface of every stone shall be thoroughly covered with concrete binder. In general, one cubic meter of rubble masonry will require one-half cubic meter of concrete binder. Actual variation in this proportion will not entitle the Contractor to any price adjustment. It is expected that the whole rubble masonry especially in the case of dam and apron as well as other structures should be well encased and covered by the concrete so that it forms the hearting of the body of dam and apron and will act contiguous with the concrete shell. This can be achieved by tamping the stones into the concrete using heavy wooden blocks handled by one or two people. After the bed has been prepared as required the first layer of mortar should be laid and rubble embedded in them. The thickness of mortar should be such that each rubble could be embedded at least 50 % of its longest dimension in the mortar so that when the next layer of mortar is poured the rubble which has been embedded is not disturbed. The next layer of boulders can be arranged in the mortar now placed following the same procedure. This will ensure that all the boulders are fully covered with mortar and they are well entrenched and stable in the mortar so that they are not disturbed when subsequent layers of mortar stones are poured. The stones shall be well set such that no stone will project beyond the lines indicated on the Drawings. The concrete binder shall be properly worked into the spaces between stones so that no void is left within the rubble masonry. In case reinforcements are placed, no stone shall be closer than four inches (10 centimeters) to the nearest reinforcing bars. Rubble masonry shall be cured by water for five days.

The general construction procedure should be always to start from lowest elevations so that the sub-grade on which the concrete is laid is not disturbed by the seepage forces when the higher layers are excavated and prepared for concrete pouring.

In situations where rubble masonry is directly constructed on the sub-grade, the sub-grade should be prepared exactly as for any other concrete structures. In these cases, also the first layer can consist of concrete of 15 centimeters thickness in the case of minor structures and 20 centimeters in the case of major structures. The concrete manufacture etc. will be as specified under Section XV and the strength will be as of Class "A" concrete.

METHOD OF MEASUREMENT

"Rubble Masonry" will be measured in cubic meters in its final position based on the neat lines of the structure as shown on the Drawings.

BASIS OF PAYMENT

The volume measured as provided above will be paid at the contract unit price per cubic meter, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, tools, equipment and all incidentals or subsidiary works necessary for the successful completion of the work described under this Section.

STEEL GATES AND LIFTING MECHANISM

SCOPE

The Contract work calls for the fabrication, supply, delivery and installation supervision of steel gates, stoplog, lifting mechanism, embedded parts including all accessories and field painting all in accordance with these specifications and the drawings:

STANDARDS AND SPECIFICATIONS

All materials and equipment to be incorporated in the works shall conform to the latest applicable standards and specifications as specified in the Contract Documents or to approved equivalent applicable standards and specifications established and adopted in the country of manufacture of the materials and equipment.

Reference to standards and specifications or to materials shall be considered as followed by the words "or equivalent". Contractor may propose equivalent standards, specifications and materials which shall conform to that specified.

If Contractor proposes equivalent standards and specifications or equivalent materials, Contractor shall state the exact nature of the change, and shall submit complete standards and specifications of the materials for the approval of NIA.

Such submittals shall be along with the bid and failure to do so, or purchase of any proposed equivalent materials prior to approval of NIA, will be at the Contractor's risk.

Abbreviations of the titles of official bodies which issue standards or specifications whenever referred to in these specifications are as follows:

ASTM - American Society for Testing Materials
AISC - American Institute of Steel Construction
AISI - American Iron and Steel Institute
ANSI - American National Standards Institute
AISE - Association of Iron and Steel Engineers
AWS - American Welding Society
JIS - Japanese Industrial Standards
SSPC - Steel Structures Painting Council
AGMA - American Gear Manufacturers Association
SAE - Society of Automotive Engineers
ASME - American Society of Mechanical Engineers

MATERIALS

A. General

All materials shall be new and shall be the best available for the purpose for which they will be used, considering strength, ductility, durability for the intended service and best engineering practice.

Materials to be used for the various components of gates and hoists shall conform to the following specifications:

Components	Material	International Specifications
Fixed wheel gates frames, girders, sill beam, rail beams, guide frames, seal clamps and other miscellaneous fabricated parts	Structural Steel	ASTM A36 Specifications for Structural Steel
Gate Wheels & Guide Rollers	Wrought Steel	ASTM A-504/A-148 Specifications for Wrought Carbon Steel
Wheel pins	Corrosion Resistant Steel	ASTM A-276 Specifications for Hot-Rolled and cold finished corrosion resisting steel bars Type 316
Seal seats and clamp plates for rubber seals	Corrosion Resistant Steel	ASTM A-240 Specifications for Chromium-Nickel Stainless Plate, Sheet and Strip
Standard steel bolts, nuts and washers	Galvanized Steel	ASTM A-307 Specifications for Low Carbon Steel Externally Threaded Fasteners
High strength steel bolts, nuts and washers	Carbon Steel	ASTM A-325 Specifications for Steel bolts and studs with suitable nuts and plain washers

Rope drum	Cast steel	ASTM A-27/ASTM A-36 Specifications for mild to medium strength carbon steel castings for General Applications
Gears/Pinions	Cast Steel/Forged Steel	ASTM A-27/ASTM A-291 Specifications for Alloy and Carbon Steel Forgings for Gears and Pinions
Worm Gear	Phosphor Gear Bronze	SAE 65
Worm	Case hardened Ground Steel	AISI-3120
Iron Castings		ASTM A-48, Class 30
Stems & Shaftings	Carbon Steel	ASTM A-108, Grade 1018 or Grade 1117 Specifications for cold finished carbon steel bars and shaftings
Wire Rope	Improved Plow Steel	R R W-410 Fed. Specifications
Bronze bushings, bearings, washers	High Lead Tin Bronze or Manga-nese Bronze	ASTM B-144 or B-147
Covers	Mild Steel	ASTM A-36
Bronze casting for lift nut, thrust nut	Manganese Bronze	ASTM B-147 Specifications for Manganese Bronze Sand Castings- Alloy 8A
Anti-friction Bearing		Ball & Roller Bearings shall be equivalent to those manufactured by SKF Industries
Gear Housing Oil Seals		Spring loaded and made of synthetic compound enclosed in a metal retainer, "Synthetic Seals" or equivalent
Lubricating Fitting		Alemite type 1610-3 or equivalent

Rubber Seal

The rubber seal shall be molded from natural or synthetic rubber containing not less than one percent by weight of copper inhibitor and shall have the following physical properties:

Property	Limit	ASTM-Test
a) Shore A Durometer Hardness	65 + or - 5	D-675
b) Minimum Elongation	450 percent	D-412

c) Ultimate Tensile Strength (min.)	14.5 N/sq.mm	D-412
d) Water Absorption (70^0 C - 7 days)	Less than 10% by weight	D-471
e) Tensile strength after accelerated ageing test of 48 hours in oxygen at 70^0 C and 2.1 N/sq.mm pressure	80 or more percent of strength before ageing	D-572
f) Compression Set (Max.)	30 percent	D-395

B. Tests of Materials

i. All materials, supplies, parts, assemblies used for the work to be done under these Specifications shall be tested according to modern approved methods for the particular type and class of work. Certified copies in triplicate of the tests made and results thereof shall be made available to NIA as soon as possible. The data shall be in such a form as to provide means of assessing compliance with the applicable relevant specifications for the material tested. The Contractor shall state in his tender the place of manufacture, testing, inspection of the various components of the work included in the contract.

ii. Wherever required, at their discretion, NIA may nominate an Inspector to inspect the tests or trials on their behalf. Sufficient notice must be given by the Contractor to the Inspector to enable him to reach the site of tests/trials except the pay and expenses of the Inspector shall be included in the quoted price. All authorized representatives of NIA shall have free access to the work premises of the contract at all reasonable times and shall be provided by the Contractor full facilities and safety to inspect the process of manufacture and the materials used. NIA will reject any material/work that in their opinion does not conform to the specifications and will order the same to be removed and replaced or altered at the expense of the Contractor to conform to the specifications.

iii. If materials are not referred to in the applicable Standard Specifications but are required to have certain physical and /or chemical properties, such properties shall be checked by two chemical samples for each 5 tons of materials and fractions thereof in each lot. For lots less than 250 kilograms, Contractor's warrants will be acceptable in lieu of actual tests provided heat treatment of the fabricated parts using such materials is not required. A lots shall consist of all materials of the same physical size and conditions submitted at one time in which the material is from the same melt or heat and on which any subsequent heat treatment has been performed at the same conditions. Not more than two heat treatment to attain the desired physical properties shall be permitted.

iv. Notwithstanding the above tests, examination and inspection, the Contractor shall be responsible for the acceptability of the finished work.

C. Manufacturing/Fabrication Program

i. The fabricator/manufacturer shall prepare a manufacturing/fabrication program in Bar Graph Form showing the activities and its sequencing in sufficient details such that the contract works can be properly monitored from commencement to completion.
ii. The fabricator/manufacturer shall submit said program within thirty (30) calendar days after the date of receipt of Notice of Award.
iii. The fabricator/manufacturer shall show the target dates for commencing and completing the principal activities as required for in the contract works including but not limited to the following:
    a. procurement of materials and the like
    b. fabrication and manufacture
    c. painting
    d. delivery dates

D. Pre-fabrication Inspection Works

i. The fabricator/manufacturer shall be required to submit mill and/or manufacturer's certificate for the steel materials, welding electrode, paints, etc. intended for use in the works.

ii. Materials to be used in the fabrication shall be adequately sampled and tested to check its compliance with the specification/standard requirements.

iii. No fabrication work and/or use of materials in such works shall commence unless materials for said works are duly inspected, tested, and certified by NIA or his authorized representatives as to conformity with the specification/ standard requirements.

iv. NIA technical inspector shall prepare and submit inspection and acceptance report on materials for use in the fabrication works.

E. Inspection Works During Actual Fabrication

1. The NIA should assign a knowledgeable and experienced technical inspectors, to conduct inspection.
2. The NIA's authorized technical inspector shall be entitled at all reasonable time free access to the manufacturer's/fabricator's plant to conduct inspection during fabrication, to ascertain that all the works shall comply in all aspect with the standards and requirements set forth in the contract documents.
3. The NIA technical inspectors shall monitor progress and conduct of the fabrication works and prepare and submit progress report on said works at regular intervals.

F. Final Inspection Works

1. Intake Gates, Main Canal Gates, Lateral and Turnout Gates

i. The NIA technical inspector shall conduct final inspection based on the approved fabrication drawings and specifications.

ii. The gates should be properly marked with the corresponding identification as per approved schedule of dimension such as size of gate, lateral, stationing for proper identification by the end user.

2. Sluice Gate, Barrage, Stoplog and Radial Steel Gates

i. The NIA technical inspector should see to it that all component parts should be properly pre-assembled at the fabricator's/manufacturer's shop to ascertain the proper fitness of all adjoining parts and should be properly punch mark before disassembling for guidance and reference during field installation.

ii. The NIA shall issue certificate of pre-delivery inspection and acceptance of completed fabrication works as a basis for the final inspection and acceptance by the field office of deliveries made at the site.

WORKMANSHIP

A. General

i) All works shall be performed in accordance with the best modern practice of the manufacturer of high grade machinery. All parts shall have accurately machined mounting and bearing surfaces so that they can be assembled without filing, chipping, or remachining. All parts shall conform accurately to the design dimensions and shall be free from any defect in workmanship or material that will impair their services. All attaching bolt holes shall be accurately drilled to the layout indicated on the approved drawings. The steel gates shall be completely shop assembled to insure the proper fit and adjustment.

B. Welding

i) *General*

Whenever welding is specified or permitted, the electric arc welding process, manual or machine welding shall be used.

Contractor shall provide adequate amount of materials for each type of welding and shall specify the materials on all relevant drawings. Contractor shall also provide detailed drawings showing joint preparation required for each type of welding to be carried out on the site.

ii) *Preparation*

The parts to be joined by electric welding shall be cut precisely to the correct size by machine methods suitable for the type of weld to be used and to allow the proper penetration and good fusion of the weld with the base metal. The cut surfaces shall not have visible defects such as scabs, superficial defects caused by shearing or torch cutting operations or any other damaging effect. The surfaces of a 40 mm wide strip on each side of the plate adjacent to the edge and the edges to be welded shall be free from rust, oil, grease and other foreign matter.

iii) *Lamination*

Any plate in which lamination has been discovered after cutting shall be rejected unless the laminated portion of plate is local and can be cut out and replaced by the welding of a sound plate in the cut out area with the approval of NIA. Repaired surfaces shall be ground smooth to assure neat appearance.

iv)*Welding Methods and Welder's Qualifications*

The welding method that would be employed by the Contractor shall be submitted to NIA for approval. Welds shall be balanced as far as possible to minimize distortion. Welding shall conform to AWS D1.1, Parts Procedures (Welding of Stressed Structural Components) not only with regard to workmanship but also with regard to qualifications of welders. Welders should be certified in the trade and such certification shall be submitted to NIA.

v) *Electrodes*

Contractor shall indicate on all detailed drawings the type and size of electrode he proposed for use for shop and/or field welding.

In general, welding electrodes for structural steel shall conform to Table 1.17.2 of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

Contractor shall provide the net quantity plus ten percent (10%) of each type of electrode required to complete each field welded joint.

C. <u>Non-Destructive Testing</u>

i) *General*

All tests shall be conducted with the approval of NIA and the cost of tests shall be borne by the Contractor

Radiographic, ultrasonic, magnetic particles or liquid dye penetrant tests shall be conducted on components as specified below. Where ultrasonic or magnetic particle tests indicate the possibility of a flaw, the suspected part shall be tested by radiography. All flaws shall be removed by thermal or mechanical gauging processed and replaced by welding. The replacement weld and contiguous parts of the original weld, if any, shall then be tested radiographically. All radiographs shall become the property of NIA.

The acceptability of parts inspected by magnetic particle and liquid dye penetrant test and the acceptability of use of these methods will be subject to agreement between Contractor and NIA.

ii) *Weld*

Radiographic examination shall be applied to the whole length of butt welds in plate furnishing stressed members.

Ultrasonic examination shall be applied to all other stressed groove welds.

Radiographic and ultrasonic examination shall be in accordance with AWS D1.1, Section 6.

iii) *Castings*

Castings shall be of fine grain quality and the surfaces which do not undergo machining, particularly those of steel or iron in contact with water, shall be dressed smooth in the foundry with all joints blended into adjacent surfaces and shall be free from foundry irregularities, such as projections, ridges, hollows, honeycombing, pock marks, blow holes and crack or chip marks, so that they will not require surface smoothing operations prior to painting. All defects shall be fully explored and castings shall be repaired, plugged or welded to the satisfaction of NIA.

iv)*Carbon Steel Plates and Shapes*

Carbon steel plates, shapes, bars, etc. for welded construction shall conform to materials specifications ASTM A-36, Steel shapes shall be in accordance with ASTM specifications. Plates from which webs, flanges and other stressed members are cut shall be ultrasonically tested for laminations according to ASTM A-578 at the place of manufacture.

v) *Forgings*

Forgings shall conform to ASTM A-668 Class D and shall be free from defects affecting their strength and durability, including seams, pipes, flaws, cracks, scales, fins, porosity, hard spots, excessive non-metallic inclusions and segregations.

The largest fillets compatible with the design shall be incorporated wherever a change in section occurs.

Tool marks or tearing of the metal by the finishing tools will not be acceptable on the surface of fillets. Such marks if it occurs, shall be removed by grinding or polishing. All finished surfaces of forging shall be smooth and free from tool marks.

All forgings in excess of 150 mm diameter shall be subjected to examination internally for the detection of flaws and to heat treatment for the relief of residual stresses.

D. <u>Fastenings</u>

i) All screws, bolts, studs and nuts shall be of International Standard (Metric) form of threads. Bolt heads and nuts shall be hexagonal. Hexagonal recesses shall be provided in the head of countersunk head bolts and machine screws. The bolt length shall be such as to ensure that at least two full threads are projecting after the nut has been tightened.

ii) Nuts and bolts for pressure containing parts shall be of best quality bright steel machined on the shank and bearing faces of head and nut.

iii) Where there is risk of corrosion, bolts shall be finished flush with the top of the nut after tightening, except in cases where the connected components are required to be frequently removed for replacement or adjustment when the bolts and nuts shall be of corrosion resisting steel or bronze.

All nuts shall be provided with washers, parallel or taper as appropriate. Mechanical locking devices of an approved form shall be provided where there is a possibility of nuts becoming loose due to vibration. Spring type washers will not be permitted where they maybe damaged any protective coating. Special locking compounds may be used as an alternative to mechanical devices subject to NIA approval.

E. Structural Work

i) Unless otherwise, specified, design and fabrication of structural parts shall conform to the applicable provisions of the AISC "Specifications for the Design, Fabrication and Erection of Structural Steel in Building" of the AISC "Code Standard Practice for Steel Building and Bridges".

F. Machine Work

All tolerances, allowances and gauges for metal shall conform to the ASA Standard B42, Tolerances, Allowances and Gauges for Metal Fits, for the class of fits as required.

Finished contact or bearing surfaces shall be true and exact to secure full contact. All holes or field assembly with bolts shall be accurately located and drilled for shop assembly. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to insure proper operation when assembled. All drilled holes for bolts shall be accurately located and drilled from template.

PROTECTION OF MACHINED SURFACES

Machined finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means.

FABRICATION

a. General

All members shall be free from twist, bonds or other deformations, and all surfaces that will be in contact hall be thoroughly cleaned before assembling.

All parts shall be cut accurately to the dimensions shown on the drawings. All edges shall show sound metal, free from laminations, surface cracks and other injurious defects.

Bumping or heating will not be allowed. Parts shall be adjusted to fit, and shall be firmly bolted or otherwise held securely together so that surfaces are in closer contact before welding is commenced. Close adherence to the dimensions and tolerance called for in the drawings is required.

b. Straightening

Rolled materials shall be straight and true before being laid out or worked. Necessary straightening shall be accomplished by methods that will not injure the metal. Sharp kinks or bents will be considered causes for rejection.

c. Bending

Where bending or forming of plates or shapes is required, the plates or shapes shall be bent to the proper curvature by cold forming. Heating shall not be employed except with specified approval of the Administrator, and special precautions, therefore shall be taken to avoid overheating. Prior to rolling or bending the plates, the edges shall be pressed properly to the correct curvature, as determined by templates, to produce continuity from the edges. Corrections of curvature by hammering will not be permitted.

d. Shearing, Chipping and Flame-Cutting

All plates or shapes shall be cut accurately to shape and size, with the edges to be joined by welding formed properly to suit the selected type of welding and to allow thorough penetration of the weld metal. Sheared edges shall be machined to a depth of not less than one-quarter of the thickness of the materials, to remove surface cracks caused by the shearing operation. Flame-cut edges shall be uniform and smooth and shall be free from loose scale and slag accumulations before being welded. Whenever possible, flame-cutting shall be guided by mechanical means. No materials shall be cut by electric arc. Chipping shall be done neatly and accurately, and exposed edges, shall be smooth.

e. Preparation for Field Welding

All necessary chipping, grinding, leveling and other preparation for joints or splice to be made by field welding shall be done in the shop.

f. Punching

In punch works, holes in materials having a thickness of less than three-quarter of an inch may be punched to full size. Holes in material having a thickness equal to or greater than three-quarter of an inch shall be drilled to full size. All holes shall be clean-cut, without torn or ragged edges.

g. Drilling, Reaming, Countersinking and Tapping

Unless otherwise called for on the drawings and except where reaming or tapping is required or where tight bolts are to be used, full sized drill and/or reamed holes shall be not less than 1.59 millimeter not more than 2.38 millimeter larger than the nominal drilled and/or reamed perpendicular to the face of the member and if necessary, shall be drilled to a template. Countersinking, where required, shall be true and square with the holes. Outside burns shall be removed. Tapped holes shall be drilled to the proper diameter for the tap used and shall be tapped carefully so that the threads will be continuous, smoothly cut, and free from imperfection.

h. Tolerance

Contact faces of gates and guides shall not depart more than 1 millimeter from a plane surface. Bottom contact edges shall not depart more than 2 millimeters from the designated planes. Fits, tolerance and finish when not specified, shall conform with the best modern shop practice in the manufacture of finished products of similar nature.

i. Lubrication

Before assembly all bearing surfaces, journals, grease and oil grooves shall be carefully cleaned and lubricated with an approved oil or grease. After assembly each lubricating system shall be filled with an approved lubricant.

GENERAL DESCRIPTION OF THE INSTALLATION AND OPERATING ARRANGEMENT

A. Sluice Gates

Sluice gates as shown on the Drawings are to be installed to desilt the sluiceway. The gates shall be of fixed wheel type. Each gate shall consist of an upstream skin plate supported by vertical and horizontal stiffeners spaced at required intervals which in turn shall be supported by end vertical girders. Wheels are to be mounted on the end vertical girders and provided with necessary bronze bushings. The total horizontal load on the gate shall be transmitted through the wheels on to the wheel track plates fixed on the piers with necessary embedments. Rubber seals on sides and bottom shall be provided on the upstream side of the gate to render the gate leak proof.

B. Intake Gates

i) Intake Gates of different sizes as shown on the drawing are to be installed to regulate the flow of water through the intake. The gates shall be of sliding type. Each gate shall consist of a downstream skin plate supported by vertical stiffeners spaced at required intervals and horizontal girders which in turn shall be supported by end vertical girders. The total horizontal load on the gate shall be transmitted to the vertical frame fixed on the piers with necessary embedments. The details of construction are shown in the NIA bid drawings.

ii) The gates are to operate at water level corresponding to normal and high flood level condition and the operation is hydraulically unbalanced.

iii) The gates are to be operated through manually operated pedestal lift with rising stem, of adequate capacity.

C. Flap Gate

a. *General*

Flap gates are to be installed to allow free flow through the gate and to close automatically to prevent backflow should a head reversal occur.

b. *Flap Cover and Frame*

The flap gate cover shall be made of steel and shall consist of an upstream skin plate supported by vertical and horizontal stiffeners spaced at required intervals. Music note type rubber seals shall be provided on the two sides as well as on the top and bottom of the upstream side of the flap to render the gate leak proof. These rubber seals shall be fixed to the flap by means of clamp steel plate and stainless steel bolts.

The flap gate shall be provided with arms mounted on steel hinges of the double pivot type using stainless steel pins and bronze bushings. A concrete counterweight shall be provided and attached to the arms in such a way that its position is adjustable in order to ease the opening of the flap gate. Final position of this counterweight will be determined by the field office.

All edges of the gate opening where the music note type rubber seal is in contact shall be provided with stainless steel seal seats. This seal seats shall be fixed/welded to the steel frames embedded on the concrete

STRUCTURAL DESIGN CRITERIA FOR GATES

a. General

The design shall ensure that:

1) The gates shall be reasonably watertight.

2) They shall be capable of being raised or lowered by the hoist at the speed specified.

3) Since all the gates are for regulation, they shall be held in partially open position within the range of travel to pass the required discharge without undue vibration.

b. Wheels and Wheel Tracks

1) The gate wheels shall be suitable to withstand the stresses developed due to the loads they carry.
2) The wheels and wheel tracks shall be machined true and shall operate smoothly without vibration and without undue drift.
3) The hardness of wheel track shall be 50 points Brinell Hardness Number (BHN) higher than the BHN of the wheel tread.

c. Wheel Bearing

1) The wheel bearing shall be bronze bushing with grooves for lubrication.

d. Wheel Pin

1) The wheels shall be mounted on fixed pins and the pin shall be harder than the bushing. Wheel pin shall be of stainless steel and the contact surfaces shall be finished smoothly.

2) The wheel pin shall be of cantilever type with support from the cantilever box of the end vertical girder. The rigidity of cantilever box should be ensured.

e. Seals and Accessories

1) Seals shall be fixed by means of stainless steel seal clamps and galvanized steel bolts to ensure positive water pressure between the seal and the gate and to bear tightly on the seal seat to prevent leakage. Edges of seal clamp adjacent to seal bulb shall be rounded.

2) Side rubber seals shall be flat or angle shape type - Bottom seal may be of wedge type.

3) The initial interference of side rubber seals shall be 3 mm pre-compression. The projection of bottom wedge seal shall be 6 mm. Suitable chamfer shall be provided at the bottom of skin plate/clamp plate to accommodate the bottom wedge seal in compressed position.

f. Guides and Sill Frames

1) The guide frames and sill frames shall be composed of steel plates and steel sections so built up as to suit the gate structure. They shall be securely fixed in concrete by means of anchor members to ensure that all hydraulic loads exerted on the gate will be safely carried and transmitted to the concrete works.

2) The guide frames shall be true and shall be sufficient for the lifting height of the gate.

3) The side seal seat shall be stainless steel with a minimum width of 75 mm. The seal seat shall be fixed on the seal seat base by welding. The fixing of the seal seat on its base shall ensure rigidity and water-tightness. The seal seat shall be finished smooth and the edges shall be rounded/chamfered to prevent damage to the seal.

4) All the seal seat base including the sill beam shall be embedded in concrete.

5) Sill beam flange width shall not be less than 100 mm and the length shall cover the entire waterway. The seal seat (stainless steel plate) welded to the top flange shall be at least 25 mm wider than the top flange width of sill beam. It shall be flushed with surrounding concrete. Each end of sill beam shall have provision for the connection of each side vertical frame to facilitate their location.

g. Embedded Parts

i) All structural parts of the guides, seal seats, wheel tracks shall be constructed straight and be free from twists and warping. The ends of sections of side guides shall be machined so that when assembled, the finished surfaces of adjoining sections shall be flushed and ends shall butt firmly to form watertight joints. The faces of all seal seats shall be in a true common plane and this plane shall be parallel to the plane tangent to wheel-track face. The ends of track sections shall also be machined smooth and square so that when tracks are assembled to the track base, the ends of adjoining sections shall butt firmly.

HOISTS

A. Hoist for Sluice Gate

1. *Gener*

a) The Contractor shall provide manually operated rope drum hoist of adequate capacity complete in every respect along with hoist supporting units and all accessories that would be required for the satisfactory operation of the sluice gates.

b) Each hoist mechanism shall consist of gear reducers, wire ropes, rope drums, shaftings, bearings, sprock-ets for diesel engine drive and all other mechanical accessories for the satisfactory operation of hoist.

c) The hoisting equipment shall be designed to raise, lower and hold the gate in any position between fully opened and fully closed positions. Hoisting equipment shall be enclosed in dust proof housing with suitable lugs and eye bolts for handling.

d) The complete equipment shall rest on a steel base framework which shall rest on the pier top.

B. <u>Mechanical Parts</u>

1. *General*

a) The components of the hoist mechanism shall be so proportioned as to take the severest load coming on individual components.

2. *Wire Rope*

a) The wire rope shall be made from improved plough steel of 6 x 37 construction with steel center, right regular lay, preformed and lubricated.

b) A turnbuckle shall be provided on one side of the wire rope connecting the gate and hoist to equalize the tension in the rope. Turnbuckle and wire rope fitting shall be galvanized.

c) The breaking strength of wire rope shall be as per standard manufacturer's specifications.

d) The strength of socket end of wire rope shall be approximately equal to the strength of the rope itself. The ends shall be safely secured against twisting.

3. *Drums*

a) The groove drum shall be of such size that there will be not more than one layer of rope on the drum when the rope is in its fully wound position.

b) The length of drum shall be such that each lead-off rope has minimum two full turns on the drum when the gate is at its lowest position and one spare groove for each lead-off of the drum when the gate is at its highest position.

c) If the ends of the drum are flanged, the flanges shall project to a height not less than two rope diameters above the rope. A spur gear secured to the drum may be regarded as forming as one of the flanges.

d) The lead angle (fleet angle) of the ropes shall not exceed 5 degrees or 1 in 12 on either side of helix angle of groove in the drum.

e) The drum shall be made of cast steel.

f) The drum shall be machined groove. Grooving shall be finished smooth and edges between groove rounded. The contour at the bottom of the grooves shall be circular over an angle of at least 120 degrees. The groove radius shall be 0.53 times the diameter of rope. The depth of groove shall not be less than 0.35 times the diameter of the rope

g) The pitch of the grooves shall be such that the clearance between adjacent turn of rope is at least:

1.5 mm for ropes up to 12 mm diameter

2.5 mm for ropes over 12mm diameter up to 30 mm diameter and

3.0 mm for ropes of over 30 mm diameter

h) The ends of the rope shall be fixed to the drum to such a way that the fixing device is accessible. Each rope shall be wound at least two turns before it is fixed (dead wrap).

4. *Gearing*

a) The reduction units of the hoist shall be composed of spur gears, bevel gears, worm and worm gears. The gears shall be machined cut with smooth finish.

b) Tooth form of spur and bevel gears shall be 20 degrees full depth involute system.

c) Spur and bevel gears shall be of cast steel, forged steel or surface hardened steel. The gears and pinions shall be made from two different grades of materials; the higher strength grade material for the pinion.

d) Standard worm and worm gears shall be high grade reduction unit of good efficiency suitable for long service life. The proportioning of parts therein shall be in accordance with the best engineering practice. The bearing section of the rotating shaft shall be fitted with anti-friction bearings designed for thrust and radial loads and the helical angle of the worm shall be designed for self-locking.

e) Keys in gear trains shall be fitted and secured that they should not work loose when in service.

f) Gears shall have removable housing with provision for convenient access for lubrication. All bolts and cap screws shall be provided with lock washers. All machined units shall be thoroughly cleaned to ensure that they are free of cutting and objectionable and abrasive material.

5. *Shafts*

a) The shafts shall be designed for appropriate torque/load that is being transmitted. Shafts shall have liberal factor of safety for strength and rigidity and shall have adequate bearing surfaces. They shall be finished smooth and, if shouldered, shall be provided with fillets of large radius.

b) All shafts shall be designed for safety against simple bending, pure torsion and the combined effect of bending and torsion.

6. *Bearings*

a) All the running shafts shall be provided with ball, roller or bush bearings. Selection of bearings shall be done on consideration of duty, load and speed of the shaft.

b) Bearings shall be easily accessible for lubrication and/or replacement.

C. <u>Intake Gate Hoists</u>

1. *Genera*

Intake gate hoist shall be manually operated. The pedestal lift shall be crank operated and the direction of rotation of the crank to open the gate shall be clearly indicated on the lifting mechanism.

2. *Manual Operation*

i) The manual operation should be designed in such a manner that the continuous effort per man does not exceed a crank force of 98 Newtons (10 Kgf) with 400 mm of crank radius at a continuous rating of 24 RPM.

3. *Gate Stem, Coupling and Stem Guides*

i) Stems shall be of cold finished steel. Each stem shall be of adequate size to safely withstand operation of the gate (both raising and lowering) under the specified head and shall be furnished in sections of suitable length with necessary couplings to facilitate removal and replacement, if necessary. The couplings shall be of the same materials as the stem and shall be safely pinned, bolted or threaded and keyed to the stem. The bolts and pins shall be of stainless steel. The stems shall be provided with suitable stop nuts with provision for adjustment to prevent damage to the bottom of the gate due to overrun of the gate when closing.

ii) Stem guides shall be as recommended by the manufacturer and shall be adjustable in two directions. Stem guides shall be provided with either bronze-bushed cast iron or steel collars bolted into place.

4. *Pedestal and Lifting Mechanism*

i) The pedestal shall have a cast bronze lift nut threaded to fit the operating stem. Ball thrust bearings shall be provided above and below the flange of this lift nut to take the computed maximum thrust developed in opening and closing the gate.

ii) Gears shall be of cast steel accurately machined with cut teeth and smooth operating with drive shafts running in bronze sleeve bearing of ample size.

iii) All gears and bearings shall be enclosed in a cast iron housing. The gears and bearings shall be easily accessible for maintenance and lubrication. The housing shall be adequate to withstand the tropical climate.

iv) The lift mechanism shall be provided with a cast iron or structural steel pedestal machined and drilled to accommodate the gear housing and suitable for bolting to the operating floor.

v) The crank shall be of cast iron and detachable and provided with a rotating handle.

D. <u>Lubrication</u>

1. *General*

i) All bearings, journals and locations where sliding between parts takes place shall be provided with adequate means of lubrication.
ii) Adequate seals shall be provided wherever necessary to prevent the escape of lubricants during normal operation and the entry of foreign matter.
iii) All the equipment covered under the scope of this contract shall be handed over to NIA in running order with all moving parts properly lubricated and fully charged with the recommended lubricant.
iv) Contractor shall provide a list of all recommended lubricants for each location and the compatible types of lubricant from the product line of all major companies in the Philippines.

2. *Grease Lubrication*

i) Unless otherwise specified, all greasing shall be effected by high pressure hand grease gun.

ii) All fittings shall, if possible, be of the same size.

iii) Underwater equipment shall be charged with lithium based grease, for other locations the grease shall be calcium based.

3. *Oil Lubrication*

i) Gear boxes shall be provided with an oil level sight glass or dipstick, a screw capped filling hole and drain cock.

ii) Where pressure oil lubrication of bearings is adopted, a filter and overload facility shall be provided in an accessible position.

iii) All opening or joints in the gear box casing shall be provided with gaskets to avoid oil leakage.

iv) Contractor shall provide the net quantity plus ten percent (10%) of the required oils and grease for the first filling and charging of the equipment at site.

v) The oil shall be delivered in steel drums and grease in steel kegs. The containers shall be non-returnable.

LIFTING MECHANISM INSTALLATION, TESTS AND ADJUSTMENTS

The installation of the lifting mechanism and anchorage shall be in accordance with the details as shown on the Drawings. The Contractor shall send qualified and experienced Installation Supervisor who will supervise the installation of the lifting mechanism.

Lifting mechanism shall be installed complete with gear reductions, couplings, shafting, shaft bearings, drums, wire ropes, anchor bolts and all other materials for complete assembly. Lifting mechanism shall be assembled and accurately placed in correct alignment by the use of shims and wedges between the sole plates or base plates and concrete. Dry packing shall be done after the dry-pack has set.

After the lifting mechanism have been completely installed, adjusted and made ready for operation, the Contractor shall conduct test runs for the gates and lifting mechanism. All units shall be tested for normal operating speed to ensure that all necessary clearances and tolerances have been provided and that no binding occurs in any moving part. The cost of performing all the required test shall be borne by the Contractor.

All tests shall be performed in the presence of an authorized representative of NIA. All data shall be certified correct and submitted to NIA. All defects found during the test as a result of the installation work shall be corrected accordingly to the satisfaction of NIA.

EMBEDDED PARTS

Special attention shall be given to the method by which embedded parts are aligned during erection and secured against movement during the placing of the second stage concrete.

The proposed method which is indicated on the Drawings utilize adjusting anchors welded at one end to anchor plates embedded in first stage concrete and fastened by means of two adjusting nuts at the other end to the embedded parts.

ANTI-CORROSION MEASURES AND PAINTING

a. General

i. The steel gate shall be designed to minimize as much as possible the effects of localized corrosion. Drain holes shall be provided in all locations where the entrapment of water can occur.

ii. All steel surfaces except stainless steel surfaces shall be coated and/or painted with a protective film specified under Section C below.

iii. Crevices over which the protective film can bridge shall be retouched or repaired prior to coating.

iv. Boxed in members shall be provided with access holes or shall be treated internally with an effective coating material.

v. All coating or paint materials to be used shall be original sealed container bearing the manufacturer's label revealing complete identification of content and shall be subject to inspection by NIA prior to coating and/or painting. The NIA shall have the right to reject any paint material supplied under these specifications which is found to be defective.

b. Surface Preparation and Shop Painting

Upon completion of fabrication and machining works but prior to application of coating materials, the Contractor shall notify NIA in writing that the surface preparation for painting is in progress. Coating application shall commence only

after the NIA or their duly authorized representatives have inspected and subsequently approved the surface preparation in accordance with these specifications.

NIA or their designated inspectors shall undertake from time to time, inspection of the painting works while it is in progress. NIA shall be at liberty to reject outright any deviation to material specifications and procedure noted during inspection.

Notwithstanding such inspection, the Contractor shall be held responsible for the acceptability of the finished work.

All oil, grease, soil and other contaminants shall be removed from steel and cast iron surfaces by the use of clean solvent, emulsion, cleaning compound or other methods which involve cleaning action.

Following the solvent, the surfaces shall be cleaned of all defective or damage areas of existing paint, and of all loose rust, loose mill scale and other foreign substance in accordance with the requirements for surface preparation as specified hereunder.

i. Immersed Steel

Except where otherwise specified, all steel surfaces and all parts of structures that have surfaces which are exposed and/or permanently immersed in water, shall be blast cleaned by commercial blast cleaning (SSPC-SP6) then painted with 2 coats of coal tar epoxy paint conforming to U.S. Military Specifications MIL-P23236 (Ships) Type I, Class 2 to produce a total dry film thickness of 400 microns (16 mils.),

ii. Steel Exposed to Atmosphere (Lifting Mechanism and Accessories including Enclosures)

Except where otherwise specified all steel and cast iron surfaces of lifting mechanism and accessories including its enclosure which are exposed to atmosphere shall be blast cleaned by commercial blast cleaning (SSPC-SP6) then applied with 1 coat of Alkyd Red Lead Primer. After proper drying time is attained apply 2 coats of Alkyd Enamel finish to attain a total dry film thickness of 175 microns (7 mils.).

iii. Embedded Steel Work

Where not otherwise specified, all steel surfaces which will be embedded or against which concrete will be placed shall be cleaned by power tool cleaning (SSPC-SP3) then painted with 1 coat of cement latex milk consisting of 10 parts of Portland Cement (by weight), 5 parts of water and 1 part modified latex emulsion.

iv. Repair of Paint Film

The Contractor shall retouch or repair areas of steel gates which maybe damaged during transit from shop to the site of delivery.

All paints shall be applied in conformity with SSPC-PAI Shop, Field and Maintenance Painting, by skilled personnel fully experienced in this type of work.

C. Machine Surfaces

All finished surfaces of ferrous metals that will be exposed during shipment or while awaiting installation shall be cleaned in accordance with a coating of heavy, gasoline rust preventive compound.

D. Stainless Steel Surfaces

No painting is required for finished or unfinished stainless steel parts.

PREPARING FOR TRANSPORTATION

i) Shipment of fabricated works to the Project Office should be made only upon issuance of pre-delivery inspection and acceptance report to the fabricator/manufacturer by the NIA Office.

ii) The Project Office reserves the right to conduct its own final inspection upon arrival at the project office before issuance of final acceptance report and any findings made thereat should be noted in the final inspection report for appropriate action by the Central Office.

iii) All parts shall be prepared for transportation so that slings for handling maybe attached readily wherever the parts are to be moved. When it is unsafe to attach slings to the boxes/crates, boxed parts shall be packed with sling attached to the part and the slings shall project through the box or crate so that attachments can be made easily.

iv) All exposed finished surfaces shall be adequately protected against abrasion and injury during transportation and all long and slender pieces shall be safely supported and blocked.

v) Rubber seals shall be dismantled after shop assembly and shall be transported separately. They shall be so packed and protected that their size, shape and physical properties are not affected during transportation.

vi) The gates shall be prepared for transportation as to involve the minimum amount of field assembly.

a. Packing

i) The bid price shall include and provide for securely protecting and packing the equipment so as to avoid the damage during transport. All packing shall allow for easy removal and checking at site. Special precaution shall be taken to prevent rusting of the parts. Gas seals or other methods if proposed to be used shall have the approval of NIA. Each carton or package shall contain a packing memorandum mentioning the name of the Contractor, the number and date of the Contract and the name of the office placing the order.

ii) The equipment shall be insured for loss or damage during transit to the field, the cost being borne by the Contractor.

iii) Notwithstanding anything stated above, the Contractor shall be entirely responsible for loss, damage or depreciation to the equipment and materials.

b. Marking

Each part of gates, hoist and embedded parts which need to be transported from the shop to the field site as separate piece shall be marked to show the unit of which it is a part and match marked to show its relative position in the unit to facilitate assembly in the field. Unit marks and match marks shall be made with heavy steel stamps and paints. Each piece, sub-assembly or package to be transported separately shall be labeled or tagged with transportation designation consisting of the Specification number and the mark number of such piece or the number of parts grouped in such assemblies or package.

ACCEPTANCE OF WORKS

After the steel gates have been installed in the field, it will be operated and tested by the NIA and when so operated and tested it shall meet all the requirements of the specifications. The gates shall be raised and lowered several times for the full length of the travel. The primary requisite for acceptance shall be that each gate operates smooth and shall be watertight.

A. Tests

i) The Contractor shall carry out such tests on the gates and hoist equipment as maybe required by the Engineer. Contractor shall be responsible for all modifications and adjustments required for the works as a result of such tests.

ii) The test shall include:
   a) operational tests in the dry
   b) operational tests with fully hydrostatic load
   c) leakage test

iii) Test maybe repeated, if necessary, until they successfully carried out to the satisfaction of the Engineer.

iv) The tests will be carried out at the convenience of the Engineer the cost thereof shall be borne by the Contractor.

B. Operational Tests in the Dry

Operational tests in the dry shall be carried out after completion of erection when all the power supply have been connected and adjusted. The tests shall include at least two complete traverses from the maximum raised position to the full seating position. Manual operation will also be similarly tested. All adjustments, clearances, brakes, motors and controls, etc. shall be checked for proper operation.

C. Operational Test under Hydrostatic Head

i) These tests shall simulate the actual operating conditions as closely as possible.

ii) At least one complete traverse will be made on the sluice and intake gates from the fully closed position to the normal raised position as follows:

   a) With the gate initially in the fully closed position raise it to the normal open position until stopped by the limit switch;

   b) Lower the gate to the fully closed position;

   c) Ascertain proper operation against over-travel;

   d) Record and report fan speed, motor torque and current while raising and fan speed during closing;

D. Leakage Tests

Leakage test shall be carried out with the gate lowered on the sill. Before the observation for leakage, the gate shall be raised and lowered by about one meter, several times to dislodge any debris that might have lodged on the side seals. The leaking shall then be measured. Excessive leakage shall be rectified until it is reduced to 15 (fifteen) litres/minute/metre length of the seal.

MANUALS

The fabricator/manufacturer shall prepare and furnish NIA and the installation contractor's staff, the installation procedure, operation, and maintenance manuals for all of the works as provided for in the Contract Documents.

METHOD OF MEASUREMENT

Measurement for furnishing and installation of gates and stoplog will be made on the number of assemblies of the different classes and sizes acceptably installed and tested.

BASIS OF PAYMENT

The cost for the supply and delivery of various steel gates will be paid at the contract unit price per assembly or the lump sum price whichever is stated in the Bill of Quantities, which shall include all equipment and materials prescribed in this section and directed by the Engineer.

The cost for the installation provided under this item will be paid at the contract unit price which shall constitute full compensation for furnishing all labor, materials, tools, equipment, supplies and all incidentals and subsidiary works necessary for the successful completion of the works.

Payment for the work provided under this item will be made separately for the supply and delivery, and installation of various gates and lifting mechanism as follows:

a) Supply and delivery

For the supply and delivery of various gates and lifting mechanism, eighty percent (80%) of the respective unit price in the Bill of Quantities shall be paid upon delivery to the project site in accordance with this technical specification acceptable to NIA.

All equipment/materials delivered at the site, shall be kept by the Contractor and will be responsible for any loss or damage of the equipment/materials until they are installed. Any loss or damage to the equipment/materials shall be replaced by the Contractor at his own expense.

Twenty percent (20%) shall be paid upon installation of the equipment and materials, and ready for operation as certified by the Engineer.

b) Installation

One hundred percent (100%) of the respective unit price of each installation works which shall include labor, consumable materials, subsidiary works and other incidentals required for the successful completion of the works shall be paid upon complete installation of the respective equipment/ materials all in accordance with the drawings and accepted by the Engineer.

MISCELLANEOUS METALWORKS AND MATERIALS

SCOPE

The work under this Section shall include furnishing, delivering and installing all miscellaneous metalworks and materials shown on the drawings which shall include but not limited to the following:

1. Trashracks or screens including frames, guides and anchors
2. Steel ladder rungs
3. Steel gratings including frames, guides and anchors
4. G.I. Pipes guardrails and handrails
5. Bearing plates for bridges
6. Bearing pads and filler board for bridges
7. Perforated drain pipes
8. Embedded metals including plates, anchors, angles, strap anchors, bolts, nuts washers, flanges, fittings, bends, tees, cross, elbow and other metals or materials which are not paid for under other items in the Bill of Quantities
9. Timber

All metalworks treated in this Section shall conform to the following standards or their approved equivalent standards:

ASTM AG General requirements for delivery of rolled steel plates, shapes, sheet piling bars for structural use

ASTM A36 Structural Steel

AWS D1-1 Structural Welding Code

AWS	Code for Arc and Gas Welding in Building construction
ASTM A307	Specification for Low-Carbon Steel Externally and Internally Threaded Std. Fasteners
ASTM A325	High Strength Bolts for Structural Steel Joints including Suitable Nuts and Plain Hardened Washers
ASTM A108	Cold Finish Carbon Steel Bars and Shafting
AISC	Manual of Steel Construction
ASTM A123	Zinc (Hot Galvanized) Coatings on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips
ASTM A53	Welded and Seamless Steel Pipe
Metal Grating	Metal Grating Institute Handbook
	Pittsburg, Pa. U.S.A
ASTM 120	Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses
AISC	Specification for Design, Fabrication and Erection of Structural Steel for Buildings
ASTM A153	Galvanized Steel Pipes

FABRICATION

Details of design and fabrication not covered by the drawings nor by these specifications shall conform to the applicable provisions of the latest "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" including all supplementary provisions of the American Institute of Steel Construction.

All metalworks and materials furnished by the Contractor and all works performed will be subject to rigid inspection. No metalworks or materials shall be delivered to the jobsite until inspection at the Contractor's fabricating plant has been made, in accordance with the provisions of these specifications.

Shearing and cutting by torch or electric arc shall be performed carefully, and all portions of the work which will be exposed to view after completion shall be finished neatly. Re-entrant cuts and copes shall be shaped notch-free to a radius of at least 12 millimeters.

In bolted connections, all holes shall be cylindrical, unless otherwise shown on the drawings, perpendicular to the members, and clean cut and without burned or ragged edges. Holes in materials more than 20 mm thick shall be drilled. All other holes may be punched or drilled to full size. Unless otherwise shown on the drawings, drilled holes shall be 1 mm larger than the nominal diameter of the bolt. Outside burrs resulting from drilling shall be removed with a tool making a 1 mm bevel. Likewise for punched holes, unless otherwise shown on the drawings, the diameter of the punch for punching to full size shall also be 1 mm larger than the nominal diameter of the bolt. The diameter of the die shall be not more than 1.50 mm larger than the diameter of the punch.

Welding shall be done by the shielded-arc method except where otherwise specifically permitted by the Engineer. Welding rods shall be furnished by the Contractor and shall be of heavily coated type designated for all position welding, and the size, type and nomenclature of the rods shall be subject to approval by NIA. Welds shall be made as indicated on the drawings and in accordance with the conventional symbols of the American Welding Society (AWS). Welding shall be done in accordance with Sections 3, 4, 5 and 6 of the AWS'

code for Arc Welding and Gas Welding in Building Construction, latest revision. All butt welds shall have complete penetration. Teeming of multiple layer welds will not be permitted.

INSTALLATION

All metalworks and materials shall be installed in accordance with the details shown on the Drawings. Care shall be taken to insure that all parts of metalworks are installed in correct position and alignment. Metalworks to be embedded in concrete shall be located accurately and shall be held in correct position and alignment during placing and setting of the concrete. Anchor bolts shall be set and held in position before concrete is placed, unless otherwise approved. Where it is impractical to embed anchor bolts or ladder, stairways or other comparatively light metal work before the concrete is placed and when it is necessary to anchor parts where inserts or anchor bolts have not been provided, holes shall be drilled in the concrete and expansion anchors with bolts shall be installed as directed. The surfaces of all metalworks to be in contact with or embedded in concrete or grouting mortar shall be cleaned.

Suitable blockouts shall be constructed in the concrete where required for installation of railing posts and other metalworks. After installation of the metalworks, blockouts shall be filled with concrete or grout as shown on the drawings. Contractor shall drill or drill and tap, as required all holes in metalwork required for installation of the metalwork.

Contractor shall drill all holes in concrete required for the installation of expansion anchors. Contractor shall slot or cut or split metalwork in the field as required for installation.

TRASHRACKS OR SCREENS

Trashracks or screens shall be a substantial all welded sectionalized steel structure, generally as shown on the drawings. Special care shall be taken to insure that all members shall be in exact position and alignment. Vertical members shall be welded to horizontal members. Trashracks shall be prime coated and painted in accordance with Section XXXVI, Painting Metalworks.

STEEL LADDER RUNGS

Steel ladder rungs shall be furnished and installed in accordance with details shown on the drawings. Bars used for steel ladder rungs shall be cold drawn steel wire conforming to the provisions of ASTM Designation A32 or its latest revision. The wire gage or bar size and spacing shall be as designated on the Drawings.

Ladder rungs embedded in concrete shall be free of mortar, oil dirt, loose mil scale, loose rust and other coatings that would destroy or reduce the bond. Bars shall conform to the dimensions shown on the drawings. Bars with links or improper bends or other deformations shall not be used or made as rungs.

STEEL GRATINGS

Gratings shall be provided as indicated on the drawings. Steel gratings shall be fabricated from steel shapes and flat bars provided with stiffeners and welded to form a rigid structures as shown on the drawings.

Flat bars of sizes and spaces shown on the drawings shall be welded at their ends into continuous rolled steel angles and provided with stiffeners. The sizes and dimensions of angles or stiffeners shall not be less than those shown on the drawings.

Steel gratings used as cover for the intake barrel manhole shall be provided with rollers on both ends as shown on the drawings, such that this cover could be opened by sliding. Roller guides shall not be shorter than the length shown on the drawings.

GALVANIZED IRON PIPE GUARDRAILS AND HANDRAILS

Galvanized iron pipe guardrail and handrail shall be provided at operating platforms and other places shown on the drawings. Sizes and dimensions shall be as shown in detail on the drawings. All railings shall be of threaded ends and furnished with complete joint fittings.

Vertical members for guardrails shall be installed plumbed and horizontal members parallel to the surface of anchorage. Vertical members shall be installed in prepared sockets, braced in true alignment and secured permanently by either threaded floor flange which is anchored to the concrete structure by means of expansion bolts as shown on the drawings or by cement grout consisting of 1 part cement and 3 parts sand (by wt.) mixed to a consistency as directed by the Engineer. Bolts in bolted connections shall be firmly tightened.

Galvanized surfaces that are abraded or damaged during installation shall be thoroughly wire brushed removing all loose and cracked coating and then painted with two coats of high zinc- dust content paint conforming to the requirements of Federal Specification MIL-P-21035 or approved equal.

BEARING PLATES FOR BRIDGES

Bearing plates, bars, rockers, assemblies, and other expansion or fixed devices for bridges shall be constructed in accordance with the details shown on the Drawings and shall be hot-dip galvanized after fabrication conforming to ASTM Designation A120 or its latest revision.

The bearing plates shall be set level and the rockers and other expansion devices shall be set to conform to the temperature at the time of erection or to the setting specified.

When bearing assemblies or masonry plates are shown on the Drawings to be placed (not embedded) directly on concrete, the concrete bearing area shall be constructed slightly above grade and shall be finished by grinding or other approved means to a true level plane which shall not vary perceptively from a straight edge placed in any direction across the area. The finished plane shall not vary more than 0.30 centimeter from the elevatio shown on the Drawings.

When elastic bearing pads, or preformed fabric pads are shown on the Drawings, the concrete surface on which pads or packing are to be placed shall be wood float finished to a level plane which shall not vary more than 0.40 centimeter from a straight edge placed in any direction across the area. The finished plane shall not vary more than 0.30 centimeter from the elevation shown on the Drawings.

BEARING PADS AND FILLER BOARDS

Bearing pads of sizes indicated on the Drawings shall be neophrene, hardness 60 and filler boards shall be canex board or as indicated on the Drawings. The concrete surfaces on which bearing pads are to be placed shall be wood float finished to a level plane which shall not vary more than 0.15 centimeter from a straight edge placed in any direction across the area. The finished plane shall not vary more than 0.30 centimeter from the elevation shown on the Drawings

PERFORATED DRAIN PIPES

Perforated drain pipes shall be installed at locations shown on the drawings and as directed by the Engineer. The sizes and type of materials to be used shall be as indicated on the drawings.

BOLTS, ANCHORS, ANGLES, NUTS, WASHERS AND OTHER METALS

Except for studbolts, the length of connection bolts shall be in 6 mm variations and when in the structure, the bolts shall extend at least six millimeters beyond the nuts. Anchor bolts and studbolts shall be as shown on the Drawings. Threads of anchor bolts shall be given a heavy coat of rust preventive compound in the shop. Washers shall be used under heads of all connection bolts where shown or called for on the drawings. Bevelled washers shall be used on sloping flanges.

GROUT AND MORTAR

Grout and mortar for miscellaneous metalworks shall be mixed in the proportions and to the specified consistency in accordance with the requirements of Section XV, Concrete. Before placing grout and mortar, the surfaces of concrete on which grout will be placed shall be roughened and shall be cleaned of all laitance, loose or defective concrete coatings and other foreign materials by effective means followed by thorough washing and such surfaces shall be kept moist for at least 24 hours.

TIMBER

This work shall consist of timber structures constructed to the dimension, lines and grades shown on the Drawings and in accordance with the specification. The timber shall be treated or kiln dried.

In handling treated timber, care shall be exercised so as not to break or penetrate the treatment with any tool or handling equipment. Any damage timber shall be replaced without any extra compensation. Any cut made or hole bored in treated timber that exposes untreated wood shall be given 3-coats of hot creosote oil before the exposed part is assembled.

All timber shall be of the specie specified in the drawing, shall be sound, free from knots, splits, ring separation, wormholes or any defects which will impair its strength or render it unfit for its intended use.

All timber which is to be stored on the job for any length of time, prior to its use in the structure, shall be neatly stacked in piles to prevent warping or distortion. Untreated timber shall be open stacked at least 300 mm above the ground and shall be close-stacked and piled to prevent warping. The ground underneath and in the vicinity of all piles shall be cleared of all weeds and rubbish.

METHOD OF MEASUREMENT

Measurement for payment of miscellaneous metalwork and materials will be made either on the weight of metalwork in kilogram or on the number of assembly or pieces actually installed in accordance with the table asfollows:

Metal/Material	Measurement
1. Trashrack or screens including frames, guides and anchors	Kilogram/Set
2. Steel ladder rungs	Kilogram
3. Steel grating, including frames guides and anchors	Kilogram
4. G.I. Pipe guardrails and handrails	Kilogram/L.M.
5. Bearing Plates for Bridges	Piece
6. Bearing Pads and Filler Boards for Bridges	Piece
7. Perforated drain pipes	Kilogram/L.M.
8. Embedded metals including plates, anchors, angles, strap anchors, bolts, nuts and washers, flanges, fittings,	Kilogram/Lump sum

bends, tees, cross, elbows and other metals or materials which are not paid under other items in the Bill of Quantities

9. Timber — Set/Assembly or bd. ft.

Weights shall be computed based on the theoretical weight of such material duly certified by the manufacturer.

BASIS OF PAYMENT

Payment for miscellaneous metalwork will be made at the contract unit price per kilogram, per piece, or per assembly whichever is called for in the Bill of Quantities which price and payment shall constitute full compensation for furnishings all labor tools, materials and all incidentals and subsidiary works necessary for the successful completion of the miscellaneous metalworks and materials described under this Section.

DIVERSION AND CARE OF RIVER DURING CONSTRUCTION

AND UNWATERING FOUNDATION

GENERAL

The Contractor shall be fully responsible for the successful diversion and care of the river and dewatering of all excavations, foundations and elsewhere as required to undertake construction works in the dry

The Contractor shall construct and maintain all necessary cofferdams, channels, flumes, drains and sumps and/or temporary diversion and protective works during construction operations. The Contractor shall furnish, install, maintain and operate all necessary pumping and other equipment for the diversion and care of river and the removal of water from excavations, foundations and the various parts of the works as required for construction. After having served their purpose, all cofferdams or other protective works, unless otherwise directed by the Engineer, shall be removed or leveled to give a sightly appearance and so as not to interfere in any way with the operation of the Project.

If materials removed from "structure excavation" are used by the Contractor for the construction of cofferdams and other temporary protective works and are washed out and carried away by floods, or rendered unsuitable for "structure backfill" by virtue of such use by the Contractor, these materials shall be replaced by the Contractor at his own expenditures.

METHOD OF CONSTRUCTION

a) **Diversion and Care of River**

The Contractor shall submit to NIA for approval any amendment to his proposed schemes for handling the river during construction within 30 calendar days after the date of receipt of the Notice to Proceed.

The arrangement of the cofferdams and the materials used for their construction, the height of these structures, and the decision for scheduling diversion and care of the river shall be the responsibility of the Contractor. However, the location of the cofferdams, the materials used in these structures and the procedure of placing and compacting the fill materials shall be subject to the approval of the NIA. If steel sheet piles are necessary in the construction of the cofferdams, same shall be furnished and installed or driven by the Contractor and all expenses incurred thereof shall be considered included in the fixed lump sum price or lump sum bid price whichever is stated in the Bill of Quantities for the Diversion & Care of River during construction and unwatering foundation.

The Contractor's method of dewatering excavations and foundations shall be subject to the approval of the NIA. Where foundation excavation extend below the water table in common materials, the portion below the water table shall be dewatered in advance of excavation. The dewatering shall be accomplished in a manner that will maintain stability of the excavated slopes and bottom of the excavation and will result in all construction operations being performed in the dry. The Contractor will also be required to control seepage along the bottom of the excavation.

BASIS OF PAYMENT

The cost of furnishing all labor, equipment and materials for construction of cofferdams, dikes, channels, flumes, sumps and other diversion and protective works, where required; maintaining the work free from water as required or removal of water from excavations and foundations; disposing of materials in cofferdams; and all other works required by this Section shall be included in the fixed lump sum price or lump sum bid price whichever is stated in the Bill of Quantities for the Diversion and Care of River during Construction and Unwatering Foundation. These items of work are not subject to price adjustment due to variation in quantities.

In order to have a working basis for making progress payments, the Contractor shall submit a detailed drawings of their proposed cofferdams covering several stages corresponding to the number of dry season period to enable computation of cofferdam fill volume. Payment for the construction of cofferdams for a certain stage can be made to the Contractor on a pro-rata basis using the cofferdam fill volume for that particular stage as proportioned against the total cofferdam fill volume for all stages and shall further be made on the following basis:

1. Fifty percent (50%) of the corresponding lump sum price will be paid after completion of the cofferdamming work.

2. Thirty percent (30%) of the corresponding lump sum price will be paid for maintenance after all works within the said enclosing cofferdam have been satisfactorily completed.

3. The remaining twenty percent (20%) of the corresponding lump sum price will be paid after the removal of all cofferdams and/or temporary diversion and protection works and corresponding clean-up operations shall have been satisfactorily undertaken by the Contractor

All dewatering in excavations and foundations for structures along canals other than bridges and siphons which may pass across rivers are considered subsidiary works for the construction of said canal structures and will not be included for payment under this Section. The cost of such work shall be considered included under Section VI, Structure Excavation, in the Bill of Quantities.

ASPHALT CONCRETE SURFACING - PLANT MIX

3701 DESCRIPTION

This work shall consist of furnishing and mixing aggregates and asphalt binder at a central mixing plant, transporting the mixture and spreading and compacting it on a prepared base in accordance with the Specifications and the Drawings.

3702 MATERIAL REQUIREMENTS

A. Aggregates

1. Coarse and fine aggregates shall be clean, hard, tough, sound particles free from decomposed materials, vegetable matter and other deleterious substances.

2. Coarse aggregate, which is material retained on a 4.75 mm (No. 4) sieve, shall consist of crushed rock or crushed river gravel. At least 50 percent by weight of the coarse aggregate shall have at least one fractured face.

3. Fine aggregate, which is material passing a 4.75 mm (No. 4) sieve, shall consist of sand or stone screenings or a mixture thereof. At least 50 percent by weight of the fine aggregates shall be angular or fractured particles. Sand shall not comprise more than 25% by weight of the total aggregate.

4. The combined aggregate shall conform to one of the gradings shown in Table I. When the combined grading of the coarse and fine aggregates is deficient in material passing the No. 200 sieve, additional filler materials shall be added. The filler material shall consist of finely divided rock dust, hydrated lime, portland cement or other suitable mineral matter and shall conform to the grading shown in Table II. However the grading shall be adjusted to take account of the results of the trials to allow the asphalt concrete mix to conform in all respects to the requirements for the job mix specified in paragraph 3703.

TABLE I AGGREGATE GRADING FOR ASPHALT CONCRETE

MIX CLASS	CLASS B
MIX USE	WEARING, BINDER
MINIMUM COMPACTED THICKNESS	35 mm

Asphalt Concrete Surfacing-Plant Mix

U.S. STANDARD SIEVE mm alternative	PERCENT PASSING BY WEIGHT
25 (1 in)	
19 (3/4 in)	100
l2.5 (1/2 in)	80-l00
9.5 (3/8 in)	70-90
4.75 (No. 4)	50-70
2.36 (No. 8)	35-50
0.600 (No. 30)	18-29
0.300 (No. 50)	13-23
0.150 (No. 100)	8-16
0.075 (No. 200)	4-10

TABLE II FILLER GRADING FOR ASPHALT CONCRETE

US STANDARD SIEVE mm alternative	PERCENT PASSING BY WEIGHT
0.600 (No. 30)	100

0.300	(No. 50)	65-100
0.075	(No. 200)	80-10

5. The coarse and fine aggregates shall meet the following requirements.

a) The percentage of wear by the Los Angeles Abrasion Test (AASHTO T 96) shall not be more than 40.

b) The loss when subjected to five cycles of the Sodium Sulphate Soundness test (AASHTO T104) shall be less than 12%.

c) The Sand Equivalent (AASHTO T 176) determined after all processing except for addition of asphalt cement shall not be less than 45.

d) All aggregates shall be non-plastic

e) The flakiness index of the aggregate retained on the 9.5 mm (3/8 in) sieve then tested in accordance with BS812 shall not exceed 35%. (The flakiness index of an aggregate is the percentage by weight of particles in it whose least dimension (thickness) is less than three fifths of their mean dimension. The test is not applicable to material passing a 6.3 mm (1/4 in sieve.)

B. Asphaltic Material

Asphalt binder to be mixed with the aggregate shall be asphalt cement penetration grade 60-70 or 85-100 as specified in the Contract and shall meet the requirements of paragraph 3705.

C. Composition of Mix

The asphalt concrete mixture shall conform to the requirements of Table III. However, the exact composition of the mixture shall be adjusted to take account of the results of the mix trials to allow the asphalt concrete mix to conform in all respects to the requirements of paragraph 3703.

TABLE III ASPHALT CEMENT CONTENT OF ASPHALT CONCRETE MIX

% OF ASPHALT CEMENT OF TOTAL MIX BY WEIGHT

BINDER COURSE		WEARING COURSE	
minimum	maximum	minimum	maximum
4.0	5.5	5.0	7.0

3703 CONSTRUCTION REQUIREMENTS

A) Mixing Plant

1.The plant shall be either a batch plant or continuous mix plant of adequate capacity, coordinated and operated to produce a mixture within the limits of the Specification.

2. The plant scales for any weigh-box or hopper shall be of either the beam or the springless dial type, sensitive to one-half of one percent of the maximum load that may be required and shall be of standard make and design. When of the beam type there shall be a separate beam with tell-tale indicator for each size of aggregate, and a tare beam for balancing the hopper.

3. Tanks for storage of asphalt cement shall have a capacity of at least 7 days run and shall be capable of heating the material, under effective and positive control at all times, to the temperature requirements given in paragraph 3406. The method of heating shall be such that the products of combustion or the flame shall not come into contact with the asphalt cement. Before the asphalt cement is placed in the mixer it shall be heated in a direct fired heater of such capacity that it need never be less than half full. Heating of material supplied in barrels shall be subject to the same conditions.

4. The plant shall be provided with accurate mechanical means for uniform feeding of the aggregates into the dryer so that a uniform production and a uniform temperature of the heated aggregates is secured.

5. A rotary dryer of satisfactory design for drying and heating the aggregates shall be provided. The dryer shall be capable of drying and heating the aggregates to the temperature requirements specified in paragraph 3703 D for the type of asphaltic material to be used.

6. Suitable screens capable of screening all aggregates to the sizes required, and having normal capacities slightly excess of the maximum output of the mixing plant shall be provided.

7. The plant shall include at least three storage bins for screened aggregates with total capacity of not less than three times the dead load of the mixer in the case of a batch mixer, or not less than a run of 10 minutes in the case of a continuous mixer. Bins shall be divided into compartments arranged to ensure separate and adequate storage of appropriate sizes of aggregate. Each compartment shall be provided with an overflow pipe that shall be of such a size and so located as to prevent any backing up of material into other bins. Adequate dry storage shall be provided for filler, if used, and satisfactory provision made for proportioning the filler for each batch of mixture.

8. Satisfactory means either by weighing, metering or volumetric measurement, shall be provided to obtain the proper amount of asphalt cement, or all measuring devices shall be sensitive to a two per cent tolerance of the amount required. Means shall be provided for checking the quantity or rate of flow of asphalt cement into the mixer. Suitable means shall also be provided, either by steam jacketing or other insulation, for maintaining the specified temperature of the asphalt cement in the pipe lines, meters, weight buckets, spray bars and other containers or flow lines.

9. If an asphalt bucket is used for weighing the asphalt cement, it shall have sufficient capacity to hold not less than twenty per-cent of the weight of aggregate required for one batch. It shall be steam jacketed or equipped with properly insulated electric heating units and shall be suspended on dial scales equipped with a telltale device so that the tare weight can be accurately measured to a tolerance of two percent of the weight required. The bucket shall be so arranged that it will deliver the heated asphalt cement in a thin uniform sheet or in multiple streams the full width of the mixer, except in the case of a rotary mixer where the asphalt cement will be sprayed into the mix.

10. An armored thermometer to include the range from 93 degrees Centigrade to 204 degrees Centigrade shall be fixed in the asphalt cement feed line at a suitable location near the discharge valve at the mixer unit. The plant shall be further equipped with an approved thermometric instrument so placed at the discharge chute of the dryer as to register automatically the temperature of the heated aggregate.

11. The plant shall be equipped with positive means to govern the time of mixing to the satisfaction of the Engineer. The time of mixing shall be considered as the interval between the time the asphalt cement is spread on the aggregate and the time the same aggregate is discharged from the mixer.

12. The plant shall have an efficient dust collecting system. Provision shall be made to waste the material so collected, or to return it uniformly to the mixture.

13. Adequate and safe stairways to the mixer platform and guarded ladders to other plant units shall be placed at all points requiring accessibility during plant operations. All gears, pulleys, chains, sprockets and other dangerous moving parts shall be adequately guarded and protected. Ample and unobstructed space shall be

provided on the mixing platform. A clear and unobstructed space shall be maintained at all times in and around the truck loading space, and this area shall be kept free from dripping from the mixing platform.

B) Special Requirements for Batching Plants

1. The plant shall include means for accurately weighing each size of aggregates in a weigh box or hopper, suspended on scales, large enough in size to hold a full batch without hand raking or running over. The weigh box or hopper shall be supported on a fulcrum and knife edges so constructed that they will not be easily thrown out of alignment or adjustment. Gates on both bins and hopper shall be so constructed as to prevent leakage when they are closed.

2. The plant shall include a batch mixer of an approved twin pugmill type, rotary drum type, or other type that has proved itself capable of producing a uniform mixture within the limits of this Specification. It shall have a batch capacity of not less than 900 kg. If of the pugmill type, the clearance of the blades from all fixed and moving parts shall not exceed 20 mm. If the mixing tank is not closed, it shall be fitted with a lid to prevent the dust from being dispersed into the air. The mixer shall be so constructed as to prevent leakage of contents. The mixer shall have an accurate time lock to control the operation of a complete mixing cycle by locking the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle; it shall lock the asphalt bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the application of asphalt cement. The wet mixing period is the interval of time between the application of asphalt cement and the opening of the mixer gate.

3. The control of the timing shall be adjustable and capable of being set at maximum intervals of 5 seconds for cycles of mixing up to 3 minutes. A mechanical batch counter shall be installed as a part of the timing device and shall be so designed as to register only completely mixed batches.

C) Special Requirements for Continuous Mixing Plants

1. The plant shall include a means for accurately proportioning each size of aggregate either by weighing or by volumetric measurement. When proportioning is by volume, the unit shall include a feeder mounted under the compartment bins. Each bin shall have an accurately controlled gate, for volumetrically measuring the material drawn from each respective bin. The gate shall be rectangular with dimensions of about 300 mm x 250 mm with one dimension adjustable by positive mechanical means provided with a lock. An indicator shall be provided on each gate to show the amount of the gate opening. Filler, if used, shall be proportioned separately from a small hopper mounted directly over the mixer.

2. The plant shall provide for the calibration of gate openings by means of weighed test samples. The materials fed out of the storage bins through their individual orifices shall be by-passed to a suitable test box, each compartment of material being confined in a separate box section. The plant shall be equipped to handle conveniently samples of about 400 kg to be weighed on accurate scales.

3. Means shall be provided in the plant to afford positive interlocking control between the flow of aggregate from the bins and the flow of asphalt cement from the meter or other proportioning source to the satisfaction of the Engineer.

4. The plant shall include a continuous mixer of an approved type. The paddles shall be of an adjustable type for angular position on the shafts and shall be reversible to retard the flow of the mix. The mixer shall carry a manufacturer's plate giving the net volumetric content of the mixer at various feed rates.

5. The mixing time shall be determined using the following formula:

Pugmill dead capacity in kilograms

Mixing time in seconds

Pugmill output in kilograms per sec

D) Preparation of Aggregates

Before being fed to the mixer aggregates and filler for binder and wearing courses shall be separated into two or more sizes and stored separately. One storage unit shall contain aggregate of such size that 80 percent will pass a 4.75 mm (No. 4) sieve and the other unit shall contain aggregate of such size that 80 percent will be retained on a 4.75 mm (No. 4) sieve. Should the Contractor elect to use natural fine material, a further separate storage unit for such material shall be provided. If filler is used as a separate component it shall also be stored and measured separately and accurately before being fed into the mixer.

In placing the materials in storage or in moving them from storage to the mixer any method which causes segregation or uncontrolled combination of materials of different grading shall be discontinued and the segregated or degraded materials shall be rescreened, or wasted, and, if necessary, passed through the dryer before being mixed.

Fine and coarse aggregates shall be fed into the dryer at a uniform rate of feed shall be maintained within 10 percent of the amount set. Coarse and fine aggregates shall be dried to a moisture content not exceeding 1% and heated so that when delivered to the mixer they shall be at a temperature of 25 degrees Centigrade above the mixing temperature for the asphalt cement being used, or as ordered by the Engineer.

E) Preparation and Composition of the Mixture

First the aggregate, including filler, shall be loaded into the mixer followed by the asphalt cement. Mixing shall continue until all particles of aggregate are coated uniformly. When the mixture is prepared in a twin pug mixer, the volume of aggregate shall not be so great as to extend above the tips of the mixer blades when these blades are in a vertical position. Mixing shall continue until all particles of aggregate are coated uniformly.

F) Mix Trials

1. Prior to commencing the supply of asphaltic concrete for flexible surfacing, the Contractor shall submit full details to his proposed gradings and mixes to the Engineer. On receiving preliminary approval of his proposals the Contractor shall then arrange to lay and properly compact trial areas of binder and wearing course materials.

2. The Contractor shall place approximately 80t of asphaltic concrete in each trial area which shall be large enough to demonstrate to the satisfaction of the Engineer that the laying and compaction equipment complies with the requirements of the Specification and that the proposed mixes as laid are acceptable.

G) Job-Mix

1. Marshall specimens are to be obtained from each of the base and wearing course materials supplied for trial laying purposes. The Marshall specimens shall be formed and compacted in proper moulds, in accordance with the procedure described in ASTM D 1559.

2. The Contractor shall demonstrate to the satisfaction of the Engineer by testing, carried out in the presence of the Engineer's Representative, in accordance with the procedures set out in the Marshall Method of Mix Design in the Asphalt Institute Manual, Mix Design Methods, for Asphalt Concrete and Other Hot mix Types, Manual Series No. 2 (MS-2), that the requirements given in Table IV below are achieved. The loss in Marshall Stability by submerging specimens in water at 60 degrees Centigrade for 24 hours shall be not more than 25 percent of the stability of the job-mix. In addition the Contractor shall demonstrate by approved tests to the satisfaction of the Engineer that the proposed mix is not subject to stripping of the asphalt cement from the aggregates.

TABLE IV MARSHALL TEST REQUIREMENT FOR ASPHALT CONCRETE

	BINDER COURSE		WEARING COURS	
	Min	max	min	max
STABILITY (1bf)	1200	-	1200	-
FLOW (0.01 in)	8	16	8	16
AIR VOIDS (1%)	3	8	3	6
AGGREGATES VOIDS FILLED WITH ASPHALT CEMENT (%)	60	75	70	80
FILLED COMPACTED DENSITY MARSHALL SPECIMEN DENSITY	97	-	97	-

3. To determine the Marshall Specimen Density, from each set of six Marshall Specimens, the highest and lowest densities shall be ignored and the Marshall Specimen Density shall then be the mean of the densities of the remaining four specimens.

4. As Compacted densities shall be determined of samples taken from the materials laid and compacted for the mix trials as specified. At least four samples shall be taken for each of the binder and wearing course materials, under the direction of the Engineer's Representative, and the required percentage of the Marshall Specimen Density shall be achieved in each case. Testing shall be in accordance with ASTM D 1188 or ASTM D 2726.

5. When the Engineer's Representative is satisfied that the materials and methods demonstrated by the Contractor during trial laying comply with the requirements of the Contract, the Engineer shall determine the job-mix and shall inform the Contractor in writing of its composition. On receipt of such information the Contractor may proceed with the work.

H) Transportation of Plant Mixture

The mixture shall be transported to the site in steel-plate lined trucks with a minimum capacity of 5 tons. The inside of the body shall be lightly coated with a soap or detergent solution to prevent adhesion of the mixture and shall be equipped with covers or tarpaulins to protect the mixture.

I) Spreading and Compacting

1. The surface to be covered shall be thoroughly cleaned. The Contractor shall, unless otherwise ordered, apply not more than 4 hours before the placing of the mixed materials a prime coat as specified in paragraph 3408 on the surface to be covered. All mixtures shall be spread and all initial compaction completed at a temperature such that the viscosity of the asphalt cement is within the range of 140 + 10 seconds Saybolt Furol. The mixture shall not be placed on wet surfaces or when weather conditions will otherwise prevent its proper handling or finishing.

2. Asphalt pavers shall be self-propelled mechanical spreading and finishing equipment, provided with a screed or strike-off assembly capable of distributing the material to not less than the full width of a traffic lane. Screed action shall include any cutting, crowding or other practical action which is effective on the mixture without treating, shoving or gouging, and which produces a surface texture of uniform appearance. The screen shall be adjustable to the required section and thickness. The paver shall be provided with either a full width roller or tamper or other suitable

compacting devices. Pavers that leave ridges, indentations or other marks in the surface that cannot be eliminated by rolling or prevented by adjustment in operation shall not be used.

3. The prepared base to be surfaced shall be marked such that minor irregularities in its surface are not repeated in the surfacing. Alternatively approved automatic levelling devices may be used.

4. The sequence of laying shall be planned in advance and shall be subject to the approval of the Engineer's Representative. Where applicable laying of material shall commence on the lower side of the road. Where a course previously laid is joined to a course to be laid later, the first course shall be cut back to a vertical face and painted with asphalt cement as directed by the Engineer.

5. A joint in any layer shall not lie above a joint in any lower bituminuos layer but shall be laterally displaced by a minimum of 100 mm.

6. The mix shall be compacted immediately after placing. Initial rolling shall follow the paver as closely as possible and shall be with a steel wheeled tandem or three-wheel roller with a minimum wheel load of 50kN/m (265 lb/in) or an approved vibrating steel wheeled roller. Immediately following the sealing of longitudinal joints, rolling shall commence on the lower side of each strip laid and progress toward the higher side. Intermediate rolling with a pneumatic tired roller with tire pressures not less than 620 kN/sq.m. (90 lbf/sq.in.) Shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. All rollers shall incorporate quick reversing mechanisms. In areas too small for the roller, a vibrating plate compactor or hand tamper shall be used to achieve the specified compaction.

7. Rolling shall continue as long as required to attain the minimum specified compaction and until all surface movement has ceased.

J) Compliance with Job-Mix Requirements

1. The material being laid shall comply with the requirements of Table V of this Section.

2. Modifications to the job-mix may only be made with the approval of the Engineer. Should the Engineer at any time have reason to believe that the materials and methods of laying are different from those approved, he shall so advise the Contractor in writing and may order work on flexible surfacing to cease pending further trial laying and testing.

3. Following each day's work the Contractor shall cut core samples from locations chosen by the Engineer's Representative. The cores will be used to test the density by either ASTM D 1188. or ASTM D 272, whichever is applicable.

TABLE V COMPLIANCE WITH ASPHALT CONCRETE JOB-MI

PERMISSIBLE VARIATION	
US STANDARD SIEVE	% of total mix
mm alternative	by weight
4.75 (No. 4) & larger	+6%
2.36 (No. 8)	+ 4%
0.600 (No. 30)	+ 3%
0.075 (No. 200)	+ 2%

Asphalt cement + 0.1%

K) Pavement Thickness and Tolerance

The asphalt concrete binder and wearing courses shall be laid to the designed levels and transverse slopes as shown on the Drawings. The allowable tolerance shall be in accordance with Table VI below:

TABLE VI TOLERANCES FOR FLEXIBLE SURFACING

	Asphalt Concrete Bituminous Surfacing (Binder & Wearing Courses)	Surface Treatment
Permitted variation from design THICKNESS OF LAYER mm	+5 - 5	+ 15
Permitted variation from design LEVEL OF SURFACE mm	+5 - 5	+15
Permitted SURFACE IRREGULARITY measured by 3 mm straight edge mm	5	5
Permitted variation from Design CROSSFALL OF CAMBER %	+0.2	+0.2

3704 ASPHALT CEMENT

1. Asphalt cement shall be an oil asphalt, or a mixture of refined solid asphalt, prepared from crude asphaltic petroleum. It shall be free from admixture with any residue obtained by the artificial distillation of coal, coal tar, or paraffin oil and shall be homogeneous and free from water. No emulsification shall occur when a 30 g sample is boiled for 2 hours with 250 cc of distilled water in a 500 cc Erlenmeyer flask equipped with a reflux condenser.

2. Asphalt cement shall be classified by penetration and when tested in accordance with the AASHTO standard method of tests, the grades of asphalts shall conform to the requirement given in Table VII below. The grade of asphalt to be used shall be as specified in the Contract.

TABLE VII REQUIREMENTS FOR ASPHALT CEMENT

	AASHTO M 20			
	PENETRATION GRADE			
	60-70		85-100	
	Min.	Max.	Min.	Max.

Penetration at 25 Degree Centigrade (77 Degree Fahrenheit)100 g, 5 sec.	60	70	85	100
Flashpoint, Cleveland Open Cup	450	-	450	-
Ductility at 25 Degree Centigrade (77 Degree Fahrenheit) 5cm, per min. cm	100	-	100	-
Solubility in trichloroethylene %	99	-	99	-
Thin-film oven test 1/8 in. (3.2 MM) 163 Degree Centigrade (325 Degree Farhrenheit) 5 Hour Loss on heating, per cent	-	0.8	-	1.0
Penetration of residue, percent of original	54	-	50	-
Ductility of residue at 25 Degree Centigrade (77 Degree Fahrenheit) 5 cm per min., c	50	-	75	-

Spot test when

not as specified

(See note with:)

Standard naphtha solvent

Negative for all grades

Naphtha-xylene solvent,

percent xylene -do-

Heptane-xylene solvent,

percent xylene -do-

NOTE: The use of the spot test is optional. When it is specified, the Engineer shall indicate whether the standard naphtha solvent, the naphtha-xylene solvent, or the heptane-xylene solvent will be used in determining compliance with the requirements, and also, in the case of the xylene solvents, the percentage of xylene to be used.

3705 CUT BACK ASPHALT

1. Liquid asphalts (cut-back) shall consist of materials conforming to the following classifications. When tested in accordance with the AASHTO standard methods of test the grades of liquid asphalt conform to the requirements specified in Table II.

2. Medium curing products designated by letters MC, shall consist of asphalt cement with a penetration of approximately 85 to 100 fluxed or blended with a kerosene solvent.

3706 MIXING TEMPERATURE FOR ASPHALT CEMENT

The mixing temperature shall be that temperature to which the asphalt must be heated to produce a viscosity of 85 + 10 seconds Saybolt Furol. A viscosity/temperature curve shall be supplied for each asphalt cement grade from each source of crude from which the asphalt cement has been manufactured.

3707 APPLICATION TEMPERATURE FOR CUT-BACK ASPHALT

The application temperature shall be in accordance with Table I.

TABLE IAPPLICATION TEMPERATURESFOR CUT-BACK ASPHALT

	TYPE AND GRADE OF ASPHALTIC MATERIAL	APPLICATION TEMPERATURE
CUTBACK ASPHALT	MC-70, RC- 70	49 Deg.- 88 Deg. Cent.
	MC-250, RC-250	74 Deg.-110 Deg. Cent.
	MC-800, RC-800	93 Deg.-129 Deg. Cent.

MC-3000 113 Deg.-149 Deg. Cent.

3708 BITUMINOUS PRIME COAT

1. This work shall consist of furnishing and applying asphaltic material on a prepared and untreated surface in accordance with the Specifications and Drawings.

2. Asphaltic materials shall conform to the requirements of paragraph 3704.

3. Construction Requirement

a) Surface Condition

Prime coats shall be applied only to surfaces which are dry or slightly moist. No prime coats shall be applied when the weather is foggy or rainy.

b) Equipment

The liquid asphaltic material shall be sprayed by means of a pressure distributor of not less than 1000 liter capacity, mounted on pneumatic tires of such width and number that the load produced on the road surface will not exceed 1 kN (100kgf) per cm width of tire. It shall be of recognized manufacture.

The tank shall have a heating device to heat a complete charge of asphaltic liquid to 180 Degree Centigrade. The heating device shall be such that overheating will not occur. Consequently the flames must not directly touch the casing of the tank containing the asphaltic liquid. The liquid shall be insulated in such a way that the drop in temperature when the tank is filled with asphaltic liquid fixed to the tank in order to be able to measure continuously the temperature of the liquid. The thermometer shall be placed in such a way that the highest temperature in the tank is measured. The tank shall be furnished with a calibrated dipstick to indicate the contents. The pipes for filling the tank shall be furnished with an easily interchangeable filter.

The distributor shall be able to vary the spray width of the asphaltic liquid in maximum steps of 0.1 m to a total width of 4 m. The spraying bar shall have nozzles from which the liquid is sprayed fan-shaped on the road surface equally distributed over the total spraying width.

For adding the liquid asphaltic material the distributor shall have a pump either driven by a separate motor, or with a device to synchronize its speed with the speed of the distributor. The pump shall be furnished with an indicator showing the rate of flow. At the suction side the pump shall have an easily exchangeable filter. A thermometer shall be fixed, such that it indicates the temperature of the liquid immediately before it leaves the spraying bar.

The distributor shall be furnished with a tachometer indicating its forward speed. The tachometer shall be visible from the driver's seat. The distributor shall be designed so that deviation from the prescribed rate of application does not exceed 20%. The distributor shall be equipped with a devise for hand spraying of the asphaltic liquid.

c) Application of Asphaltic Materials

1. Immediately before applying the prime coat, the full width of surface to be treated shall be swept with a power broom and if necessary scraped to removed all dirt and other objectionable material. Where required by the Engineer, immediately prior to the application of the prime coat, the surface shall be lightly sprayed with water but not saturated. Asphaltic materials shall be applied by means of a pressure distributor and at a

temperature given in Paragraph 3707.

2. The rate of application of the liquid asphalt shall be within the range of 0.5 to 2.0 liters per cu.m. the exact rate being specified in the Contract or ordered by the Engineer. The Contractor shall furnished certified weight tickets in duplicate to the Engineer immediately upon delivery to the Site.

3. The prime coat shall be left undisturbed for a period of at least 24 hours and shall not be opened to traffic until it has penetrated and cured sufficiently so that it will not be picked up by the wheels of passing vehicles. The Contractor shall maintain the prime coat until the next course is applied. Care shall be taken that the application of bituminous materials is not in excess of the specified amount; any excess shall be blotted with sand or similarly treated. All areas inaccessible to the distributor shall be sprayed manually using the device for hand spraying from the distributor.

3709 METHOD OF MEASUREMENT

The quantity of asphalt concrete surfacing shall be the design volume in place as shown on the Drawings. No allowances will be given for materials placed outside the design limits shown on the cross-sections.

3710 BASIS OF PAYMENT

The quantities measured as provided above shall be paid for at the contract unit price per cubic meter of asphalt wearing Surfaces in the Bill of Quantities, which price and payment shall constitute full compensation for furnishing all materials, hauling, placing, watering, rolling, compacting, labor, equipment, tools and all incidental expenses and subsidiary works necessary for the successful completion of the work.

GATE VALVE AND BUTTERFLY VALVE

3901 SCOPE

The work under this Section shall include furnishing, or the fabrication or manufacture, installation and testing for proper operation of gate valve and butterfly valve with all accessories in accordance with the dimensions, elevations and design shown on the drawings or as directed by the Engineer.

3902 CONTRACTOR'S DRAWINGS AND OTHER DATA

Contractor shall submit to the Engineer for approval all installation drawings, operating and maintenance instructions, illustrations and repair procedures of gate valve and butterfly valve.

Installation, operation and maintenance instructions shall be in the English language.

3903 MATERIALS

All materials shall be new, free from defects and shall be the best available for the purpose for which used, considering strength, ductility, suitability for the intended service and best engineering practice.

Materials to be furnished by the Contractor shall conform to the following specifications:

Body	:	Cast Steel
Valve Disc	:	Cast Steel
Valve Shaft	:	Stainless Steel
Body Seat Ring	:	Bronze Casting
Pressure Rating	:	150 psi

3904 FABRICATION AND MANUFACTURE

Workmanship shall be of the highest quality and in accordance with the best shop practice of the industry. All works shall be in accordance with the approved practices and by approved machine methods. Like parts shall

be accurate to specified dimensions so that replacement parts made in conformity with the drawings may be installed.

3905 PROTECTIVE COATINGS

The surfaces of the steel which are susceptible to corrosion shall be sunblast-cleaned by commercial blast-cleaning tools (SSPC-SP-6) prior to application of protective coatings as specified hereunder

a) Interior Surfaces - To be painted with two (2) coats of coal tar epoxy paint conforming to U.S. Military Specifications MIL-P-23236 (ships) Type 1, Class 2 to produce a total dry film thickness of 400 microns (16 mils).
b) Buried Exterior Surfaces - Cement-mortar lining (one coat of cement latex milk consisting of ten (10) parts of portland cement by weight, five (5) parts of water and one part of modified latex emulsion.
c) Exterior Surfaces Exposed to Atmosphere - Red lead primer and aluminum paint.

3906 INSTALLATION

The Contractor shall furnish and install the gate valve, butterfly valve and its appurtenances as shown in the drawings and as required to provide a complete and workable installation.

3907 TESTS AND ADJUSTMENTS

After complete installation and adjustment ready for0 operation, Contractor shall conduct test runs for the gate valve and butterfly valve. The cost of performing the test shall be considered included in the contract unit price.

All tests shall be performed in the presence of the Engineer or its authorized representative. All defects attributed to installation works which are found during the test shall be corrected accordingly to the satisfaction of the Engineer.

3908 METHOD OF MEASUREMENT

Gate valve and butterfly valve including accessories shall be measured per assembly completely installed and accepted.

3909 BASIS OF PAYMENT

Payment for gate valve and butterfly valve measured as provided above shall be made at the contract unit price per assembly, which price and payment shall constitute full compensation for furnishing all materials, labor, equipment tools including all incidentals and subsidiary works necessary for the successful completion of the works described under this Section.

STEEL PIPE MANHOLE, BLOW-OFF VALVE

AND MANHOLE COVER

3401 SCOPE

The work under this Section shall include furnishing or the fabrication or manufacture, installation and testing for proper operation of the steel pipe manhole, manhole cover, blow-off valve and pumping complete with all accessories in accordance with the dimensions, elevations and design shown on the Drawings or as directed by the Engineer.

3402 CONTRACTOR'S DRAWINGS, AND OTHER DATA

Contractor shall submit to NIA for approval all installation drawings, operating and maintenance instructions, illustrations and repair procedure of the blow-off valve, and manhole with cover.

Installation, operating and maintenance instructions shall be submitted in English.

3403 MATERIALS

All materials shall be new, free from defects and shall be the best available for the purpose for which used, considering strength, ductility, suitability for the intended service and best engineering practice.

Materials to be furnished by the Contractor shall conform to the following specifications:

a) Steel Plates

Steel plates for welded construction of manhole and cover shall conform to material specification ASTM A 570 Grade C.

b) High Strength Steel Bolts, Nuts and Washers

Bolts, nuts and washers for watertight connection shall conform to ASTM designation A 325 "High Strength Steel Bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers".

c) Lock Washers

Lock washers shall conform to SAE proportions, regular series and shall be spring steel.

d) Iron Casting

Cast iron for general purpose iron castings shall conform to ASTM Designation A 48, "Gray Iron Castings", Class 50.

e) Rubber Gasket

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, homogenous, 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 sole element depended upon to make the joint water tight.

f) Galvanized Manhole Cover

Manhole cover shall be hot-dipped zinc galvanized in accordance with ASTM A153.

g) Bronze Castings

Bronze casting shall conform to ASTM Designation B 584 or 937 Alloy 862.

3404 FABRICATION OR MANUFACTURE

a) General. Workmanship shall be of the highest quality and in accordance with the best shop practice of the industry. All work shall be in accordance with approved practices and by approved machine methods. Like parts shall be interchangeable whenever possible. Machining of fits on renewable parts shall be accurate to specified dimensions so that replacement parts made in conformity with the Drawings may be installed.

b) Welding, Electric and Oxy-Acetylene

1. *Preparation for Welding*. Members to be joined by welding shall be cut accurately to size and where required, shall be rolled or pressed to the proper curvature. The edges of the members shall be sheared, flame cut and machined to suit the required type of welding and to allow thorough penetration. The cut surfaces shall expose sound metal free from laminations, surface defects caused by shearing and flame-cutting operations and other injurious defects. The surfaces of the members to be welded shall be free from grease, rust and other foreign matter.

2. *Welding Procedure*. All welding shall be performed in accordance with a procedure at least equal to standard required by qualification procedures of the American Welding Society (AWS).
3. *Qualification of Welders and Welding Operators*. All welders and welding operators assigned to the Work shall have passed a performance qualification test at least equal to that specified in AWS "Standard Qualification Procedure".

c) Structure Work. Unless otherwise specified, design and fabrication of structural parts shall conform to the applicable provision of the AISC.

d) Machine Work

1. *General*. All tolerances, allowances, and gauges for metal fits shall conform to ANSI Standard B4a, "Tolerance, Allowances and Gauges for Metal Fits", or other approved equivalent standard of other countries for the class of fit required. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to insure proper operation when assembled. All drilled holes shall be accurately located and drilled from templates.

2. *Finished Surfaces*. Surface finishes shall be indicated on the shop drawings in accordance with ANSI B46.1, "Surface Roughness, Waviness and Lay".

3. *Unfinished Surface*. So far as practicable, all work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined, to secure proper alignment. Unfinished surface shall be chipped or ground free of all projections and rough spots.

e) Steel Casting. Castings shall be free from injurious defects and shall be satisfactorily cleaned for their intended use. The surfaces of castings which do not undergo machining and are exposed in the final installation shall be free of foundry irregularities such as projections, ridges, hollows, honey-combing, pock marks or chip marks, so that they shall not require surface smoothing operations at the site prior to painting. The Structure of the castings shall be homogeneous and free from excessive non-metallic inclusions.

f) Pins and Pin Holes. Pin holes shall be bored true to gauges, smooth and straight, and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position.

g) Protection of Machined Surfaces. Machine finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistance paper or protected by other approved means.

h) Lubrication. Before assembly, all bearing surfaces, journals, and grease and oil grooves shall be carefully cleaned and lubricated with an approved oil or grease. After assembly, each lubricating system shall be filled with an approved lubricant.

3405 DESIGN AND TEST PRESSURE

The piping system, including valves, manholes and covers shall meet the following design conditions:

a) Pressure Head

The system specified herein shall operate at full hydraulic pressure of 100-feet head.

b) Hydrostatic Test Pressure

The pipes, valves, manholes and covers shall be designed to safely withstand a test pressure equivalent to 1-1/2 times the operating pressure.

3406 INSTALLATION

The Contractor shall furnish and install all pipes, fittings, manholes and covers, valves, supports, bolts, nuts, gaskets, jointing materials and all other appurtenances as shown in the drawings and as required to provide a complete and workable installation.

All anchor bolts shall be set accurately to the grade and alignment designated on the drawing or as directed.

Before installation, the rust preventive compounds on all thread joints shall be removed with a solvent and all joints shall be re-lubricated, where applicable.

After installation is completed and before closing the manhole cover, the pipes shall be checked to ensure that all extraneous foreign matter has been removed.

3407 TEST AND ADJUSTMENTS

After complete installation and adjustment ready for operation, Contractor shall conduct test runs for the blow-off valves. The cost of performing the test shall be considered included in the contract unit price.

All test shall be performed in the presence of an authorized representative of NIA. All data shall be certified correct and submitted to NIA. All defects found during the test as a result of the installation work shall be corrected accordingly to the satisfaction of NIA.

3408 PAINTING

All surfaces subject to rust or corrosion shall be given coat of paint in accordance with the provisions of Section XXXVI, Painting Metalworks.

3409 PROTECTION COATING

a) Immersed Steel

Except where otherwise specified, all steel surfaces and all parts of structures that have surfaces which are normally immersed in water, shall be painted with two coats of coal tar epoxy paint in accordance with SSPC No. 11.01 Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint System.

b) Embedded Steelwork

Where not otherwise specified, all steel surfaces which will be embedded or against which concrete shall be placed shall be cleaned in accordance with SSPC-SP3 then painted with one coat of cement latex milk consisting of 10 parts of Portland Cement (by weight), five parts of water and one part of modified latex emulsion.

3410 CLEANING AND SHIPPING

All pipes and fittings, manholes and covers, shall be cleaned internally of all oil, grease, loose mill scale, rust weld spatter and flux by pickling if necessary. All welds shall be thoroughly cleaned by all flux, and wire brushed.

For shipping, the ends of all threaded pipes shall be capped with suitable metal protectors. Flange sections shall be protected with suitable wooden covers bolted in positions. All pipes shall be protected against rust in transit and storage.

3411 METHOD OF MEASUREMENT

Steel pipe manholes, manhole covers and blow-off valve compartment including all accessories shall be measured per assembly completely installed and accepted.

3412 BASIS OF PAYMENT

Payment for steel pipe manhole, manhole covers and blow-off valve including all 0accessories, measured as provided above shall be made at the contract unit price per assembly, which price and payment shall constitute full compensation for furnishing all materials, labor, equipment, tools including all incidentals and subsidiary works necessary for the successful completion of the work described under this Section.

REINFORCING STEEL BARS

2301 SCOPE

All reinforcing steel bars required for the works as detailed in the Construction Drawings or as directed by the Engineer shall be furnished by the Contractor.

The work under this Section includes the hauling of all reinforcing steel bars required for the works to the project site, storing, cutting, bending and proper placing, all in accordance with the drawings and these Specifications.

The length for each size of reinforcing steel bar to be furnished by the Contractor shall be computed by taking the theoretical length of steel bars shown on the drawings multiplied by 1.07 to get the approximate length required for the work. All reinforcing steel bars shall be furnished in commercial standard lengths and the Contractor shall cut and bend the reinforcing steel bars to the detail and dimensions shown on the Drawings.

2302 MATERIALS

All reinforcing steel bars to be furnished by the Contractor shall be Grade 40 or PS 275, deformed type and conforming to the requirements of ASTM A-615. The nominal dimensions and unit weights of bar designation shall be in accordance with the following table:

		Nominal Dimensions	
Nominal Bar Diameter	Unit Weight (kg/m.)	Cross Section Area (sq.mm.)	Perimeter (mm.)
6 mm.	0.222	28.27	18.85
8 mm.	0.395	50.27	25.13
10 mm.	0.616	78.54	31.42
12 mm.	0.888	113.10	37.70
16 mm.	1.579	201.10	50.27

20 mm.	2.466	314.20	62.83
25 mm.	3.854	491.90	78.54
28 mm.	4.833	615.75	87.96
32 mm.	6.313	804.25	100.53
36 mm.	7.991	1,017.90	113.10

The nominal diameter of a deformed bar is equivalent to the diameter of a plain bar having the same weight per unit length of the deformed bar.

2303 CONSTRUCTION REQUIREMENT

Workmanship shall be at the highest grade and shall be in accordance with the latest standard practice of the industry.

1. **Cutting and Bending**. Cutting and bending of reinforcing bars may be done in shop or at the job site. All bending works shall be in accordance with the latest standard practice and by approved machine methods. Radii for bends and hooks will be specified on the approved detailed reinforcement Drawings in accordance with sound design procedures.

2. **Placing.** Reinforcement shall be laid, anchored and embedded in the concrete as shown on the Drawings or as directed by the Engineer. Unless otherwise directed, the spacing of reinforcement bars shall be measured along the center line of the bars. Reinforcement shall be inspected for compliance with requirements as to size, length, splicing, position and number after placement based on the approved reinforcement drawings.

Before reinforcement are placed, the surfaces of the bars and the surfaces of any metal bar support shall be cleaned of heavy flaky rust, loose scales, dirt, grease or other foreign substance which, in the opinion of the Engineer, are objectionable. Heavy flaky rust that can be removed by firm rubbing with burlap or equivalent treatment is considered objectionable. After being placed, the reinforcing bars shall be maintained in a clean condition until completely embedded in concrete.

Reinforcing bars shall be accurately placed and secured in position so as to avoid displacement during the pouring of concrete. Special care shall be exercised to prevent any disturbance of the embedded reinforcement during the setting of concrete. Metal chairs, hangers, spacers or other approved support may be used by the Contractor for supporting reinforcing bars. Metal supports shall be galvanized when they are to be exposed to view on completed concrete surfaces or where it is use will contribute in any way to the discoloration or deterioration of the concrete.

3. **Relaton of Bars to Concrete Surfaces**. The minimum cover for all reinforcements shall conform to the dimensions shown on the detailed reinforcement Drawings.

4. **Splicing.** All splices in reinforcement shall be as shown on the Drawings or as directed by the Engineer. The lapped ends to bars shall be either supported sufficiently to permit the embedment of the entire surface of each bar in concrete or shall be securely wired.

5. **Welding.** Welding of bars shall be performed only where shown on the Drawings or as authorized in writing by the Engineer and shall conform to the requirements of AWS: D12.1, latest revision. All welders employed shall show proof of their welding qualifications to the Engineer. All welding shall be done using metal arc welding, pressure gas welding, submerged arc welding or thermit welding. All electric shall be acceptable to NIA. Coverings of low hydrogen electrodes must be thoroughly dry when used. The surfaces to be welds shall be clean and shall be free

from rust and dirt. All welds shall develop the full strength of the bar or the smaller bar when two different sizes are welded. Test will be required of not more than five percent of the welds. Approved testing equipment for testing welds shall be furnished by Contractor.

6. **Protection.** Reinforcement to remain exposed and intended for future concrete embedment shall be protected from corrosion or other damages in an approved manner where directed. The reinforcement protection shall be of such nature that it can be thoroughly cleaned without difficulty prior to encasement in concrete.

2304 PREPARATION OF REINFORCEMENT DRAWINGS

Contractor shall submit for the approval of NIA detailed reinforcement drawings in accordance with Article GC-47. These drawings will include bar-placing drawings, bar bending drawings, bar list, and any other reinforcement drawings as may be required to facilitate placement and checking of reinforcing bars. No work shall be done by contractor until such approval has been secured from NIA.

The Reinforcement Drawings submitted shall show the name of the structure location by stationing where the reinforcement drawings is intended and all the necessary informations required by NIA. It shall likewise bear the stamp or seal of Contractor as evidence that the Drawings have been checked by Contractor.

Contractor shall be held responsible for any delay in the progress of the work occasioned by his failure to observe the requirements and the time for the completion of the contract will not be extended on account of his failure to promptly submit said drawings in strict adherence herewith.

2305 SAMPLING FOR TESTING AND ACCEPTANCE OF MATERIALS THAT FAIL TO MEET CONTRACT REQUIREMENTS (FOR STEEL BARS FURNISHED BY CONTRACTOR)

Sampling of reinforcing steel bars furnished by the Contractor for incorporation in the Permanent Works shall be carried out by NIA at the manufacturer's stockyard before delivery to the project site. The NIA authorized representative shall, at random, take two representative samples of reinforcing steel bars per lot covered by the manufacturer's mill certificate. A lot shall consist of all steel bars of the same heat or blow as shown in the mill certificate, and the same nominal cross-section and grade. Samples shall be tested at the manufacturer's testing laboratory, if any, or to any approved Government testing laboratory at Contractor's expense. A lot or lots represented by samples tested which failed to meet specified requirements shall be rejected and will not be counted for delivery to the project site. Sampling and testing shall be in accordance with ASTM requirements. All deliveries shall be subject to prior approval of NIA.

The NIA reserves the right to accept steel brs that fail to meet the contract requirement provided that the deficiency is not more than nine percent (9%) of the requirement per each type of test and provided further that a corresponding reduction in the unit price will be made. The percentage of reduction equal to the percentage of deficiency based on the minimum requirement of the ASTM A-615 Standard. For example, if the value of the test result for one type of test is five per cent (5%) below the minimum requirement, the unit price for payment will be reduced by 5%. If the non-compliance with the test requirements is on two or more tests, the price reduction will be the summation of the percentage of the deficiencies.

2306 METHOD OF MEASUREMENT

A. Furnishing and Stockpiling

Measurement for payment for the furnishing and stockpiling of reinforcing steel bars shall be made on the actual deliveries to the project site and after presentation of the following documents:

a) Delivery receipt duly acknowledged by the Engineer and the Project Auditor or their duly authorized representatives

b) Manufacturer's certificate showing the details of manufacture, composition and physical properties of the steel bars.

c) Certificate of acceptance by the Engineer of the actual quantity delivered at the site

B. Cutting, Bending and Placing

Measureent for payment of reinforcing steel bars will be made on the weight of reinforcing steel bars actually placed with the concrete structure and drilled holes for anchorage in accordance with the Drawings and Bar Schedule approved by NIA or as directed by the Engineer and weights will be computed based on the published manufacturer's weights or in the absence thereof, on the weights specified in the table presented in Paragraph 2302. Steel bars in laps or splices indicated in the approved reinforcement Drawings, as required by NIA will be measured for payment. Additional steel bars in laps which are authorized for the convenience of the Contractor and such items as wires, clips, chairs, or other devices for securing the steel bars in place will not be measured for payment. Where weld splices are specified on the Drawings, weld splices will not be measured for payment but the weight for its equivalent lap splices will be measured for payment instead. Where contractor chooses to weld reinforcement bars for his convenience and welding is not specified, no separate payment will be made for such welds. Where Contractor substitute welded splices for lapped splices, separate payment will not be made for such welds, but instead the weight for the lapped splices shown on the Drawings will be measured for payment.

2307 BASIS OF PAYMENT

Payment for reinforcing steel bars measured as provided above, will be paid for at the contract unit price per kilogram which price and payment shall constitute full compensation for furnishing all labor, tools, equipment and all incidentals and subsidiary works necessary for the successful completion of the work described under this Section.

As indicated in the Bill of Quantities, payment per kilogram of reinforcing steel bars (same measurement as provided above) shall be made separately and in accordance with the following schedule:

a) Ninety percent (90%) of furnishing and delivery cost which shall include all labor, tools, equipment and supplies involved in the manufacture, and delivery to the project site which includes loading, hauling, unloading and stockpiling at the delivery site;

b) Ten percent (10%) of furnishing and delivery cost shall be paid upon successful completion of the works under this Section.

b) installation cost which shall include all labor, tools and equipment involved in cutting, bending and placing into permanent structures and all incidentals necessary for the successful completion of the work under this Section.

STRUCTURE EXCAVATION

601 SCOPE

Structure Excavation includes the removal of all materials within the structure lines including necessary dewatering operations not otherwise specified. It shall also include additional excavations within the vicinity of the structure in order to shape the ground as shown on the Drawings or as directed by the Engineer.

602 CLASSIFICATION

Structure excavation shall be classified in accordance with paragraph 402.

603 CONSTRUCTION REQUIREMENTS

All excavation requirements described in paragraph 403 are applicable under this Section.

604 METHOD OF CONSTRUCTION

All structures, where practicable shall be constructed in open excavation. The method of construction or excavations shall be in accordance with the applicable provisions of paragraph 404 and the following requirements.

Foundations shall be excavated according to the outline of the footings and floors of structure as shown on the Drawings or as directed by the Engineer, and shall be of sufficient size to permit free movement of workers.

On excavation of common materials the foundation bed upon which structures are to be placed shall be finished accurately to the established lines and grades after a thorough compaction and trimming of the foundation with the use of suitable tools and equipment. As soon as the foundation excavations have been trimmed to their final level, it should be protected from degradation by weathering. Should the foundation material soften through exposure then the soft material shall be removed and replaced at the Contractor's expense. If at any point, material is excavated beyond the lines and grades of any part of the structure, the over-excavation shall be filled with selected materials approved by the Engineer and shall be placed in layers of not more than 20 centimeters thick, moistened and thoroughly compacted by special roller, mechanical tampers or by other approved methods. A density not less than 90% of the maximum dry density determined by ASTM test D-698 is required. The cost of filling over-excavation ordered by the Engineer shall be borne by the Contractor.

On excavation of rock materials, the bottom and side surfaces of excavated rock excavation upon or against which concrete and weep holes are to be placed shall conform to the required grades and dimensions as shown on the drawings or as established by the Engineer. If at any point, materials are excavated beyond the required limits, the over-excavation shall be filled with concrete at the expense of the Contractor including the cost of all materials required

When concrete is to be placed upon or against rock, the excavation shall be of sufficient depth to provide for the minimum thickness of concrete at all points and any deviation from the required minimum thickness of concrete shall be avoided as much as possible. The surface on which concrete will be laid shall be trimmed and thoroughly cleaned as directed by the Engineer.

When excavation of rock materials reaches the surface upon or against which concrete is to be placed, blasting shall be stopped and the remaining mass of rock shall be carefully removed by means of jack-hammer or any appropriate hand tool. The point beyond which blasting will not be allowed shall be determined by the Engineer. All damages to the rock foundation caused by improper blasting operation shall be repaired by the Contractor at his own expense in a manner acceptable to the Engineer.

All foundations for bridge pier footings shall be excavated to such depths as may be necessary to secure stable bearing for the structure. Whenever the safe bearing power of the soil as uncovered is less than that called for on the Drawings, pilings or appropriate spread footings will be used. The elevations of the bottoms of footings, as shown in the Drawings shall be considered as approximate, and the Engineer may order, in writing, such changes in elevations and dimensions of footings as may be necessary to ensure a satisfactory foundation. Bearing tests, upon written order of the Engineer, shall be taken to determine the supporting power of the soil. Cost of bearing test will be paid as "Extra Work"

If, in the opinion of the Engineer, the material at the base of the excavation is unsuitable for foundation he shall instruct the Contractor to either a) Carry out additional excavation to a depth of 50 cm. below the proposed bottom of concrete shown on the Drawings and to maximum depth of 60 cm. outside of the outermost lines of said base and replace with backfill compacted to at least 90% of the maximum dry density or b) strengthen the soft material by ramming in gravel and cobbles until a firm foundation is obtained. Measurement and payment for the backfill shall be made under Section XII, "Structure Backfill".

605 METHOD OF MEASUREMENT

Structure Excavation shall be measured by the cubic meter in its original position before being excavated in accordance with the Drawings, or as may be ordered by the Engineer. No excavation beyond the paylines shown on the Drawings will be measured for payment. For canal structures, the limit of measurement along the lines perpendicular to the flow of water shall be the vertical planes at the outer edges of the inlet cut-off walls. The upper limits of the solid

measured for payment shall be the canal bottom for canal structures or the original ground surface in case of diversion structures. The lower limit shall be the bottom of the required excavation. Excavated materials not vertically above the boundaries as specified above shall not be measured for payment. The volume measured shall not include water and other liquids removable by pumping. Such materials as mud, muck, quagmire and other similar semi-solids not removable by ordinary pumping shall be considered pay quantities and shall be measured and paid for as "Structure Excavation".

However, in case structure excavation for canal structures is done before canal excavation, the upper limit of the solid measured for payment shall be the original ground surface in accordance with the structure excavation paylines.

606 BASIS OF PAYMENT

The volume measured as provided above will be paid per cubic meter, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, equipment, tools and incidentals and subsidiary works necessary to complete the work described under this Section

For diversion works, canal siphons and bridge structure excavations, the cost of dewatering operation unless otherwise specified in the Bill of Quantities shall be paid under a separate item in the Bill of Quantities. For all other structure excavations, dewatering operations involved are considered subsidiary works and the cost thereof shall be considered included in the unit price of structure excavation.

The Contractor shall be paid sixty percent (60%) of the pay quantities of the actual excavation acceptably accomplished in accordance with the paylines as shown on the Drawings or as directed by the Engineer. The remaining forty percent (40%) will be paid upon pouring of concrete for the foundation or upon placing of riprap, gravel blanket or grouted riprap in accordance with the Drawings and Specifications.

CANAL EXCAVATION

401 SCOPE

The work under this Section shall consist of excavating and removal of all classes of materials in canal prism including placing into canal embankments with excavated suitable materials, stockpiling of excavated materials suitable for embankment and backfilling, and trimming of side slopes inside canal prism and canal beds except on portion of the canal where concrete lining is required (trimming of the foundation bed will be considered included under Section XX, Concrete Canal Lining) all in accordance with the Drawings and these Specifications or as directed by the Engineer.

All excavations shall be true to lines, grades, slopes and profiles shown on the Drawings or as required by the Engineer.

402 CLASSIFICATION

All excavated materials under this Section will be classified as follows:

1. **Rock Excavation** - For purposes of classification of excavation, rock is defined as sound and solid masses or formation, layers or ledges of mineral matter in place of such hardness and texture that:

a) Cannot be effectively loosened or broken down by ripping in a single pass with a latest model tractor mounted hydraulic ripper equipped with one digging point of standard manufacturer's design adequately sized for use with and propelled by a crawler-type tractor above 305 HP.

b) In the areas where it is impracticable to classify the use of the ripper described above, rock is defined as sound and solid material of such hardness and texture which cannot be loosened or broken by a 2.72 kg. (6 pound) drifting pick.

c) Can only be loosened or broken by a special equipment such as jack hammer and pencil hammer attached to an excavator.

All formation of materials as defined above whose volume is one (1) cubic meter or more will be classified as rock.

2. **Common Excavation** - Excavation of any materials and boulders (whose volume is less than one cubic meter) that can be ripped to be loosened by, a dozer of equal or below 305 HP capacity.

403 CONSTRUCTION REQUIREMENTS

(a) **Explosives and Blasting**

1) *Explosives*

Caps or other exploders or fuses shall in no case be stored in the same place in which dynamite or other explosives are stored, transported or kept. The location and design of powder magazines, the methods of transporting explosives and the precautions taken to prevent accidents shall be in accordance with the provisions of all laws, orders, regulations and decrees that are in force in the Philippines or may be issued from time to time by the Government.

The Contractor shall maintain an inventory for storage and withdrawal of powder stocks and detonators. The NIA shall be notified immediately of any loss or theft of explosives. The Contractor shall provide such reasonable and adequate protective subversive action or sabotage to any property. Only reliable personnel shall be permitted to store and handle explosives.

Explosives, if used, shall be of such quantity and power and shall be used in such locations so as to minimize opening of seams and disturbing of material outside the prescribed limits of excavation. As excavation approaches its final limits, the depth of holes for blasting and the quantity of explosives used for each hole shall be reduced so that the underlying or adjacent material will not be disturbed or shattered. Whenever further blasting might injure the surface of the final excavation, as determined by the Engineer, the use of explosives shall be discontinued.

The cost of furnishing, hauling, storing and handling all explosives shall be included in the contract unit price of the work for which they are required.

2) *Blasting*

Blasting will be permitted only when proper precautions are taken for the protection of persons, the works, and public or private property. The Contractor shall satisfactorily cover all shots in deep cut excavations and shall take extra precautions on all blasting work as maybe required by the NIA. The Contractor shall blast to the extent necessary and in such a manner that the excavation will not be unduly large or irregular, nor unduly disturb the ground and make it unstable, nor shatter the rock, if encountered, upon or against which concrete is to be placed, nor injure concrete already placed or existing structures at the site or in the vicinity thereof. Whenever, in NIA's opinion, the Contractor's operations are liable to result in unduly large excavations or unstable ground, as to injure the rock, concrete or structures, the Contractor shall drill shorter holes and use lighter charges. Approval by the NIA of any of the Contractor's blasting operations shall not relieve the Contractor of his responsibility under this paragraph.

The Contractor shall submit his drilling and blasting operations for approval of the Engineer before commencing with his blasting works. No blasting operations shall be undertaken without the approval of the Engineer.

When concrete is to be placed upon or against rock, the excavation shall be of sufficient depth to provide for the minimum thickness of concrete at all points and any deviation from the required minimum thickness of concrete shall be avoided as much as possible. The surface on which concrete will be laid shall be trimmed and thoroughly cleaned as directed by the Engineer.

When excavation of rock materials reaches the surface upon or against which concrete is to be placed, blasting shall be stopped and the remaining mass of rock shall be carefully removed by means of jack-hammer or any appropriate hand tool. The point beyond which blasting will not be allowed shall be determined by the Engineer. All damages to the rock foundation caused by improper blasting operation shall be repaired by the Contractor at his own expense in a manner acceptable to the Engineer.

(b) **Sections and Slopes**

Excavation sections, profiles and slopes shall be cut true and straight in conformity with the lines and grades shown on the Drawings within the following tolerances, measured normal to the excavated surfaces:

Item	Tolerances
1. Side slopes above minimum elevation of operating roads	+ 30 cms.
2. Profile of operating roads, access roads and protection dike	+ 9 cms.
3. Profile of invert of canals	+ 3 cms.
4. Side slopes inside canal prism for canals and laterals	+ 15 cms.
5. Side slopes outside canal prism for canals and laterals	+ 15 cms.

The extreme of the above tolerances shall not be continuous over a distance of 40 meters measured at any place, in any direction, parallel to the excavated surface.

(c) **Excavation Beyond Established Lines**

Precautions shall be taken to preserve, in an undisturbed condition, materials beyond the designated limits of excavations as shown on the Drawings except unsuitable materials ordered removed by the Engineer. Materials loosened beyond the excavation limits as a result of excavation operations shall be considered defective work and shall be compacted or removed and replaced with compacted embankment at the Contractor's expense, as directed by the Engineer.

404 METHOD OF CONSTRUCTION

Canal excavation shall include all excavation works in the canal prism whether common, indurated or rock materials, except additional excavations at structure sites which is specified to be done and measured for payment under excavation for structure.

The Contractor shall only excavate after the area of operation is acceptably cleared and grubbed in accordance with Section II, "Clearing and Grubbing". Excavation of all canals shall be in accordance with the cross section, lines and grades shown on the Drawings. On portion of the canal where concrete lining is required, canal excavation shall not extend beyond the neat lines of the underside face of the canal lining as shown on the Drawings. The Contractor must exercise care not to extend his excavation beyond the limits called for in the Drawings. Excavation operations shall be such that all materials suitable for embankment or back filling and filling shall be separated from objectionable materials which are to be wasted. All surfaces from excavation shall be trimmed to the required slopes and grades

within the specified tolerances under paragraph 403 (b). Blasting if permitted by the NIA, shall be in accordance with paragraph 403 (a), "Explosives and Blasting".

In sections of deep cut in which the canal section is continuous with the roadway section and its side slopes, excavation for roadway shall be included under this Section. If slides occur on excavated slopes or if run-off flows deposit additional materials in excavations before acceptance of the works, the removal of said slides and/or deposits shall be at the expense of the Contractor.

Large canals like main canals should preferably be excavated with the use of motorized scrapers, excavating in successive layers of about 30 centimeters followed subsequently by trimming of the side slopes using a Grader. Medium sized canals like laterals should preferably be excavated by initially using a D-6 or D-7 Bulldozer for the upper layers and then excavating the bottom layers and side slopes with the use of a Backhoe. Should the Contractor proposes to do excavation works by some other means, prior approval of the Engineer must be secured.

405 FINISHING CANAL AND ROADWAYS

Upon completion of all construction operations, the canal section, including slopes of canal embankments, and roadway embankments, shall be finished as specified and shown on the Drawings. Canal beds, canal embankments and side slopes shall be trimmed and shaped to the finished cross-section to produce smooth surfaces and slopes, and uniform cross-sections.

Stockpiling of materials on finished canal sections, roadways and embankments shall not be permitted. All finished works and surfaces shall be cleaned of all dirt and foreign materials.

The Contractor shall also be required to clear the entire right-of-way and areas outside the limits of the right-of-way for all excess of objectionable materials, if such excess or objectionable materials are the result of the Contractor's operation as determined by the Engineer.

All weeds and other objectionable growth, roots, excess earth, debris, loosened rock larger than 7.5 centimeters shall be removed and disposed off in approved sites outside the right-of-way as specified or directed by the Engineer.

The entire canal sections including roadways, side slopes and structure approaches shall be left in a neat and presentable condition.

406 METHOD OF MEASUREMENT

Canal Excavation will be measured for every cubic meter of material excavated from the canal prism. Measurement shall be made in its original position after undertaking clearing and grubbing including stripping operations and computed by the Average-End Area method for every 20-meter section of finished canal within the paylines or neat lines shown on the Drawings, acceptably excavated and formed into embankments or used for structure backfill, or wasted as directed.

Hauling of excavated materials within the free haul distance of 200 meters for disposal to waste areas and trimming of side slopes in canal prism and canal beds except on portion of the canal where concrete lining is required, are considered subsidiary works under canal excavation, thus, shall be paid under this Section and the cost thereof shall be considered included in the contract unit price for Canal Excavation. Hauling beyond the free haul distance of 200 meters (for waste materials only) and spreading of excavated materials into canal and roadway embankments and structure backfill shall be paid under Sections IX & XII, respectively. Hauling or overhauling for disposal of excavated materials into canal embankments is a subsidiary work for Embankment Construction and Compaction, thus, it will not be measured for payment and the cost thereof is considered included in the contract unit price for Embankment Construction and Compaction.

407 BASIS OF PAYMENT

The volume measured as provided above shall be paid per cubic meter, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, equipment, tools and all incidentals necessary for the successful completion of the work described under this Section and for all subsidiary works except for hauling of excavated materials beyond the free haul distance of 200 meters for disposal to waste areas which shall be paid under Section IX, OVERHAUL, and except for trimming of side slopes on portion of canals where concrete lining is required which shall be considered as a subsidiary work under Section XX, Concrete Canal Lining.

MISCELLANEOUS METALWORKS AND MATERIALS

3501 SCOPE

The work under this Section shall include furnishing, delivering and installing all miscellaneous metalworks and materials shown on the drawings which shall include but not limited to the following:

10. Trashracks or screens including frames, guides and anchors
11. Steel ladder rungs
12. Steel gratings including frames, guides and anchors
13. G.I. Pipes guardrails and handrails
14. Bearing plates for bridges
15. Bearing pads and filler board for bridges
16. Perforated drain pipes
17. Embedded metals including plates, anchors, angles, strap anchors, bolts, nuts washers, flanges, fittings, bends, tees, cross, elbow and other metals or materials which are not paid for under other items in the Bill of Quantities
18. Timber

All metalworks treated in this Section shall conform to the following standards or their approved equivalent standards:

ASTM AG	General requirements for delivery of rolled steel plates, shapes, sheet piling bars for structural use
ASTM A36	Structural Steel
AWS D1-1	Structural Welding Code
AWS	Code for Arc and Gas Welding in Building construction
ASTM A307	Specification for Low-Carbon Steel Externally and Internally Threaded Std. Fasteners
ASTM A325	High Strength Bolts for Structural Steel Joints including Suitable Nuts and Plain Hardened Washers
ASTM A108	Cold Finish Carbon Steel Bars and Shafting
AISC	Manual of Steel Construction
ASTM A123	Zinc (Hot Galvanized) Coatings on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips
ASTM A53	Welded and Seamless Steel Pipe
Metal Grating	Metal Grating Institute Handbook
	Pittsburg, Pa. U.S.A

ASTM 120 Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses

AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings

ASTM A153 Galvanized Steel Pipes

3502 FABRICATION

Details of design and fabrication not covered by the drawings nor by these specifications shall conform to the applicable provisions of the latest "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" including all supplementary provisions of the American Institute of Steel Construction.

All metalworks and materials furnished by the Contractor and all works performed will be subject to rigid inspection. No metalworks or materials shall be delivered to the jobsite until inspection at the Contractor's fabricating plant has been made, in accordance with the provisions of these specifications.

Shearing and cutting by torch or electric arc shall be performed carefully, and all portions of the work which will be exposed to view after completion shall be finished neatly. Re-entrant cuts and copes shall be shaped notch-free to a radius of at least 12 millimeters.

In bolted connections, all holes shall be cylindrical, unless otherwise shown on the drawings, perpendicular to the members, and clean cut and without burned or ragged edges. Holes in materials more than 20 mm thick shall be drilled. All other holes may be punched or drilled to full size. Unless otherwise shown on the drawings, drilled holes shall be 1 mm larger than the nominal diameter of the bolt. Outside burrs resulting from drilling shall be removed with a tool making a 1 mm bevel. Likewise for punched holes, unless otherwise shown on the drawings, the diameter of the punch for punching to full size shall also be 1 mm larger than the nominal diameter of the bolt. The diameter of the die shall be not more than 1.50 mm larger than the diameter of the punch.

Welding shall be done by the shielded-arc method except where otherwise specifically permitted by the Engineer. Welding rods shall be furnished by the Contractor and shall be of heavily coated type designated for all position welding, and the size, type and nomenclature of the rods shall be subject to approval by NIA. Welds shall be made as indicated on the drawings and in accordance with the conventional symbols of the American Welding Society (AWS). Welding shall be done in accordance with Sections 3, 4, 5 and 6 of the AWS' code for Arc Welding and Gas Welding in Building Construction, latest revision. All butt welds shall have complete penetration. Teeming of multiple layer welds will not be permitted.

3503 INSTALLATION

All metalworks and materials shall be installed in accordance with the details shown on the Drawings. Care shall be taken to insure that all parts of metalworks are installed in correct position and alignment. Metalworks to be embedded in concrete shall be located accurately and shall be held in correct position and alignment during placing and setting of the concrete. Anchor bolts shall be set and held in position before concrete is placed, unless otherwise approved. Where it is impractical to embed anchor bolts or ladder, stairways or other comparatively light metal work before the concrete is placed and when it is necessary to anchor parts where inserts or anchor bolts have not been provided, holes shall be drilled in the concrete and expansion anchors with bolts shall be installed as directed. The surfaces of all metalworks to be in contact with or embedded in concrete or grouting mortar shall be cleaned.

Suitable blockouts shall be constructed in the concrete where required for installation of railing posts and other metalworks. After installation of the metalworks, blockouts shall be filled with concrete or grout as shown on the drawings. Contractor shall drill or drill and tap, as required all holes in metalwork required for installation of the metalwork

Contractor shall drill all holes in concrete required for the installation of expansion anchors. Contractor shall slot or cut or split metalwork in the field as required for installation.

3504 TRASHRACKS OR SCREENS

Trashracks or screens shall be a substantial all welded sectionalized steel structure, generally as shown on the drawings. Special care shall be taken to insure that all members shall be in exact position and alignment. Vertical members shall be welded to horizontal members. Trashracks shall be prime coated and painted in accordance with Section XXXVI, Painting Metalworks.

3505 STEEL LADDER RUNGS

Steel ladder rungs shall be furnished and installed in accordance with details shown on the drawings. Bars used for steel ladder rungs shall be cold drawn steel wire conforming to the provisions of ASTM Designation A32 or its latest revision. The wire gage or bar size and spacing shall be as designated on the Drawings.

Ladder rungs embedded in concrete shall be free of mortar, oil dirt, loose mil scale, loose rust and other coatings that would destroy or reduce the bond. Bars shall conform to the dimensions shown on the drawings. Bars with links or improper bends or other deformations shall not be used or made as rungs.

3506 STEEL GRATINGS

Gratings shall be provided as indicated on the drawings. Steel gratings shall be fabricated from steel shapes and flat bars provided with stiffeners and welded to form a rigid structures as shown on the drawings.

Flat bars of sizes and spaces shown on the drawings shall be welded at their ends into continuous rolled steel angles and provided with stiffeners. The sizes and dimensions of angles or stiffeners shall not be less than those shown on the drawings.

Steel gratings used as cover for the intake barrel manhole shall be provided with rollers on both ends as shown on the drawings, such that this cover could be opened by sliding. Roller guides shall not be shorter than the length shown on the drawings.

3507 GALVANIZED IRON PIPE GUARDRAILS AND HANDRAILS

Galvanized iron pipe guardrail and handrail shall be provided at operating platforms and other places shown on the drawings. Sizes and dimensions shall be as shown in detail on the drawings. All railings shall be of threaded ends and furnished with complete joint fittings.

Vertical members for guardrails shall be installed plumbed and horizontal members parallel to the surface of anchorage. Vertical members shall be installed in prepared sockets, braced in true alignment and secured permanently by either threaded floor flange which is anchored to the concrete structure by means of expansion bolts as shown on the drawings or by cement grout consisting of 1 part cement and 3 parts sand (by wt.) mixed to a consistency as directed by the Engineer. Bolts in bolted connections shall be firmly tightened.

Galvanized surfaces that are abraded or damaged during installation shall be thoroughly wire brushed removing all loose and cracked coating and then painted with two coats of high zinc- dust content paint conforming to the requirements of Federal Specification MIL-P-21035 or approved equal.

3508 BEARING PLATES FOR BRIDGES

Bearing plates, bars, rockers, assemblies, and other expansion or fixed devices for bridges shall be constructed in accordance with the details shown on the Drawings and shall be hot-dip galvanized after fabrication conforming to ASTM Designation A120 or its latest revision.

The bearing plates shall be set level and the rockers and other expansion devices shall be set to conform to the temperature at the time of erection or to the setting specified.

When bearing assemblies or masonry plates are shown on the Drawings to be placed (not embedded) directly on concrete, the concrete bearing area shall be constructed slightly above grade and shall be finished by grinding or other approved means to a true level plane which shall not vary perceptively from a straight edge placed in any direction across the area. The finished plane shall not vary more than 0.30 centimeter from the elevation shown on the Drawings

When elastic bearing pads, or preformed fabric pads are shown on the Drawings, the concrete surface on which pads or packing are to be placed shall be wood float finished to a level plane which shall not vary more than 0.40 centimeter from a straight edge placed in any direction across the area. The finished plane shall not vary more than 0.30 centimeter from the elevation shown on the Drawings.

3509 BEARING PADS AND FILLER BOARDS

Bearing pads of sizes indicated on the Drawings shall be neophrene, hardness 60 and filler boards shall be canex board or as indicated on the Drawings. The concrete surfaces on which bearing pads are to be placed shall be wood float finished to a level plane which shall not vary more than 0.15 centimeter from a straight edge placed in any direction across the area. The finished plane shall not vary more than 0.30 centimeter from the elevation shown on the Drawings.

3510 PERFORATED DRAIN PIPES

Perforated drain pipes shall be installed at locations shown on the drawings and as directed by the Engineer. The sizes and type of materials to be used shall be as indicated on the drawings.

3511 BOLTS, ANCHORS, ANGLES, NUTS, WASHERS AND OTHER METALS

Except for studbolts, the length of connection bolts shall be in 6 mm variations and when in the structure, the bolts shall extend at least six millimeters beyond the nuts. Anchor bolts and studbolts shall be as shown on the Drawings. Threads of anchor bolts shall be given a heavy coat of rust preventive compound in the shop. Washers shall be used under heads of all connection bolts where shown or called for on the drawings. Bevelled washers shall be used on sloping flanges.

3512 GROUT AND MORTAR

Grout and mortar for miscellaneous metalworks shall be mixed in the proportions and to the specified consistency in accordance with the requirements of Section XV, Concrete. Before placing grout and mortar, the surfaces of concrete on which grout will be placed shall be roughened and shall be cleaned of all laitance, loose or defective concrete coatings and other foreign materials by effective means followed by thorough washing and such surfaces shall be kept moist for at least 24 hours.

3513 TIMBER

This work shall consist of timber structures constructed to the dimension, lines and grades shown on the Drawings and in accordance with the specification. The timber shall be treated or kiln dried.

In handling treated timber, care shall be exercised so as not to break or penetrate the treatment with any tool or handling equipment. Any damage timber shall be replaced without any extra compensation. Any cut made or hole bored in treated timber that exposes untreated wood shall be given 3-coats of hot creosote oil before the exposed part is assembled.

All timber shall be of the specie specified in the drawing, shall be sound, free from knots, splits, ring separation, wormholes or any defects which will impair its strength or render it unfit for its intended use.

All timber which is to be stored on the job for any length of time, prior to its use in the structure, shall be neatly stacked in piles to prevent warping or distortion. Untreated timber shall be open stacked at least 300 mm above

the ground and shall be close-stacked and piled to prevent warping. The ground underneath and in the vicinity of all piles shall be cleared of all weeds and rubbish.

3514 METHOD OF MEASUREMENT

Measurement for payment of miscellaneous metalwork and materials will be made either on the weight of metalwork in kilogram or on the number of assembly or pieces actually installed in accordance with the table as follows:

Metal/Material	Measurement
1. Trashrack or screens including frames, guides and anchors	Kilogram/Set
2. Steel ladder rungs	Kilogram
3. Steel grating, including frames guides and anchors	Kilogram
4. G.I. Pipe guardrails and handrails	Kilogram/L.M.
5. Bearing Plates for Bridges	Piece
6. Bearing Pads and Filler Boards for Bridges	Piece
7. Perforated drain pipes	Kilogram/L.M.
8. Embedded metals including plates, anchors, angles, strap anchors, bolts, nuts and washers, flanges, fittings, bends, tees, cross, elbows and other metals or materials which are not paid under other items in the Bill of Quantities	Kilogram/Lump sum
9. Timber	Set/Assembly or bd. ft.

Weights shall be computed based on the theoretical weight of such material duly certified by the manufacturer.

3515 BASIS OF PAYMENT

Payment for miscellaneous metalwork will be made at the contract unit price per kilogram, per piece, or per assembly whichever is called for in the Bill of Quantities which price and payment shall constitute full compensation for furnishings all labor tools, materials and all incidentals and subsidiary works necessary for the successful completion of the miscellaneous metalworks and materials described under this Section.

CONSTRUCTION SAFETY AND HEALTH

BASIC PPE'S FOR WORKERS:

1. Helmet/Safety Hardhat
2. Safety Shoes
3. Rubber Boots
4. Working Gloves
5. Rain Coats

Section VII. Drawings

(annexed in a separate folder)

Section VIII. Bill of Quantities

Bill of Quantities

Project Title:	**TANJAY-BAIS RIVER IP, PACKAGE 2**
Contract No:	**NOSO-LMC-TANJAY-BAIS-02-2024**
Description of Contract:	**Construction of Canal Structures at Main Canal**
Location:	**Tanjay City, Negros Oriental**

ITEM NO.	DESCRIPTION	QTY.	UNIT
I. CANAL STRUCTURES			
1	Temporary Works, Mobilization & Demobilization, Health & Safety	1.00	l.s.
2	Clearing & Grubbing	4,864.00	m2
3	Common Structure Excavation (mech.)	11,773.00	m3
4	211kg/cm2 Class "A" Concrete	1,394.00	m3
5	Furnishing & Ins.of RSB, all sizes	139,710.00	kgs.
6	Structure Backfill within FHD	11,701.00	m3
7	Ladder Rung 16mm Ø	154.00	kgs.
8	Lean Concrete	30.00	m3
9	Rubble Masonry	2.00	m3
10	Fab./Ins. of Steelgate w/lifting mechanism	2.00	unit
11	12 mm Ø Vertical Stainless Screen	1.00	unit
12	Fab./Ins. of 16 mm thick Steel Plate Manhole Cover	5.00	unit
13	Cofferdam	1,600.00	m3
14	20 cm Dump bell type water stop (meter)	15.00	m3
15	Rock Structure Excavation (mech.)	2,944.00	m
16	Hard Asphalt	20.00	m3
17	Spiral Steel Pipe ASTM A36 (1,300 mm x 6 mm thk)	460.00	m
18	Fab/Inst'n of 24" schedule 20 steel pipe manhole, blow off valve and manhole cover	5.00	unit

Section IX. 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 **and** registration for the type and cost of the contract to be bid; **and**

☐ (e) Original copy of Bid Security. If in the form of a Surety Bond, submit also a certification issued by the Insurance Commission **or** original copy of Notarized Bid Securing Declaration; **and**

(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 Manager, 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 ownership or certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be; **and**

☐ (g) Original duly signed Omnibus Sworn Statement (OSS) **and** 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 **or**

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

☐ (k) Original of duly signed Bid Prices in the Bill of Quantities; **and**

☐ (l) 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; **and**

☐ (m) Cash Flow by Quarter.

Section IX. LOCAL CONDITION

LC-01 PROJECT LOCATION

TANJAY-BAIS RIVER IP, PACKAGE 2 is located in Tanjay City, Negros Oriental. The Project is approximately 40 kilometers from Dumaguete City. Accessible through Dumaguete City - Sibulan-San Jose-Amlan, Tanjay City, Negros Oriental route.

LC-02 ACCESS TO THE SITE

The contract work is located at Tanjay City, Negros Oriental. Passing through different service roads by fairly to well graveled road which may deteriorate if used during rainy days. Maintenance and repair of these service roads by the contractor is necessary if so used by them. The cost of maintenance and repair shall be included in the unit bid price of the contractor.

LC-03 FUEL AND POWER SUPPLIES

The major fuel station outlets such as Petron, Caltex and Shell are found in the nearest city of the project and other surrounding municipalities.

The main source of energy is supplied by the Negros Oriental Electric Cooperative II (NORECO II) and locally distributed by the respective electric cooperatives and is presently available at the above-stated address of the project site.

LC-04 CLIMATE AND HYDROLOGY

Using the Corona Climate Classification System, Negros Oriental falls within the Type III classification, which is characterized by seasons not very pronounced, relatively dry from November to April, and wet during the rest of the year. The maximum rain periods are not very pronounced, with the short dry season lasting only from one to three months. These localities are only partly sheltered from the northeast monsoon and trade winds and open to the Southwest monsoon or at least to frequent cyclonic storms.

Rainfall summarized in the following table, but NIA will assume no responsibility whatsoever for the accuracy of these data. Any risk arising from the interpretation of such data is to be entirely borne by the Contractor.

CLIMATE

Month	Rainfall in BES/1 (mm)	Rainy Days BES/2
Jan.	199.40	9
Feb.	170.50	7
March	127.40	1
April	90.06	2
May	178.30	4
June	174.03	7
July	142.65	9
Aug.	163.00	4
Sept.	165.25	7
Oct.	196.00	1
Nov.	212.30	7
Dec.	164.60	7
Total	2049.6	

/1: BES is the rainfall station close to the project area

/2: Daily rainfall less than 5 mm is deemed zero and not counted as rainy day.

LC-05 BANKING FACILITIES

Most rural banks are available at nearby of the project area while major banking facilities are found in Dumaguete City like; Development Bank of the Philippines, Land Bank of the Philippines, Philippine National Bank, Bank of the Philippine Island, Allied Bank, Bank of Commerce, Metro Bank and other private banks.

LC-06 COMMUNITY AND FIRST AID FACILITIES

The Contractor is advised that the NIA will take no direct part in providing community facilities such as churches, shops, community center and recreation facilities for Contractor's employees. The Contractor shall make his own arrangements for such as he considers being necessary for the approval of the NIA and shall meet all codes or regulations in effect. It shall be the responsibility of the Contractor to furnish and operate first aid for his personnel. Such facilities may be integrated with the NIA facilities, if any, upon mutual agreement.

LC-07 CONTRACTOR'S WORKING AREA AND SITE OFFICE

The Contractor shall, at his own expense, be responsible for housing, feeding and accommodation of all his employees for the execution of the Contract Work. Construction equipment, materials, tools, supplies, and other incidentals, and all cost incurred for the protection and safety shall be borne by him.

LC-08 WATER SUPPLY

The Contractor shall, at his own expense, be responsible for the provision or installation, operation and maintenance of a safe, adequate and temporary supply of drinking and domestic water, and the adequate water supply for his construction purposes.

LC-09 RIGHT OF WAY

The NIA will provide all right of way, free of charge to the contractor, which, in the opinion of the Regional Manager, necessary for carrying out the contract work.

LC-10 SITE INVESTIGATION

It is the responsibility of the Contractor to visit the work site to make their own investigation to satisfy themselves as to the existing conditions affecting the work to be done under these Specifications.

The Contractor shall assume all responsibilities for deduction and conclusions that he may obtain or arrive at from the site inspection.

INFORMATION AND DATA REFERRED TO IN THESE BID DOCUMENTS

PROJECT: **TANJAY-BAIS RIVER IP, PACKAGE 2 (CONSTRUCTION OF CANAL STRUCTURES AT MAIN CANAL), TANJAY CITY, NEGROS ORIENTAL**

1. Site Visit and Inspection

   Register at NIA-Negros Oriental Satellite Office, Osmeña St., Poblacion, Sibulan, Negros Oriental NIA, Regional Office No.7, Dao District, Tagbilaran City, Bohol

2. Wet Season Period, Article LC-04

3. Contract Duration - 360 calendar days

4. List of Officers/Offices to be furnished correspondence from the Contractor

   The Regional Manager
   NIA Regional Office 7
   Dao District, Tagbilaran City

5. Minimum Equipment Requirement for the Contract:

Equipment		Capacity	Number of Units
1.	Dump Truck		1
2.	Cargo Truck		1
3.	Backhoe	1 cu.m.	1
4.	Concrete Mixer	1 bagger	2
5.	Concrete Vibrator		2
6.	Plate Compactor		1
7.	Survey Instrument (set)		1
8.	Bar Cutter		2
9.	Water Pump (4" dia.)		2

6. List of Initial Equipment required to be mobilized within ten (7) calendar days after receipt of Notice to Proceed

Equipment		Capacity	Number of Units
1.	Dump Truck		1
2.	Cargo Truck		1
3.	Backhoe	1 cu.m.	1
4.	Concrete Mixer	1 bagger	2
5.	Concrete Vibrator		2
6.	Plate Compactor		1
7.	Survey Instrument (set)		1
8.	Bar Cutter		2
9.	Water Pump (4" dia.)		2

Section X. BIDDING FORMS

National Irrigation Administration
Region 7

STATEMENT OF THE BIDDERS OF ALL ITS ONGOING GOVERNMENT & PRIVATE CONTRACTS INCLUDING CONTRACTS AWARDED BUT NOT YET STARTED

Business Name : _____

Business Address : _____

NAME OF CONTRACT	CONTRACT DATE	CONTRACT PERIOD	CONTRACT AMOUNT	Amount or Value of Outstanding Works or Unperformed Portion
Government				
Private				

Submitted by : _____
(Printed Name & Signature)

Designation : _____

Date : _____

National Irrigation Administration
Region 7

STATEMENT OF THE BIDDER'S SINGLE LARGEST COMPLETED CONTRACTS (SLCC) SIMILAR TO THE CONTRACT TO BE BID

Business Name : _____

Business Address : _____

NAME OF COMPLETED CONTRACT	DATE OF CONTRACT	CONTRACT DURATION	CONTRACT AMOUNT
Government			
Private			

Note: This statement shall be supported with:
Owner's Certificate of Final Acceptance or a final rating of at least Satisfactory in the CPES

Submitted by : _____
(Printed Name & Signature)

Designation : _____

Date : _____

REPUBLIC OF THE PHILIPPINES)
CITY OF _____) S.S.

BID SECURING DECLARATION
Project Identification No.: NOSO-LMC-TANJAY-BAIS-02-2024

To: [Insert name and address of the Procuring Entity]

I/We, the undersigned, declare that:

1. I/We understand that, according to your conditions, bids must be supported by a Bid Security, which may be in the form of a Bid Securing Declaration.
2. I/We accept that: (a) I/we will be automatically disqualified from bidding for any procurement contract with any procuring entity for a period of two (2) years upon receipt of your Blacklisting Order; and, (b) I/we will pay the applicable fine provided under Section 6 of the Guidelines on the Use of Bid Securing Declaration, within fifteen (15) days from receipt of the written demand by the procuring entity for the commission of acts resulting to the enforcement of the bid securing declaration under Sections 23.1(b), 34.2, 40.1 and 69.1, except 69.1(f),of the IRR of RA No. 9184; without prejudice to other legal action the government may undertake.
3. I/We understand that this Bid Securing Declaration shall cease to be valid on the following circumstances:
   a. Upon expiration of the bid validity period, or any extension thereof pursuant to your request;
   b. I am/we are declared ineligible or post-disqualified upon receipt of your notice to such effect, and (i) I/we failed to timely file a request for reconsideration or (ii) I/we filed a waiver to avail of said right; and
   c. I am/we are declared the bidder with the Lowest Calculated Responsive Bid, and I/we have furnished the performance security and signed the Contract.

IN WITNESS WHEREOF, I/We have hereunto set my/our hand/s this ____ day of [month] [year] at [place of execution].

[Insert NAME OF BIDDER OR ITS AUTHORIZED REPRESENTATIVE]
[Insert signatory's legal capacity]
Affiant

[Jurat]

[Format shall be based on the latest Rules on Notarial Practice]

LIST OF CONTRACTOR'S EQUIPMENT PLEDGE TO THE CONTRACT TO BE BID.

CONTRACT No. _____

NAME OF CONTRACT: _____

Name of Equipment	Unit	Plate No./Model	Motor No./Body No./Engine No.	Proof of Ownership	Present Location	Remarks

Submitted by :

_____ Date: _____

(Name of Contractor & Signature)

_____

(Name of Firm)

Omnibus Sworn Statement

REPUBLIC OF THE PHILIPPINES)
CITY/MUNICIPALITY OF _____) S.S.

AFFIDAVIT

I, [Name of Affiant], of legal age, [Civil Status], [Nationality], and residing at [Address of Affiant], after having been duly sworn in accordance with law, do hereby depose and state that:

1. [Select one, delete the other:]
   [If a sole proprietorship:] I am the sole proprietor or authorized representative of [Name of Bidder] with office address at [address of Bidder];

   [If a partnership, corporation, cooperative, or joint venture:] I am the duly authorized and designated representative of [Name of Bidder] with office address at [address of Bidder];

2. [Select one, delete the other:]

   [If a sole proprietorship:] As the owner and sole proprietor, or authorized representative of [Name of Bidder], I have full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached duly notarized Special Power of Attorney;

   [If a partnership, corporation, cooperative, or joint venture:] I am granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached [state title of attached document showing proof of authorization (e.g., duly notarized Secretary's Certificate, Board/Partnership Resolution, or Special Power of Attorney, whichever is applicable;)];

3. [Name of Bidder] is not "blacklisted" or barred from bidding by the Government of the Philippines or any of its agencies, offices, corporations, or Local Government Units, foreign government/foreign or international financing institution whose blacklisting rules have been recognized by the Government Procurement Policy Board, **by itself or by relation, membership, association, affiliation, or controlling interest with another blacklisted person or entity as defined and provided for in the Uniform Guidelines on Blacklisting;**

4. Each of the documents submitted in satisfaction of the bidding requirements is an authentic copy of the original, complete, and all statements and information provided therein are true and correct;

5. [Name of Bidder] is authorizing the Head of the Procuring Entity or its duly authorized representative(s) to verify all the documents submitted;

6. [Select one, delete the rest:]
   [If a sole proprietorship:] The owner or sole proprietor is not related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

   [If a partnership or cooperative:] None of the officers and members of [Name of Bidder] is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the

Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

[If a corporation or joint venture:] None of the officers, directors, and controlling stockholders of [Name of Bidder] is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

7. [Name of Bidder] complies with existing labor laws and standards; and

8. [Name of Bidder] is aware of and has undertaken the responsibilities as a Bidder in compliance with the Philippine Bidding Documents, which includes:

   a. Carefully examining all of the Bidding Documents;
   b. Acknowledging all conditions, local or otherwise, affecting the implementation of the Contract;
   c. Making an estimate of the facilities available and needed for the contract to be bid, if any; and
   d. Inquiring or securing Supplemental/Bid Bulletin(s) issued for the [Name of the Project].

9. [Name of Bidder] did not give or pay directly or indirectly, any commission, amount, fee, or any form of consideration, pecuniary or otherwise, to any person or official, personnel or representative of the government in relation to any procurement project or activity.

10. In case advance payment was made or given, failure to perform or deliver any of the obligations and undertakings in the contract shall be sufficient grounds to constitute criminal liability for Swindling (Estafa) or the commission of fraud with unfaithfulness or abuse of confidence through misappropriating or converting any payment received by a person or entity under an obligation involving the duty to deliver certain goods or services, to the prejudice of the public and the government of the Philippines pursuant to Article 315 of Act No. 3815 s. 1930, as amended, or the Revised Penal Code.

IN WITNESS WHEREOF, I have hereunto set my hand this __ day of ___, 20__ at _____, Philippines.

[Insert NAME OF BIDDER OR ITS AUTHORIZED REPRESENTATIVE]
[Insert signatory's legal capacity]
Affiant

[Jurat]

[Format shall be based on the latest Rules on Notarial Practice]

BID FORM

Date: _____

Project Identification No.: NOSO-LMC-TANJAY-BAIS-02-2024

To: [name and address of Procuring Entity]

Having examined the Philippine Bidding Documents (PBDs) including the Supplemental or Bid Bulletin Numbers [insert numbers], the receipt of which is hereby duly acknowledged, we, the undersigned, declare that:

a. We have no reservation to the PBDs, including the Supplemental or Bid Bulletins, for the Procurement Project: [insert name of contract];

b. We offer to execute the Works for this Contract in accordance with the PBDs;

c. The total price of our Bid in words and figures, excluding any discounts offered below is: [insert information];

d. The discounts offered and the methodology for their application are: [insert information];

e. The total bid price includes the cost of all taxes, such as, but not limited to: [specify the applicable taxes, e.g. (i) value added tax (VAT), (ii) income tax, (iii) local taxes, and (iv) other fiscal levies and duties], which are itemized herein and reflected in the detailed estimates,

f. Our Bid shall be valid within the a period stated in the PBDs, and it shall remain binding upon us at any time before the expiration of that period;

g. If our Bid is accepted, we commit to obtain a Performance Security in the amount of [insert percentage amount] percent of the Contract Price for the due performance of the Contract, or a Performance Securing Declaration in lieu of the the allowable forms of Performance Security, subject to the terms and conditions of issued GPPB guidelines[12] for this purpose;

h. We are not participating, as Bidders, in more than one Bid in this bidding process, other than alternative offers in accordance with the Bidding Documents;

i. We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal Contract is prepared and executed; and

j. We understand that you are not bound to accept the Lowest Calculated Bid or any other Bid that you may receive.

k. We likewise certify/confirm that the undersigned, is the duly authorized representative of the bidder, and granted full power and authority to do, execute and perform any and

all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for the [Name of Project] of the [Name of the Procuring Entity].

l. We acknowledge that failure to sign each and every page of this Bid Form, including the Bill of Quantities, shall be a ground for the rejection of our bid.

Name: _____
Legal Capacity: _____
Signature: _____
Duly authorized to sign the Bid for and behalf of: _____
Date: _____

Bill of Quantities

Project Title:	TANJAY-BAIS RIVER IP, PACKAGE 2
Contract No:	NOSO-LMC-TANJAY-BAIS-02-2024
Description of Contract:	Construction of Canal Structures at Main Canal
Location:	Tanjay City, Negros Oriental

ITEM NO.	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
I. CANAL STRUCTURES					
1	Temporary Works, Mobilization & Demobilization, Health & Safety	1.00	l.s.	₱	₱
2	Clearing & Grubbing	4,864.00	m2	₱	₱
3	Common Structure Excavation (mech.)	11,773.00	m3	₱	₱
4	211kg/cm2 Class "A" Concrete	1,394.00	m3	₱	₱
5	Furnishing & Ins.of RSB, all sizes	139,710.00	kgs.	₱	₱
6	Structure Backfill within FHD	11,701.00	m3	₱	₱
7	Ladder Rung 16mm Ø	154.00	kgs.	₱	₱
8	Lean Concrete	30.00	m3	₱	₱
9	Rubble Masonry	2.00	m3	₱	₱
10	Fab./Ins. of Steelgate w/lifting mechanism	2.00	unit	₱	₱
11	12 mm Ø Vertical Stainless Screen	1.00	unit	₱	₱
12	Fab./Ins. of 16 mm thick Steel Plate Manhole Cover	5.00	unit	₱	₱
13	Cofferdam	1,600.00	m3	₱	₱
14	20 cm Dump bell type water stop (meter)	15.00	m3	₱	₱
15	Rock Structure Excavation (mech.)	2,944.00	m	₱	₱
16	Hard Asphalt	20.00	m3	₱	₱
17	Spiral Steel Pipe ASTM A36 (1,300 mm x 6 mm thk)	460.00	m	₱	₱
18	Fab/Inst'n of 24" schedule 20 steel pipe manhole, blow off valve and manhole cover	5.00	unit	₱	₱

The undersigned bidder hereby certifies that he has fully informed himself of all condition, local and otherwise affecting the carrying out of the and that his bid has been prepared strict accordance with the terms and condition.

Name of Firm: _____

_____

Name in Print & Signature of Bidder

DETAILED COST ESTIMATE

Contract No.	:	
Name of Project	:	

DERIVATION OF UNIT COST		Unit	
		Quantity	
Item No.	:		
Work Description	:		

DESCRIPTION	QTY	UNIT	UNIT COST	AMOUNT
A. ESTIMATED DIRECT COST (EDC)				
1. MATERIAL COST				
TOTAL MATERIAL COST:				
2. LABOR COST				
TOTAL LABOR COST:				
3. EQUIPMENT COST				
TOTAL EQUIPMENT COST:				
TOTAL A (Estimated Direct Cost):				
B. MARK - UPS				
OCM				
Contractor's Profit				
TOTAL B (OCM and Contractor's Profit):				
C. VALUE ADDED TAX (VAT)				
TOTAL C (VAT) (5% of A and B):				
TOTAL COST OF WORK ITEM (Sum of A, B and C)				
UNIT COST (Total Cost of Work Item/Quantity)				

ESTIMATED DIRECT COST (EDC)	INDIRECT COST % FOR OCM AND PROFIT		TOTAL INDIRECT COST % FOR OCM AND PROFIT
	OCM (% OF EDC)	PROFIT (% OF EDC)	
Up to Php 5 Million	15	10	25
Above Php 5M up to Php 50M	12	8	20
Above Php 50M up to Php 150M	10	8	18
Above Php 150M	8	8	16

OCM - Overhead, Contingencies and Miscellaneous

VAT COMPONENT - shall be **5%** of the sum of EDC, OCM and Profit

Regional Irrigation Office 7
National Irrigation Administration

Contract No. :
Name of Contract :
Address :
Calendar Days :

CASH FLOW AND PAYMENT SCHEDULE

PARTICULAR	% WT.	QTR	1st QUARTER			2ND QUARTER			3RD QUARTER			4TH QUARTER		
		MO.	1	2	3	4	5	6	7	8	9	10	11	12
		CD	30	60	90	120	150	180	210	240	270	300	330	360
ACCOMPLISHMENT (%)														
CASH FLOW (P)														
CUMULATIVE ACCOMPLISHMENT (%)														
CUMULATIVE CASH FLOW (P)														

Submitted by:

Date:

Name and Signature

Name of Firm