

**GOVERNMENT OF KHYBER PAKHTUNKHWA  
IRRIGATION DEPARTMENT**



**NAME OF WORK: CONSTRUCTION OF RAMAK DAM TSD D.I. KHAN  
(AIP ADP No.2335-210105)**

**TENDER DOCUMENTS**



**VOLUME-I**

**January2022**

## **BIDDING DOCUMENTS**

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2. Instructions to Bidders
3. Bidding Data
4. Forms of Bid and Appendices to Bid
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# **INVITATION FOR BID**

**GOVERNMENT OF KHYBER PAKHTUNKHWA  
DIRECTORATE GENERAL SMALL DAMS IRRIGATION DEPARTMENT**

**NOTICE INVITING E-BIDDING**

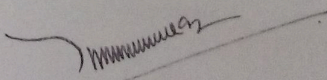
**Single Stage Single Envelope Procedure**

Project Director PSU Small Dams Merged Area Peshawar invites electronic bids in accordance with KPPRA procurement Rules 2014 on single stage single Envelope procedure for the following work, from eligible Firms/Contractors registered with PEC and Government of Khyber Pakhtunkhwa in required category.

S.No.	Name of Work	Required Category	PEC Code	Earnest Money
1.	Construction of Ramak Dam TSD DIKhan AIP ADP No.2335-210105	C-02 & above PK-C2 & above	CE-04	2% of estimated cost

**TERMS AND CONDITIONS**

1. Bid Solicitation Documents containing Instructions to Bidders can be downloaded from Irrigation website <http://www.irrigation.gkp.pk/as> well as KPPRA website otherwise bids submitted without these documents (duly filled) will be considered non responsive.
2. Bid Solicitation Documents issued to the bidders contains requirements for eligible bidders and other important terms and conditions.
3. Electronic Bidding shall be done on "above / below system" on BOQ/Engineer estimate, based on MRS/NSI where applicable only two digits after the decimal point shall be considered for evaluation purpose.
4. As per Notification No. Chief/INF/P&D/003-02/2022/01, dated 03-01-2020, issued by the office of Additional Chief Secretary Khyber Pakhtunkhwa Peshawar, that all The interested eligible bidders shall deposit their Call Deposits in the name of Procuring Entity (Project Director PSU Small Dams Merged Area) 05 days prior to the closing date of bid submission i.e 17-02-2022, in case of no security deposit is credited, the bid shall be considered non responsive and shall summarily be rejected.
5. The Employer has the authority to reject any bid or all the bids assigning cogent reasons.
6. Bid security of the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> lowest Electronic bidder for the specific work will be retained by the Department for one week after issuance of letter of acceptance to the successful bidder.
7. All the bidder / Firms must be register with the Khyber Pakhtunkhwa Revenue Authority.
8. All the prevailing KPPRA Acts / Rules updated instruction/notifications and other Government Notifications will be applicable issued from time to time.
9. The interested firms/contractors may obtain clarification regarding bid solicitation documents during office hours on any working day from the office of the undersigned.
10. The last date for bid submission is 22-02-2022 at 12:30 PM which will be opened on 22-02-2022 at 01:00 PM in the office of the undersigned in presence of Contractors and their representative who wishes to attend.

  
 Project Director  
 PSU Small Dam Merged Area  
 Directorate General Small Dam  
 Irrigation Department Khyber Pakhtunkhwa  
 Hayatabad, Peshawar

Address: Plot No. 27, Street No. 12,  
Sector E-8, Phase-VII Phone No. 091-9219537  
Email: psusmalldam@gmail.com

**TERMS AND CONDITIONS:**

1. Bid Soliciting Documents containing Instructions to Bidders, advertisement for Notice Inviting Bids and required forms to be filled by the bidders can be downloaded from the official websites of Irrigation Department Khyber Pakhtunkhwa ([www.irrigation.gkp.pk](http://www.irrigation.gkp.pk)) and KPPRA([www.kppra@gov.pk](mailto:www.kppra@gov.pk)).
2. Electronic Bidding shall be done on “Above / Below System” on BOQ / Engineer’s Estimate, based on the MRS applicable. Only two digits after the decimal point shall be considered for evaluation purpose.
3. The Bidder should submit **02% Bid Security** of the estimated cost and **Additional security** if required through registered mail/courier in sealed envelope in the shape of Call Deposit (Original) in the name of Project Director PSU Small Dams Merged Area before closing date & time.
4. The contractors quoting their bids up to a limit of 15% below Engineer estimate shall submit bid security to the extent of 2% of Engineer Estimate only.
5. The contractors quoting their bids more than 15% below on Engineer’s Estimate shall submit along with their bids, an **Additional Security** to the extent of their bid / rates more than 15% below on engineer estimate in the form of percentage.
6. In case the bidder quotes more than 15% below the Engineer Estimate and the bid is not accompanied by the Additional Security then the bid shall be considered as non-responsive and the 2<sup>nd</sup> lowest bidder and so on will be considered accordingly.
7. In case a contractor quotes more than 30% below on Engineer Estimate, the procuring entity shall, in addition to additional security, require the contractor to produce detailed rate analysis of his bid price in relation to any or all the items of bill of quantities, scope of work, allocation of risks and responsibilities and/or any other requirements of the bid solicitation document. The contract shall be awarded to the lowest evaluated bidder who has satisfied the procuring entity on rate analysis. However, if the procuring entity determines that the contractor has failed to demonstrate its capability to execute the contract at the offered price, the matter shall be referred to the next higher authority for rejection of the bid on the basis of being financially unviable.
8. All the Bidders are bound to follow the instructions content KPPRA Notification **No.S.R.O.(13)/Vol:1-21/2021- 22, dated15-09-2021.**
9. All Bidders are required to have valid Registration with Khyber Pakhtunkhwa Revenue Authority established under the Khyber Pakhtunkhwa Finance Act 2018 (Khyber Pakhtunkhwa Act, XXIof2013).
10. Electronic Bids shall be submitted electronically on or before the fix date/time.

11. Downloaded tender form (signed by concerned Firm/Contractor) & B.O.Q along with photocopies of the following i.e., Pakistan Engineering Council Registration for the Year 2021-22, Registration with Khyber Pakhtunkhwa Revenue Authority, NIC, Ownership Documents, Income Tax/NTN Certificate & other mandatory documents shall be submitted before closing date and time of bids which will be required for bid evaluation / Approval purposes of the concerned Firm/ Contractor after E-Bidding Procedure, any bidder who provides incorrect information shall stand disqualified and will be debarred.
12. Call Deposit of schedule Banks shall be acceptable. **No Bank Cheque or Pay Order shall be acceptable.**
13. The Competent Authority reserves the right to Accept / Reject any or all bids at any time prior to acceptance of a bid as per Para 47(i) of KPPRARules2014.
14. Bid Securities of 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> lowest bidders shall be retained till signing of the Contract Agreement with the lowest responsive bidder.
15. All the prevailing KPPRA Act / Rules, taxes/duties and other Government Notifications issued will be applicable.
16. After commencement of work by the successful bidder, the additional security shall be released to the bidders in four installments i.e., 25% to be released after completing 25% of the Project and soon.
17. Electronic bids validity period is 120-days.
18. Successful bidder should sign the Agreement with the Department within 28-days after issuance of LOA and after that work order will be issued.
19. If the evaluated electronic bid costs of two or more than two bidders are equal then the successful bidder will be declared through draw.
20. The interested Firms/Contractors may obtain clarification regarding bid solicitation documents during office hours on any working day from the Office of the Project Director PSU Small Dams Merged Area.

Project Director  
PSU Small Dam Merged Area  
Directorate General Small Dam  
Irrigation Department Khyber Pakhtunkhwa Hayatabad, Peshawar

Address: Plot No. 27, Street No. 12,  
Sector E-8, Phase-VII Phone No. 091-9219537  
Email; psusmalldam@gmail.com



# INVITATION FOR BIDS

**GOVERNMENT OF KHYBER PAKHTUNKHWA**  
**DIRECTORATE GENERAL SMALL DAMS IRRIGATION DEPARTMENT**  
**NOTICE INVITING E-BIDDING**  
**SINGLE STAGE SINGLE ENVELOPE PROCEDURE**

Project Director PSU Small Dams Merged Area Peshawar invites electronic bids in accordance with KPPRA procurement Rules 2014 on single stage single Envelope procedure for the following work, from eligible Firms/Contractors registered with PEC and Government of Khyber Pakhtunkhwa in required category.

S#	Name of Work	Required Category	PEC Code	Earnest Money
1.	Construction of Ramak Dam TSD DIKhan AIP ADP No.2335-210105	C-02 & above PK-C2 & above	CE-04	2% of estimated cost

**TERMS AND CONDITION**

- Bid Solicitation Documents containing Instructions to Bidders can be downloaded from Irrigation website <http://www.irrigation.gkp.pk> as well as KPPRA website otherwise bids submitted without these documents (duly filled) will be considered non responsive.
- Bid Solicitation Documents issued to the bidders contains requirements for eligible bidders and other important terms and conditions.
- Electronic Bidding shall be done on "above / below system" on BOQ/Engineer estimate, based on MRS/NSI where applicable only two digits after the decimal point shall be considered for evaluation purpose.
- As per Notification No. Chief/INF/P&D/003-02/2022/01, dated 03-01-2020, issued by the office of Additional Chief Secretary Khyber Pakhtunkhwa Peshawar, that all The interested eligible bidders shall deposit their Call Deposits in the name of Procuring Entity (Project Director PSU Small Dams Merged Area) 05 days prior to the closing date of bid submission i.e 17-02-2022, in case of no security deposit is credited, the bid shall be considered non responsive and shall summarily be rejected.
- The Employer has the authority to reject any bid or all the bids assigning cogent reasons.
- Bid security of the 1st, 2nd and 3rd lowest Electronic bidder for the specific work will be retained by the Department for one week after issuance of letter of acceptance to the successful bidder.
- All the bidder / Firms must be registered with the Khyber Pakhtunkhwa Revenue Authority.
- All the prevailing KPPRA Acts / Rules updated instruction/notifications and other Government Notifications will be applicable issued from time to time.
- The interested firms/contractors may obtain clarification regarding bid solicitation documents during office hours on any working day from the office of the undersigned.
- The last date for bid submission is 22-02-2022 at 12:30 PM which will be opened on 22-02-2022 at 01:00 PM in the office of the undersigned in presence of Contractors and their representative who wishes to attend.

**Project Director**  
 PSU Small Dam Merged Area  
 Directorate General Small Dam  
 Irrigation Department Khyber Pakhtunkhwa Hayatabad, Peshawar  
 Address: Plot No.27 Street No.12 Sector E-8, Phase-VII Phone:091-9219537  
 Email:psusmalldam@gmail.com  
 INF(P)482/2022

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 Our Faith, Corruption Free Pakistan  
 TAKE SPECIAL CARE OF SPECIAL PERSONS

**INSTRUCTIONS**

**TO**

**BIDDERS**

## INSTRUCTIONS TO BIDDERS

### A. GENERAL

#### IB.1 Scope of Bid

- 1.1 The Procuring Entity / Employer as defined in the Bidding Data hereinafter called “the Procuring Entity / Employer” wishes to receive bids for the construction and completion of works as described in these Bidding Documents, and summarized in the Bidding Data hereinafter referred to as the “Works”.
- 1.2 The successful bidder will be expected to complete the Works within the time specified in Appendix-A to Bid.
- 1.3 Throughout these bidding documents, the terms ‘bid’ and ‘tender’ and their derivatives (bidder / tenderer, bid / tender, bidding / tendering etc.) are synonymous.

#### IB.2 Source of Funds

- 2.1 The project is proposed to be financed from the provincial resources of Khyber Pakhtunkhwa under AIP/ADP scheme “**Construction of Ramak Dam TSD D.I. Khan AIP ADP No. 2335-210105 (2021-22)**”.

#### IB.3 Eligible Bidders

- 3.1 This Invitation for Bids is open to all bidders meeting the following requirements:
  - a. Duly licensed by the Pakistan Engineering Council (PEC) in the required category as per NIT.
  - b. Duly registered with Khyber Pakhtunkhwa Revenue Authority for the purpose of sales tax on services. Referred reference: KPPRA Notification No. KPPRA / M&E / Esst: / 1-14 / 2017-18 dated June 27, 2018.
  - c. Registered with Provincial Works Department, Govt of KP in the required category.
  - d. Is neither associated, nor has been associated, directly or indirectly, with the Consultants or any other entity that has prepared the design, specifications and other documents for the Project or being proposed for any position in the Project Management.
- 3.2 A bidder having a conflict of interest will be declared as non-responsive if the bidder has a close business relationship with the Procuring Entity / Employer’s professional personnel, who directly or indirectly involved in any part of: (i) the preparation of the bidding documents for the Works,

(ii) the Bid evaluation or (iii) the supervision of such Works.

**IB.4 One Bid per Bidder**

4.1 Each bidder shall submit only one bid either by himself, or as a partner in a joint venture. A bidder who submits or participates in more than one bid (other than alternatives pursuant to Clause IB.16) will be disqualified.

**IB.5 Cost of Bidding**

5.1 The bidders shall bear all costs associated with the preparation and submission of their respective bids and the Procuring Entity / Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

**IB.6 Site Visit**

6.1 The bidders are advised to visit and examine the Site of Works and its surroundings and obtain for themselves on their own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. All cost in this respect shall be at the bidder's own expense.

6.2 The bidders and any of their personnel or agents will be granted permission by the Procuring Entity / Employer to enter upon his premises and lands for the purpose of such inspection, but only upon the express condition that the bidders, their personnel and agents, will release and indemnify the Procuring Entity / Employer, his personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of such inspection.

**B. BIDDING DOCUMENTS**

**IB.7 Contents of Bidding Documents**

7.1 The Bidding Documents, in addition to invitation for bids, are those stated below and should be read in conjunction with any Addenda issued in accordance with Clause IB.9.

1. Instructions to Bidders.
2. Bidding Data.
3. Conditions of Contract, Part-I - General Conditions
4. General Conditions of Contract, Part-I (GCC)
5. Particular Conditions of Contract, Part-II (PCC)
6. Specifications – Special Provisions
7. Specifications - Technical Provisions.
8. Form of Bid & Appendices to Bid.
9. Bill of Quantities (Appendix-D to Bid).

10. Form of Bid Security.
11. Form of Contract Agreement.
12. Forms of Performance Security and Mobilization Advance Guarantee/Bond.
13. Bid Drawings.

7.2 The bidders are expected to examine carefully the contents of all the above documents. Failure to comply with the requirements of bid submission will be at the Bidder's own risk. Pursuant to Clause IB.26, bids which are not substantially responsive to the requirements of the Bidding Documents will be rejected.

#### **IB.8 Clarification of Bidding Documents**

- The interested Firms/Contractors may obtain clarification regarding bid solicitation documents during office hours on any working day from the address indicated in the Invitation for Bids.

#### **IB.9 Amendment of Bidding Documents**

- 9.1 At any time prior to the deadline for submission of bids, the Procuring Entity / Employer may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective bidder, modify the Bidding Documents by issuing addendum.
- 9.2 Any addendum thus issued shall be part of the Bidding Documents pursuant to Sub-Clause 7.1 hereof and shall be communicated in writing to all purchasers of the Bidding Documents. Prospective bidders shall acknowledge receipt of each addendum in writing to the Procuring Entity / Employer.
- 9.3 To afford prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Procuring Entity / Employer may extend the deadline for submission of bids in accordance with Clause IB.20.

### **C. PREPARATION OF BIDS**

#### **IB.10 Language of Bid**

- 10.1 The bid and all correspondence and documents related to the bid exchanged by a bidder and the Procuring Entity / Employer shall be in the bid language stipulated in the Bidding Data and Particular Conditions of Contract. Supporting documents and printed literature furnished by the bidders may be in any other language provided the same are accompanied by an accurate translation of the relevant parts in the bid language, in which case, for purposes of evaluation of the bid, the translation in bid language shall prevail.

**IB.11 Documents Accompanying the Bid**

NA

**IB.12 Bid Prices**

12.1 Unless stated otherwise in the Bidding Documents, the Contract shall be for the whole of the Works as described in Sub-Clause 1.1 hereof, based on SINGLE PERCENTAGE RATE, with two digits after the decimal point, "ABOVE / BELOW / AT PAR" of the Engineer's Estimated Cost on Market Rate System – 2020 and Non-Schedule Items as well, (ENDST: No. KPPRA / M&E/Estt:/1-17/2019-20: Dated Peshawar, the June 12, 2020) submitted by the bidder.

12.2 All duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as on the date 28 days prior to the deadline for submission of bids shall be included in the rates and prices and the total Bid Price submitted by a bidder.

Additional / reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 70.2 of the General Conditions of Contract Part-I.

12.3 The rates and prices, resulting from the bidders quoted SINGLE PERCENTAGE RATE, with two digits after the decimal point, "ABOVE / BELOW / AT PAR" of the Engineer's Estimated cost, are subject to adjustment during the performance of the Contract in accordance with the provisions of Clause 70 of the Conditions of Contract. Price adjustments will be accomplished in line with the weightages/coefficients quantified by the Procuring Entity in Appendix-C to Bid.

**IB.13 Currencies of Bid and Payment**

13.1 The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Procuring Entity/Procuring Entity / Employer's country (referred to as the "Foreign Currency Requirements") shall indicate the same in Appendix-B to Bid. The proportion of the Bid Price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either

(i) Entirely in the currency of the Bidder's home country or, (ii) at the bidder's option, entirely in Pak rupees

provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in his bid.

13.2 The rates of exchange to be used by the bidder for currency conversion shall be the TT&OD Selling Rates published or authorized by the State Bank of Pakistan prevailing on the date 28 days prior to the deadline for

submission of bids.

For the purpose of payments, the exchange rates used in bid preparation shall apply for the duration of the Contract.

**IB.14 Bid Validity**

- 14.1 Bids shall remain valid for the period stipulated in the Bidding Data after the Date of Bid Opening specified in Clause IB.23.
- 14.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Procuring Entity / Employer may request that the bidders extend the period of validity for a specified additional period which shall in no case be more than the original bid validity period. The request and the responses thereto shall be made in writing. A bidder may refuse the request without forfeiting his Bid Security. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his Bid Security for the period of the extension, and in compliance with Clause IB.14 in all respects. The bidder shall bear all costs to be incurred on such extensions.

**IB.15 Bid Security**

- 15.1 Each bidder shall furnish, as part of his bid, a Bid Security in the amount stipulated in the Bidding Data in Pak Rupees or an equivalent amount in a freely convertible currency.
- The Bids security shall be submitted from the account of the firm/bidder/contractor who submits the bid, vide KPPRA Notification No. KPPRA/M&E/Esst:/1-12/2017-18 dated April 05, 2018
- 15.2 The Bid Security shall be, in the form of Deposit at Call issued by a Scheduled Bank in Pakistan, in favor of the Procuring Entity / Employer valid for a period 28 days beyond the Bid Validity date.
- 15.3 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Procuring Entity / Employer as non-responsive.
- 15.4 The bid securities of unsuccessful bidders except 1<sup>st</sup>, 2<sup>nd</sup>& 3<sup>rd</sup> will be returned as promptly as possible, but not later than 28 days after the expiration of the period of Bid Validity.
- 15.5 The Bid Security of the successful bidder will be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement. The Bid Security may be adjusted by the Procuring Entity / Employer as part of the Performance Security.
- 15.6 The Bid Security may be forfeited:
- (a) If the bidder withdraws his bid during the period of bid validity

except as provided in Sub-Clause 22.1;

- (b) If the bidder does not accept the correction of his Bid Price pursuant to Sub-Clause 27.2 hereof; or
- (c) In the case of successful bidder, if he fails within the specified time limit to:
  - (i) Furnish the required Performance Security; or
  - (ii) Sign the Contract Agreement.

#### **IB.16 Alternate Proposals by Bidder**

- 16.1 Should any bidder consider that he can offer any advantages to the Procuring Entity / Employer by a modification to the designs, specifications or other conditions, he may, in addition to his bid to be submitted in strict compliance with the Bidding Documents, submit any Alternate Proposal(s) containing (a) relevant design calculations; (b) technical specifications; (c) proposed construction methodology; and (d) any other relevant details / conditions, provided always that the total sum entered on the Form of Bid shall be that which represents complete compliance with the Bidding Documents.
- 16.2 Alternate Proposal(s), if any, of the lowest evaluated responsive bidder only may be considered by the Procuring Entity / Employer as the basis for the award of Contract to such bidder.

#### **IB.17 Pre-Bid Meeting**

- 17.1 The Procuring Entity / Employer may, on his own motion or at the request of any prospective bidder(s), hold a pre-bid meeting to clarify issues and to answer any questions on matters related to the Bidding Documents. The date, time and venue of pre-bid meeting, if convened, is as stipulated in the Bidding Data. All prospective bidders or their authorized representatives shall be invited to attend such a pre-bid meeting.
- 17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Procuring Entity / Employer not later than seven (7) days before the proposed pre-bid meeting.
- 17.3 Minutes of the pre-bid meeting, including the text of the questions raised and the replies given, will be transmitted without delay to all purchasers of the Bidding Documents. Any modification of the Bidding Documents listed in Sub-Clause 7.1 hereof which may become necessary as a result of the pre-bid meeting shall be made by the Procuring Entity / Employer exclusively through the issue of an Addendum pursuant to Clause IB.9 and not through the minutes of the pre-bid meeting.
- 17.4 Absence at the pre-bid meeting will not be a cause for disqualification of a bidder.



**IB.18 Format and Signing of Bid**

- 18.1 Bidders are particularly directed that the amount entered on the Form of Bid shall be for performing the Contract strictly in accordance with the Bidding Documents.
- 18.2 All appendices to Bid are to be properly completed and signed.
- 18.3 No alteration is to be made in the Form of Bid nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.
- 18.4 Each bidder shall prepare by filling out the forms completely and without alterations one (1) original and number of copies, specified in the Bidding Data, of the documents comprising the bid as described in Clause IB.7 and clearly mark them "ORIGINAL" and "COPY" as appropriate. In the event of discrepancy between them, the original shall prevail.
- 18.5 The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person or persons duly authorized to sign on behalf of the bidder pursuant to Sub- Clause 11.1(a) hereof. All pages of the bid shall be initialed and stamped by the person or persons signing the bid.
- 18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the Procuring Entity, or as are necessary to correct errors made by the bidder, in which case such corrections shall be initialed by the person or persons signing the bid.
- 18.7 Bidders shall indicate in the space provided in the Form of Bid their full and proper addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the Contract is to be sent.
- 18.8 Bidders should retain a copy of the Bidding Documents as their file copy.

**D. SUBMISSION OF BIDS****IB.19 Sealing and Marking of Bids**

- 19.1 Each bidder shall submit his bid as under:
- (a) ORIGINAL Bid shall be put in envelope and marked as such.
  - (b) The envelope containing the ORIGINAL bid will be put in one sealed envelope and addressed / identified as given in Sub-Clause 19.2 hereof.
- 19.2 The inner and outer envelopes shall:
- (a) Be addressed to the Procuring Entity / Employer at the address provided in the Bidding Data;

- (b) Bear the name and identification number of the contract as defined in the Bidding Data; and
  - (c) Provide a warning not to open before the time and date for bid opening, as specified in the Bidding Data.
- 19.3 In addition to the identification required in Sub- Clause 19.2 hereof, the inner envelope shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to Clause IB.21
- 19.4 If the outer envelope is not sealed and marked as above, the Procuring Entity will assume no responsibility for the misplacement or premature opening of the Bid.

**IB.20 Deadline for Submission of Bids**

- 20.1 (a) Bids must be received by the Procuring Entity at the address specified no later than the time and date stipulated in the Bidding Data. In the event of the specified date for the submission of bids declared a holiday, the Bids will be received up to the appointed time on the next working day.
- (b) Bids with charges payable will not be accepted, nor will arrangements be undertaken to collect the bids from any delivery point other than that specified above. Bidders shall bear all expenses incurred in the preparation and delivery of bids. No claims will be entertained for refund of such expenses.
  - (c) Where delivery of a bid is by mail and the bidder wishes to receive an acknowledgment of receipt of such bid, he shall make a request for such acknowledgment in a separate letter attached to but not included in the sealed bid package.
  - (d) Upon request, acknowledgment of receipt of bids will be provided to those making delivery in person or by messenger.
- 20.2 The Procuring Entity may, at his discretion, extend the deadline for submission of bids by issuing an amendment in accordance with Clause IB.9, in which case all rights and obligations of the Procuring Entity / Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

**IB.21 Late Bids**

- 21.1 (a) Any bid received by the Procuring Entity after the deadline for submission of bids prescribed in Clause IB.20 will be returned unopened to such bidder.

- (b) Delays in the mail, delays of person in transit, or delivery of a bid to the wrong office shall not be accepted as an excuse for failure to deliver a bid at the proper place and time. It shall be the bidder's responsibility to determine the manner in which timely delivery of his bid will be accomplished either in person, by messenger or by mail.

**IB.22 Modification, Substitution and Withdrawal of Bids**

- 22.1 Any bidder may modify, substitute or withdraw his bid after bid submission provided that the modification, substitution or written notice of withdrawal is received by the Procuring Entity / Employer prior to the deadline or the extended deadline pursuant to clause IB.20.2, for submission of bids.
- 22.2 The modification, substitution or notice for withdrawal of any bid shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause IB.19 with the outer and inner envelopes additionally marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" as appropriate.
- 22.3 No bid may be modified by a bidder after the deadline for submission of bids except in accordance with Sub-Clauses 22.1 and 27.2.
- 22.4 Withdrawal of a bid during the interval between the deadline for submission of bids and the expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the Bid Security in pursuance to Clause IB.15.

**E. BID OPENING AND EVALUATION**

**IB.23 Bid Opening**

- 23.1 The Procuring Entity will open all the bids, including withdrawals, substitution and modifications made pursuant to Clause IB.22, in the presence of bidders' or their representatives who choose to attend, at the time, date and location stipulated in the Bidding Data. In the event of the specified date for the opening of bids being declared a holiday, the bids will be opened at the appointed time and location on the next working day. The bidders' representatives who are present shall sign a register evidencing their attendance.
- 23.2 Envelopes marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause IB.22 shall not be opened.
- 23.3 The bidder's name, total Bid Price and price of any Alternate Proposal(s), any discounts, bid modifications, substitution and

withdrawals, the presence or absence of Bid Security, and such other details as the Procuring Entity may consider appropriate, will be announced by the Procuring Entity / Employer at the opening of bids.

- 23.4 The Procuring Entity shall prepare minutes of the bid opening including the information disclosed to those present in accordance with the Sub-Clause 23.3.

#### **IB.24 Process to be Confidential**

- 24.1 Information relating to the examination, clarification, evaluation and comparison of bid and recommendations for the award of a contract shall not be disclosed to bidders or any other person not officially concerned with such process before the announcement of bid evaluation report, which shall be done at least ten (10) days prior to issue of Letter of Acceptance. The announcement to all Bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated. Any effort by a bidder to influence the Procuring Entity processing of bids or award decisions may result in the rejection of such bidder's bid. Whereas any bidder feeling aggrieved may lodge a written complaint not later than fifteen (15) days after the announcement of the bid evaluation report; however mere fact of lodging a complaint shall not warrant suspension of the procurement process.

#### **IB.25 Clarification of Bids**

- 25.1 To assist in the examination, evaluation and comparison of bids, the Procuring Entity / Employer may, at his discretion, ask any bidder for clarification of his bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the Procuring Entity / Employer in the evaluation of the bids in accordance with Clause IB.28.

#### **IB.26 Examination of Bids and Determination of Responsiveness**

- 26.1 Prior to the detailed evaluation of bids, the Procuring Entity / Employer will determine whether each bid is substantially responsive to the requirements of the Bidding Documents.
- 26.2 A substantially responsive bid is one which (i) meets the eligibility

criteria; (ii) has been properly signed; (iii) is accompanied by the required Bid Security; and (iv) conforms to all the terms, conditions and specifications of the Bidding Documents, without material deviation or reservation. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the Works; (ii) which limits in any substantial way, inconsistent with the Bidding Documents, the Procuring Entity / Employer's rights or the bidder's obligations under the Contract; or (iii) adoption whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

26.3 If a bid is not substantially responsive, it will be rejected by the Procuring Entity / Employer, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

#### **IB.27 Correction of Errors**

27.1 Bids determined to be substantially responsive will be checked by the Procuring Entity / Employer for any arithmetic errors. Errors will be corrected by the Procuring Entity / Employer as follows:

- (a) Where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; and
- (b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern, unless in the opinion of the Procuring Entity / Employer there is an obviously gross misplacement of the decimal point in the unit rate, in which case the line item total as quoted will govern and the unit rate will be corrected.

27.2 The amount stated in the Form of Bid will be adjusted by the Procuring Entity / Employer in accordance with the above procedure for the correction of errors and with the concurrence of the bidder, shall be considered as binding upon the bidder. If the bidder does not accept the corrected Bid Price, his Bid will be rejected, and the Bid Security shall be forfeited in accordance with Sub- Clause 15.6(b) hereof.

#### **IB.28 Evaluation and Comparison of Bids**

28.1 The Procuring Entity will evaluate and compare only the Bids determined to be substantially responsive in accordance with Clause IB.26.

28.2 In evaluating the Bids, the Procuring Entity / Employer will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:

- (a) Making any correction for errors pursuant to Clause IB.27;

- (b) Excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including competitively priced Day work; and
  - (c) Making an appropriate adjustment for any other acceptable variation or deviation, including discounts or other price modification in the bids
- 28.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in Bid evaluation.
- 28.4 If the Bid of the successful bidder is seriously unbalanced in relation to the Procuring Entity / Employer's estimate of the cost of work to be performed under the Contract, the Procuring Entity / Employer may require the bidder to produce detailed price analyses for any or all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Procuring Entity / Employer may require that the amount of the Performance Security set forth in Clause IB.32 be increased at the expense of the successful bidder to a level sufficient to protect the Procuring Entity / Employer against financial loss in the event of default of the successful bidder under the Contract.

## **F. AWARD OF CONTRACT**

### **IB.29 Award**

- 29.1 Subject to Clauses IB.30 and IB.34, the Procuring Entity / Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid Price, provided that such bidder has been determined to be eligible in accordance with the provisions of Clause IB.3 and qualify pursuant to Sub-Clause IB 29.2
- 29.2 The Procuring Entity / Employer, at any stage of the bid evaluation, having credible reasons for or *prima facie* evidence of any defect in supplier's or contractor's capacities, may require the suppliers or contractors to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not:

Provided that such qualification shall only be laid down after recording reasons therefore in writing. They shall form part of the records of that bid evaluation report.

### **IB.30 Procuring Entity / Employer's Right to Accept or Reject any or all Bids**

- 30.1 Notwithstanding Clause IB.29, the Procuring Entity / Employer reserves the right to accept or reject any Bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidders or any obligation except that the grounds for rejection of all bids shall upon request be communicated to any bidder who submitted a bid, without justification of grounds. Rejection of all bids shall be notified to all bidders promptly.

**IB.31 Notification of Award**

- 31.1 Prior to expiration of the period of bid validity prescribed by the Procuring Entity / Employer, the Procuring Entity / Employer will notify the successful bidder in writing ("Letter of Acceptance") that his Bid has been accepted. This letter shall name the sum which the Procuring Entity / Employer will pay the Contractor in consideration of the execution and completion of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called the "Contract Price").
- 31.2 No Negotiation with the bidder having evaluated as lowest responsive or any other bidder shall be permitted, however, Procuring Entity / Employer may have clarification meetings to get clarify any item in the bid evaluation report.
- 31.3 The notification of award and its acceptance by the bidder will constitute the formation of the Contract, binding the Procuring Entity / Employer and the bidder till signing of the formal Contract Agreement.
- 31.3 Upon furnishing by the successful bidder of a Performance Security, the Procuring Entity / Employer will promptly notify the other bidders that their Bids have been unsuccessful and return their bid securities.

**IB.32 Performance Security**

- 32.1 The successful bidder shall furnish to the Procuring Entity a Performance Security in the form and the amount stipulated in the Bidding Data and the Conditions of Contract plus additional security for unbalanced bids in accordance with Clause IB.28.4 within a period of 28 days after the receipt of Letter of Acceptance.
- 32.2 Failure of the successful bidder to comply with the requirements of Sub-Clause IB.32.1 or Clauses IB.33 or IB.35 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.

**IB.33 Signing of Contract Agreement**

- 33.1 Within 14 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Procuring Entity / Employer will send the successful bidder the Contract Agreement in the form provided in the Bidding Documents, incorporating all agreements

between the parties.

- 33.2 The formal Agreement between the Procuring Entity / Employer and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the successful bidder from the Procuring Entity / Employer.

**IB.34 General Performance of the Bidders**

The Procuring Entity reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts/works. The Procuring Entity / Employer may in case of consistent poor performance of any Bidder as reported by the Procuring Entity / Employers of the previously awarded contracts, interalia, reject his bid and/or refer the case to the Pakistan Engineering Council (PEC) and KPPRA. Upon such reference, PEC/KPPRA in accordance with its rules, procedures and relevant laws of the land take such action as may be deemed appropriate under the circumstances of the case including black listing of such Bidder and debarring him from participation in future bidding for similar works.

**IB.35 Integrity Pact**

The Bidder shall sign and stamp the Integrity Pact provided at Appendix-L to Bid in the Bidding Documents for all Federal Government procurement contracts exceeding Rupees ten million. Failure to provide such Integrity Pact shall make the bidder non-responsive.

**IB.36 Instructions not Part of Contract**

Bids shall be prepared and submitted in accordance with these Instructions which are provided to assist bidders in preparing their bids, and do not constitute part of the Bid or the Contract Documents.

**IB.37 Guidelines for submission of Technical Proposals**

NA

**37.1 Technical Evaluation Criteria**

NA

**37.3 Conflict of Interest**

37.3.1 The bidder (including all members of a JV) must not be associated, nor have been associated in the past, with the consultant or any other entity that has prepared the design, specifications, and other bidding documents for the project, or was proposed as Engineer for the contract, over the last five years. Any such association may result in disqualification of the Bidder.



**37.5 Other Factors**

## 37.5.1 NA

37.5.2 The Procurement Entity reserves the right to: -

- a) Reject or accept any or all applications, as per para 33 (i) of KPPRA rules 2014

The Procurement Entity shall neither be liable for any such actions nor be under any obligation to inform the Bidders of the grounds for rejection, however, may be debriefed if solicited.

# **BIDDING DATA**

**BDS-1****[NOTES ON BIDDING DATA]**

This Section is intended to assist the Procuring Entity in providing the specific information in relation to corresponding clauses in Instructions to Bidders and should be prepared to suit each individual contract.

The Procuring Entity should provide in the Bidding Data information and requirements specific to the circumstances of the Procuring Entity, the processing of the Bid, the applicable rules regarding Bid Price and currency, and the Bid evaluation criteria that will apply to the Bids. In preparing this section, the following aspects should be checked:

- (a) Information that specifies and complements the provisions of section; Instruction to Bidders must be incorporated.
- (b) Amendments and/or supplements, if any, to the provisions of Instructions to Bidders, necessitated by the circumstances of each individual contract, can be introduced only in this section since Instructions to Bidders will remain unchanged.

## **BIDDING DATA**

The following specific data for the Works to be bided shall complement, amend, or supplement the provisions in the Instructions to Bidders. Wherever there is a conflict, the provisions herein shall prevail over those in the Instructions to Bidders.

### **INSTRUCTIONS TO BIDDERS**

#### **CLAUSE REFERENCE**

#### **1.1 NAME AND ADDRESS OF THE PROCURING ENTITY / EMPLOYER**

Director General, Directorate General Small Dams, Irrigation Department, Government of Khyber Pakhtunkhwa.

#### **1.1.1 NAME AND ADDRESS OF THE ENGINEER**

Project Director PSU Small Dams Merged Areas Peshawar

#### **1.2 NAME OF THE PROJECT & SUMMARY OF THE WORKS**

Construction of Ramak Dam, TSD D.I. Khan.

The Project designated as Ramak Dam, TSD D.I. Khan consists of Earth Fill Zoned Dam, Spillway, Outlet Structure, Irrigation Channel including Affiliated Structures, Approach Road and Construction of Chowkidar Hut.

#### **2.1 A) NAME OF THE BORROWER/SOURCE OF FINANCING/FUNDING AGENCY**

Government of Khyber Pakhtunkhwa

#### **B) TYPE OF FINANCING**

Block allocation Irrigation Department KP ADP (AIP).

#### **4.1 ONE BID PER BIDDER**

Out of a parent organization and / or sister organizations, only one entity shall submit a Bid. If more than one Bid is submitted by the entities belonging to same parent organization and / or being sister organizations, all such Bids shall be rejected to avoid Conflict of Interest.

#### **7.1 CONTENTS OF BIDDING DOCUMENTS**

The Bidding Documents, in addition to invitation for bids, are those stated below and should be read in conjunction with any Addenda issued in accordance with Clause IB.9.

1. InstructionstoBidders.
2. BiddingData.
3. LetterofTechnicalBid.
4. LetterofPriceBid.
5. AppendicestoBid.

6. FormsofBidSecurity.
7. FormofPerformanceSecurity.
8. FormsofContractAgreement,andMobilizationAdvanceGuarantee.
9. GeneralConditionsofContract,Part-I(GCC).
10. ParticularConditionsofContract,Part-II(PCC)
11. TechnicalSpecifications.
12. GeneralSpecifications (Technical Specifications for Workmanship) MRS – 2021, Communication and Works Department, KPK.
13. Drawings

**8.1 TIME LIMIT FOR CLARIFICATION**

28 days prior to the day fixed for submission of Bid.

**10.1 BID LANGUAGE**

The language shall be English and will be used for the bid and all correspondence and documents related to the bid exchanged by a bidder and the Procuring Entity.

**11.1(A) FURNISH TECHNICAL PROPOSAL**

NA

**11.1(B) THE BIDDER SHALL SUBMIT WITH ITS PRICE BID THE FOLLOWING DOCUMENTS:**

- a) Letter of Price Bid.
- b) 2% Bid Security of the estimated Cost.
- c) Additional Security if required as per Terms & Conditions.
- d) Pakistan Engineering Council Registration for the Year 2021-22.
- e) Registration with Khyber Pakhtunkhwa Revenue Authority.
- f) CNIC
- g) Ownership Documents
- h) Income Tax/NTN Certificate

**13.1 Bidders quote entirely in Pak Rupees**

Payments shall be made in Pak Rupees only and no foreign currency payment is admissible.

**14.1 PERIOD OF BID VALIDITY**

Validity period for the bid will be 120 days.

**15.1 AMOUNT OF BID SECURITY**

At the Rate of 2% of the quoted Bid.

**17.2 VENUE, TIME AND DATE OF PRE-BID MEETING**

NA

**17.4 PRESENCE AT THE PRE-BID MEETING**

NA

**18.4 NUMBER OF COPIES OF THE BID TO BE COMPLETED AND RETURNED**

Each bidder shall prepare by filling out the forms completely and without alterations one (1) original and one (1) copy of the bid.

**19.2 (A) PROCURING ENTITY / EMPLOYER'S ADDRESS FOR THE PURPOSE OF BID SUBMISSION**

Office of the Project Director PSU Small Dams Merged Area Irrigation Deptt:

Plot No.27, Street No.12, Sector E-8, Phase-VII Hayatabad Peshawar

**19.2 (B) NUMBER OF THE CONTRACT**

**20.1 DEADLINE FOR SUBMISSION OF BIDS:**

As Per NIT.

**23.1 VENUE, TIME AND DATE OF BID OPENING**

As Per NIT.

**32.1 STANDARD FORM AND AMOUNT OF PERFORMANCE SECURITY ACCEPTABLE TO THE PROCURING ENTITY**

The Contractor shall provide Performance Security to the Procuring Entity in the prescribed form. The said Security shall be furnished or caused to be furnished by the Contractor within 28 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 10% of the Contract Price stated in the Letter of Acceptance. Such Security shall be in the form of bank guarantee from any Scheduled Bank in Pakistan.

**LETTERS OF TECHNICAL BID/PRICE BID**

**AND**

**APPENDICES TO BID**

LTB-1

**LETTER OF TECHNICAL BID**

LPB-1

**NOT  
APPLICABLE**



**LETTER OF PRICE BID****Date:** .....**Bid Reference No:**Construction of Ramak Dam  
TSD D.I. Khan

To

Project Director,  
PSU Small Dams Merged Areas,  
Irrigation Department,  
Peshawar.

We, the undersigned, declare that:

- (a) We have examined the Bidding Documents including Instructions to Bidders, Bidding Data, and Conditions of Contract. Specifications, Drawings, Bill of Quantities and Addenda for the execution of the above-named Works and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (IB) 9.
- (b) We offer to execute and complete such Works and remedy any defects therein in conformity with the Conditions of Contract. Specifications, Drawings, Bill of Quantities and Addenda for the sum of Rs. \_\_\_\_\_ (Rupees \_\_\_\_\_) or such other sum as may be ascertained in accordance with the said conditions. We understand that all the Appendices attached hereto form part of this Bid.
- (c) We undertake, if our Bid is accepted, to obtain a performance security in accordance with the Bidding Documents, Commence the Works and to Complete the whole of the Works comprised in the Contract within the time stated in Appendix-A to Bid.
- (d) We agree to abide by this Bid for the period of ..... days from the date fixed for the bid submission deadline in accordance with the Bidding Documents and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

**LPB-2**

- (e) Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.
- (f) We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other bidder for the Works.
- (g) We understand that you are not bound to accept the lowest or any Bid you may receive.

Dated this \_\_\_\_\_ day of \_\_\_\_\_ 20 \_\_\_\_\_

Signature: \_\_\_\_\_

in the capacity of \_\_\_\_\_ duly authorized to sign Bids for and on behalf of

\_\_\_\_\_

(Name of Bidder in Block Capitals)

(CNIC #)

\_\_\_\_\_

(Seal)

Address:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Witness:

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

CNIC # \_\_\_\_\_

Address. \_\_\_\_\_

Occupation \_\_\_\_\_

# **APPENDICES**

BA-1

Appendix-A to Bid

**SPECIAL STIPULATIONS****CLAUSE****CONDITIONS OF CONTRACT**

1.	Engineer's Authority to issue Variation in emergency	2.1	2% of the Contract Price as stated in the Letter of Acceptance.
2.	Amount of Performance Security	10.1	10% of Contract Price as stated in the Letter of Acceptance.
3.	Time for Furnishing Programme	14.1	Within 42 days from the date of receipt of Letter of Acceptance.
4.	Minimum amount of Third-Party Insurance	23.2	Rs. 1.0 million per occurrence with number of occurrences unlimited.
5.	Time for Commencement	41.1	Within 14 days from the date of receipt of Engineer's Notice to Commence which shall be issued within fourteen (14) days after signing of Contract Agreement.
6.	Time for Completion	43.1, 48.2	2 years from the date of receipt of Engineer's Notice to Commence.
7.	Amount of Liquidated Damages	47.1	Rs. 0.041 % of the Contract price for each day of delay in completion of the Works subject to a maximum of 10% of Contract Price stated in the Letter of Acceptance.
8.	Defects Liability Period	49.1	365 days from the effective date of Taking Over Certificate.
9.	Percentage of Retention Money	60.2	10% of the amount of Interim Payment Certificate.
10	Limit of Retention Money	60.2	5% of the Contract Price as stated in the Letter of Acceptance.
11	Minimum amount of Interim Payment Certificates (Running Bills)	60.2	Rs. 15,000,000. (Fifteen Million)
12	Time of Payment from delivery of Engineer's Interim Payment Certificate to the Procuring Entity / Employer.	60.10	30 days, subject to availability of funds, work done or any other unavoidable hindrance.
13	Mobilization Advance (InterestFree)	60.12	10% of Contract Price as stated in the Letter of Acceptance.

**BB-1**  
**Appendix-B to Bid**

**FOREIGN CURRENCY  
REQUIREMENTS**

**NOT  
APPLICABLE**

BC-1

## Appendix-C to Bid

**PRICE ADJUSTMENT UNDER CLAUSE 70 OF CONDITIONS OF CONTRACT**

The source of indices and the weightages or coefficients for use in the adjustment formula under Clause 70 shall be as follows (Price adjustment will be worked out as per Pakistan Engineering Council Formula):

<b>Cost Element</b>	<b>Description</b>	<b>Weightages</b>	<b>Applicable index</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
(i)	Fixed Portion	0.35	
(ii)	Local Labour (Skilled & Unskilled) <i>With unskilled as representative items.</i>	0.15	Government of Pakistan (GoP) Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin.
(iii)	Cement – in bags. <i>Portland cement shall be considered representative items for all types of cement.</i>	0.20	“ “ “
(iv)	Reinforcing Steel - in tons. <i>½ “diameter round bar is the representative item for all types of steel to be used in this project.</i>	0.10	“ “ “
(v)	High Speed Diesel (HSD) – in Liter	0.20	Fixed by OGRA
<b>Total</b>		<b>1.00</b>	

**Notes:**

- 1) Indices for “(ii)” to “(v)” shall be taken from the Government of Pakistan Federal Bureau of Statistics, Monthly Statistical Bulletin for the nearest city of the project area. The base cost indices or prices shall be those applying 28 days prior to the latest day for submission of bids. Current indices or prices shall be those applying 28 days prior to the last day of the billing period.
- 2) Any fluctuation in the indices or prices of materials other than those given above shall not be subject to adjustment of the Contract Price.
- 3) Except Labour & POL, if any other adjustable item(s) is not used in the particular billing period, then the ratio of the current date price and the base date price for this particular adjustable item(s) shall be considered as one.
- 4) Pakistan Engineering Council price adjustment formula and guidelines will be used for

escalation.

**BD-1**  
**Appendix-D to Bid**

## **BILL OF QUANTITIES**

### **A. PREAMBLE**

1. The Bill of Quantities shall be read in conjunction with the Conditions of Contract, Specifications and Drawings.
2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work executed and measured by the Contractor and verified by the Engineer / Engineer representative and valued at the rates and prices entered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix as per the Contract.
3. The rates and prices, resulting from the bidders quoted **SINGLE PERCENTAGE RATE**, with two digits after the decimal point, "**ABOVE / BELOW / AT PAR**" of the Engineer's Estimated Cost on Market Rate System – 2021 and Non-Schedule Items as well , shall, except insofar as it is otherwise provided under the Contract include all costs of Contractor's plant, labour, supervision, materials, execution, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract. Furthermore, all duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as on the date 28 days prior to deadline for submission of Bids, shall be included in the offered percentage's "**ABOVE / BELOW / AT PAR**" of the Engineer's Estimated Rates and Prices and the Total Bid Price, by the Bidder.
4. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the priced Bill of Quantities, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the Works.
5. General directions and description of work and materials are not necessarily repeated nor summarised in the Bill of Quantities. References to the relevant sections of the Bidding Documents shall be made before entering prices against each item in the priced Bill of Quantities.
6. Provisional sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with Sub-Clause 58.2 of Part I, General Conditions of Contract.



**BD-2**  
**Appendix-D to Bid**

**BD-12**  
**Appendix-D to Bid**

### SCHEDULE OF DAYWORK RATES

#### I. Labour

Item #	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
1	Ganger	Hour	75		
2	Labour	Hour	175		
3	Brick Layer	Hour	75		
4	Mason	Hour	90		
5	Carpenter	Hour	100		
6	Steel work Erector	Hour	125		
7	Steel work binders	Hour	125		
8	Driver for vehicles up to 10 tons	Hour	150		
9	Operator for Excavator, shovel or crane.	Hour	150		
10	Operator for tractor, dozer blade or ripper.	Hour	150		
11	Operator for compressor machine	Hour	100		
12	Other Skilled operators	Hour	100		

<b>Sub Total: (without Contractor's profit)</b>	
<b>Allow _____ % of subtotal for Contractor's overhead ,profit etc., (in accordance with Paragraph 3(b) of Daywork Schedule)</b>	
<b>Total for Daywork – Labor:</b>	

**BD-13**  
**Appendix-D to Bid****Daywork Material**

4. The Contractor shall be entitled to payment in respect of materials used for Daywork (except for materials for which the cost is included in the percentage addition to labour costs as detailed heretofore), at the basic rates entered by him in the Schedule of Daywork Rates for materials together with an additional percentage payment on the basic rates to cover overhead charges and profit, as follows:
- a) the basic rates for materials shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, losses, etc., and shall provide for delivery to store for stockpiling at the site. The basic rates shall be stated in local currency but payment will be made in the currency or currencies expended upon presentation of supporting documentation;
  - b) the additional percentage payment shall be quoted by the Bidder and applied to the equivalent local currency payments made under Sub-Para(a) above; and
  - c) the cost of hauling materials used on work ordered to be carried out as Daywork from the store or stockpile on the site to the place where it is to be used will be paid in accordance with the terms for Labour and Constructional Plant in this Schedule.

BD-14

Appendix-D to Bid

**SCHEDULE OF DAYWORK RATES****II. Materials**

<b>Item #</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Rate (Rs)</b>	<b>Amount (Rs)</b>
<b>1</b>	Ordinary Portland cement.	bags	1,500		
<b>2</b>	Sulphate resistant cement in bags.	bags	700		
<b>3</b>	Reinforcing Steel up to 25mm diameter to BS 4449 or equivalent.	Metric Ton	15.000		
<b>4</b>	Structural Steel WF 200mm x 150mm x 12mm.	Metric Ton	7		
<b>5</b>	Aggregates for Concrete.	cu.m.	200		
<b>6</b>	Sand for Concrete.	cu.m.	150		
<b>Sub Total: (without Contractor's profit)</b>					
<b>Allow _____ % of subtotal for Contractor's overhead, profit etc., (in accordance with Paragraph 4(b) of Daywork Schedule)</b>					
<b>Total for Daywork – Materials:</b>					

**BD-15**  
**Appendix-D to Bid**

**Daywork Constructional Plant**

5. The Contractor shall be entitled to payments in respect of constructional plant already on Site and employed on Daywork at the basic rental rates entered by him in the Schedule of Daywork Rates for constructional plant. The said rates shall be deemed to include complete allowance for depreciation, interest, indemnity and insurance, repairs, maintenance, supplies, fuel, lubricants, and other consumables, and all overhead, profit and administrative costs related to the use of such equipment. The cost of drivers, operators and assistants will be paid for separately as described under the section on Daywork Labour.
6. In calculating the payment due to the Contractor for constructional plant employed on Daywork, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Engineer, the travelling time from the part of the Site where the constructional plant was located when ordered by the Engineer to be employed on Daywork and the time for return journey thereto shall be included for payment.
7. The basic rental rates for constructional plant employed on Daywork shall be stated in Pakistani Rupees.

BD-16

Appendix-D to Bid

**SCHEDULE OF DAYWORK RATES****III. Constructional Plant**

Item #	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
1	Excavator (Hydraulic), face-shovel or dragline:				
	1: up to including 1 Cu. M.	Hour	60		
	2: over 1 to 2 Cu.M.	Hour	60		
	3: over 2 Cu. M.	Hour	55		
2	Tractor (tracked) including bull or angle dozer:				
	1: up to and including 150 HP	Hour	50		
	2: over 150 to 200 HP	Hour	60		
	3: over 200 to 250HP	Hour	50		
3	Tractor (tracked) with ripper				
	1: over 150 to 200 HP	Hour	60		
	2: over 200 to 250HP	Hour	60		
4	Wheel Loader up to 4 Cu.m capacity	Hour	60		
5	Rear Dump Trucks				
	1: 10 tons capacity	Hour	60		
	2: 20 tons capacity	Hour	65		
7	Concrete Mixer up to 1 Cu.M.	Hour	60		
<b>Total for Daywork – Constructional Plant</b> <i>(Including Contractor's overhead, profit etc., in accordance with Paragraph 5 of Daywork Schedule)</i>					

BD-17

Appendix-D to Bid

**DAYWORK****Summary (Daywork)**

		<b>Amount (Rs.)</b>
(I)	Sub Total for Daywork: Labour	_____
(II)	Sub Total for Daywork : Materials	_____
(III)	Sub Total for Daywork: Constructional Plant	_____
Total for Daywork		_____
(Carried forward to Summary Page of Bill of Quantities at <b>BD-2</b> )		

BE-1

## Appendix-E to Bid

**PROPOSED CONSTRUCTION SCHEDULE**

Pursuant to Sub-Clause 43.1 of the General Conditions of Contract, the Works shall be completed on or before the date stated in Appendix-A to Bid. The Bidder shall provide as Appendix-E to Bid, the Construction Schedule as specified herein showing the sequence of work items and the period of time during which he proposes to complete each work item in such a manner that his proposed programme for completion of the whole of the Works (and parts of the Works) may meet Procuring Entity completion targets in days noted below and counted from the date of receipt of Engineer's Notice to Commence.

The bidders are required to submit the Summary of Proposed Construction Schedule as specified in Bidding Data Sheet. However, the other details of schedule mentioned in sub-paras (a), (b) & (c) below, will be submitted by the successful bidder to the Procuring Entity after the Contract Agreement is signed and letter of Commencement is issued.

- a) Manpower, Equipment, and other resources must be allocated to each activity according to their capacity.
- b) Critical Path be identified in different colour.
- c) CD containing the soft copy of schedule in MS Project/Primavera format / Bar Charts must be provided, in which the linkage between manpower, equipment and activities must be provided.

(Attach sheets as required for the specified form of Construction Schedule):

<b>Description</b>	<b>Time for Completion</b>
a) Approach Road	_____ days
b) Chowkidar Hut	_____ days
c) Main Dam	_____ days
d) Spillway	_____ days
e) Outlet Structure	_____ days
f) Irrigation Channel & Structures	_____ days

BF-1

Appendix-F to Bid

## METHOD OF PERFORMING THE WORK

[The Bidder is required to submit a narrative outlining the method of performing the Work. The narrative should indicate in detail and include but not be limited to:

1. Organization Chart indicating head office and field office personnel involved in management and supervision, engineering, equipment maintenance and purchasing.
2. Mobilization at Site, the type of facilities including personnel accommodation, office accommodation, provision for maintenance and for storage, communications, security and other services to be used.
3. The method of executing the Works, the procedures for installation of equipment and machinery and transportation of equipment and materials to the site.
4. Methodology Regarding Safety of Environment/ Environmental Management Plan (EMP), as per EPA rules.
5. Quality control / Quality assurance measures to be adopted including procedures to be followed for carrying out all tests required under specifications.
6. Safety/ Security Management System



**BG-1****Appendix-G to Bid****LIST OF MAJOR EQUIPMENT – RELATED ITEMS**

[The Bidder will provide on Sheet 2 of this Appendix a list of all major equipment and related items, under separate heading for items owned, to be purchased or to be arranged on lease by him to carry out the Works. The information shall include make, type, capacity, and anticipated period of utilization for all equipment which shall be in sufficient detail to demonstrate fully that the equipment will meet all requirements of the Specifications.]

BG-2

Appendix-G to Bid

**LIST OF MAJOR EQUIPMENT**

<b>Owned Purchased or Leased</b>	<b>Description of Unit (Make, Model, Year)</b>	<b>Capacity HP Rating</b>	<b>Condition</b>	<b>Present Location or Source</b>	<b>Date of Delivery at Site</b>	<b>Period of Work on Project</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
a. Owned						
b. To be Purchased						
c. To be arranged on Lease						

BH-1

## Appendix-H to Bid

**CONSTRUCTION CAMP AND HOUSING FACILITIES**

The Contractor in accordance with Clause 34 of the Conditions of Contract shall provide description of his construction camp's facilities and staff housing requirements.

The Contractor shall be responsible for pumps, electrical power, water and electrical distribution systems, and sewerage system including all fittings, pipes and other items necessary for servicing the Contractor's construction camp.

The Bidder shall list or explain his plans for providing these facilities for the service of the Contract as follows:

1. Site Preparation (clearing, land preparation, etc.).
2. Provision of Services.
  - a) Power (expected power load, etc.).
  - b) Water (required amount and system proposed).
  - c) Sanitation (sewage disposal system, etc.).
3. Construction of Facilities
  - a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type of construction of buildings, etc.).
  - b) Warehouses and Storage Areas (area required, type of construction and layout).
  - c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction, etc.).
4. Construction Equipment Assembly and Preparation (detailed plans for carrying out this activity).
5. Other Items Proposed (Security services, etc.).
6. Detail of testing Lab with testing equipment etc.

BI-1

## Appendix-I to Bid

**LIST OF SUBCONTRACTORS**

I/We intend to subcontract the following parts of the Work to subcontractors. In my/our opinion, the subcontractors named hereunder are reliable and competent to perform that part of the work for which each is listed.

Enclosed are documentation outlining experience of subcontractors, the curriculum vitae and experience of their key personnel who will be assigned to the Contract, equipment to be supplied by them, size, location and type of contracts carried out in the past.

<b>Part of Works (Give Details)</b>	<b>Subcontractor (With Complete Address)</b>
1	2

BJ-1

Appendix-J to Bid

**ESTIMATED PROGRESS PAYMENTS**

Bidder's estimate of the value of work which would be executed by him during each of the periods stated below, based on his Programme of the Works and the Rates in the Bill of Quantities:

<b>Quarter/ Year/ Period</b>	<b>Amounts (Rs.)</b>
1 <sup>st</sup> Quarter	
2 <sup>nd</sup> Quarter	
3 <sup>rd</sup> Quarter	
4 <sup>th</sup> Quarter	
5 <sup>th</sup> Quarter	
6 <sup>th</sup> Quarter	
7 <sup>th</sup> Quarter	
8 <sup>th</sup> Quarter	
<b>Bid Price</b>	

**BK-1**

**Appendix-K to Bid**

**ORGANIZATION CHART**

**FOR THE**

**SUPERVISORY STAFF AND LABOUR**

*(It shall be restricted to the staff and labor to be allocated to the Contract in case of award; brochure of the Firm listing the entire staff of the Firm **should not** be attached).*

BL-1

Appendix-L to Bid

**(INTEGRITY PACT)**

**DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC.  
PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN  
CONTRACTS WORTH RS. 10.00 MILLION OR MORE**

Contract No. \_\_\_\_\_ Dated \_\_\_\_\_

Contract Value: \_\_\_\_\_

Contract Title: Construction of Ramak Dam TSD D.I. Khan.

..... [Name of Constructor] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan/Khyber Pakhtunkhwa (GoP/GoKP) or any administrative subdivision or agency thereof or any other entity owned or controlled by GoP through any corrupt business practice.

Without limiting the generality of the foregoing, [name of Constructor] represents and warrants that it has fully declared the brokerage, commission, fees etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultation fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP/GoKP, except that which has been expressly declared pursuant hereto.

..... [Name of Constructor] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP/GoKP and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

..... [Name of Constructor] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other rights and remedies available to GoP/GoKP under any law, contract or other instrument, be voidable at the option of GoP/GoKP.

Notwithstanding any rights and remedies exercised by GoP/GoKP in this regard, [name of Constructor] agrees to indemnify GoP/GoKP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP/GoKP in an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by [name of Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right,

interest, privilege or other obligation or benefit in whatsoever form from GoP/GoKP.

Name of Procuring Entity: .....

Name of Constructor: .....

Signature: .....

[Seal]

Signature: .....

[Seal]



**FORMS**

**BID SECURITY**

**PERFORMANCE SECURITY**

**CONTRACT AGREEMENT**

**MOBILIZATION ADVANCE**

**GUARANTEE/BOND**

**BID SECURITY**  
**(BANK GUARANTEE)**

Security Executed on \_\_\_\_\_  
(Date)

Name of Surety (Bank) with Address: \_\_\_\_\_  
(Scheduled Bank in Pakistan)

Name of Principal (Bidder) with Address \_\_\_\_\_  
\_\_\_\_\_

Penal Sum of Security Rupees \_\_\_\_\_ (Rs. \_\_\_\_\_)

Bid Reference No. \_\_\_\_\_

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bid and at the request of the said Principal (Bidder) we, the Surety above named, are held and firmly bound unto \_\_\_\_\_.

(hereinafter called the 'Procuring Entity / Employer') in the sum stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Bidder has submitted the accompanying Bid dated \_\_\_\_\_ for Bid No. \_\_\_\_\_ for \_\_\_\_\_ (Particulars of Bid) to the said Procuring Entity / Employer; and

WHEREAS, the Procuring Entity / Employer has required as a condition for considering said Bid that the Bidder furnishes a Bid Security in the above said sum from a Scheduled Bank in Pakistan or from a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan, to the Procuring Entity / Employer, conditioned as under:

- (1) that the Bid Security shall remain in force up to and including the date 28 days after the deadline for validity of bids as stated in the Instructions to Bidders or as it may be extended by the Procuring Entity / Employer, notice of which extension(s) to the Surety is hereby waived;
- (2) that the Bid Security of unsuccessful Bidders will be returned by the Procuring Entity / Employer after expiry of its validity or upon signing of the Contract Agreement; and
- (3) that in the event of failure of the successful Bidder to execute the proposed Contract Agreement for such work and furnish the required Performance Security, the entire said sum be paid immediately to the said Procuring Entity / Employer pursuant to Clause 15.6 of the Instruction to Bidders for the successful Bidder's failure to perform.

NOW THEREFORE, if the successful Bidder shall, within the period specified therefor, on the prescribed form presented to him for signature enter into a formal Contract with the said Procuring Entity / Employer in accordance with his Bid as accepted and furnish within twenty eight (28) days of his being requested to do so, a Performance Security with good and sufficient surety, as may be required, upon the form prescribed by the said Procuring Entity / Employer for the faithful performance and proper fulfilment of the said Contract or in the event of non-withdrawal of the said Bid within the time specified for its validity then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

PROVIDED THAT the Surety shall forthwith pay the Procuring Entity / Employer the said sum upon first written demand of the Procuring Entity / Employer (without cavil or argument) and without requiring the Procuring Entity / Employer to prove or to show grounds or reasons for such demand, notice of which shall be sent by the Procuring Entity / Employer by registered post duly addressed to the Surety at its address given above.

PROVIDED ALSO THAT the Procuring Entity / Employer shall be the sole and final judge for deciding whether the Principal (Bidder) has duly performed his obligations to sign the Contract Agreement and to furnish the requisite Performance Security within the time stated above, or has defaulted in fulfilling said requirements and the Surety shall pay without objection the said sum upon demand from the Procuring Entity / Employer forthwith and without any reference to the Principal (Bidder) or any other person.

IN WITNESS WHEREOF, the above bounden Surety has executed the instrument under its seal on the date indicated above, the name and seal of the Surety being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

SURETY (Bank)

WITNESS:

Signature

1.

Name

Title

Corporate Secretary (Seal)

Corporate Guarantor (Seal)

2.

\_\_\_\_\_

Name, Title & Address

**FORM OF PERFORMANCE SECURITY**  
**(BANK GUARANTEE)**

Guarantee No. \_\_\_\_\_

Executed on \_\_\_\_\_

Expiry date \_\_\_\_\_

[Letter by the Guarantor to the Procuring Entity / Employer]

Name of Guarantor (Bank) with address: \_\_\_\_\_

(Scheduled Bank in Pakistan)

Name of Principal (Contractor) with address: \_\_\_\_\_

Penal Sum of Security (express in words and figures) \_\_\_\_\_

Letter of Acceptance No. \_\_\_\_\_ Dated \_\_\_\_\_

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bidding Documents and above said Letter of Acceptance (hereinafter called the Documents) and at the request of the said Principal we, the Guarantor above named, are held and firmly bound unto the \_\_\_\_\_ (hereinafter called the Procuring Entity / Employer) in the penal sum of the amount stated above for the payment of which sum well and truly to be made to the said Procuring Entity / Employer, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has accepted the Procuring Entity / Employer's above said Letter of Acceptance for \_\_\_\_\_ (Name of Contract) for the

\_\_\_\_\_ (Name of Project).

NOW THEREFORE, if the Principal (Contractor) shall well and truly perform and fulfil all the undertakings, covenants, terms and conditions of the said Documents during the original terms of the said Documents and any extensions thereof that may be granted by the Procuring Entity / Employer, with or without notice to the Guarantor, which notice is, hereby, waived and shall also well and truly perform and fulfil all the undertakings, covenants terms and conditions of the Contract and of any and all modifications of said Documents that may hereafter be made, notice of which modifications to the Guarantor being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue till all requirements of Clause 49, Defects Liability, of Conditions of Contract are fulfilled.

Our total liability under this Guarantee is limited to the sum stated above and it is a condition of any liability attaching to us under this Guarantee that the claim for payment in writing shall be received by

us within the validity period of this Guarantee, failing which we shall be discharged of our liability, if any, under this Guarantee.

We, \_\_\_\_\_ (the Guarantor), waiving all objections and defences under the Contract, do hereby irrevocably and independently guarantee to pay to the Procuring Entity / Employer without delay upon the Procuring Entity / Employer's first written demand without cavil or arguments and without requiring the Procuring Entity / Employer to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Procuring Entity / Employer's written declaration that the Principal has refused or failed to perform the obligations under the Contract which payment will be effected by the Guarantor to Procuring Entity / Employer's designated Bank & Account Number.

PROVIDED ALSO THAT the Procuring Entity / Employer shall be the sole and final judge for deciding whether the Principal (Contractor) has duly performed his obligations under the Contract or has defaulted in fulfilling said obligations and the Guarantor shall pay without objection any sum or sums up to the amount stated above upon first written demand from the Procuring Entity / Employer forthwith and without any reference to the Principal or any other person.

IN WITNESS WHEREOF, the above-bounden Guarantor has executed this Instrument under its seal on the date indicated above, the name and corporate seal of the Guarantor being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

\_\_\_\_\_  
Guarantor (Bank)

1. \_\_\_\_\_

Signature \_\_\_\_\_

\_\_\_\_\_  
Corporate Secretary (Seal)

Name \_\_\_\_\_

2. \_\_\_\_\_

Title \_\_\_\_\_

\_\_\_\_\_  
Name, Title & Address

\_\_\_\_\_  
Corporate Guarantor (Seal)

## FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the \_\_\_\_\_ / \_\_\_\_ /20\_\_ between Directorate General Small Dams (hereafter called the "Procuring Entity / Employer") of the one part and \_\_\_\_\_ (hereafter called the "Contractor") of the other part.

WHEREAS the Procuring Entity / Employer is desirous that certain Works, viz \_\_\_\_\_ should be executed by the Contractor and has accepted a Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

NOW this Agreement witness as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents after incorporating addenda, if any, except those parts relating to Instructions to Bidders shall be deemed to form and be read and construed as part of this Agreement, viz:
  - (a) The Contract Agreement;
  - (b) The Letter of Acceptance;
  - (c) The completed Form of Bid;
  - (d) Special Stipulations (Appendix-A to Bid);
  - (e) The Particular Conditions of Contract – Part II;
  - (f) The General Conditions – Part I;
  - (g) The priced Bill of Quantities (Appendix-D to Bid);
  - (h) The completed Appendices to Bid (B, C, E to N);
  - (i) The Drawings;
  - (j) The Specifications.
  - (k) \_\_\_\_\_ (any other)
3. In consideration of the payments to be made by the Procuring Entity / Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Procuring Entity / Employer to execute and complete the Works and remedy defects therein in conformity and in all respects with the provisions of the Contract.
4. The Procuring Entity / Employer hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works as per provisions of the Contract, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed on the day, month and year first before written in accordance with their respective laws.

Signature of the Contactor

Signature of Procuring Entity

(Seal)

(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:

Witness:

\_\_\_\_\_  
(Name, Title and Address)

\_\_\_\_\_  
(Name, Title and Address)

**MOBILIZATION ADVANCE GUARANTEE/BOND**

Guarantee No. \_\_\_\_\_ Date \_\_\_\_\_

WHEREAS \_\_\_\_\_ (hereinafter called the 'Procuring Entity / Employer') has entered into a Contract for \_\_\_\_\_ (Particulars of Contract)

with \_\_\_\_\_ (hereinafter called the "Contractor").

AND WHEREAS, the Procuring Entity / Employer has agreed to advance to the Contractor, at the Contractor's request, an amount of Rupees \_\_\_\_\_ (Rs \_\_\_\_\_ ) which amount shall be advanced to the Contractor as per provisions of the Contract.

AND WHEREAS, the Procuring Entity / Employer has asked the Contractor to furnish Guarantee to secure the mobilization advance for the performance of his obligations under the said Contract.

AND WHEREAS,

\_\_\_\_\_ (Scheduled Bank in Pakistan)

(hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the Procuring Entity / Employer agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

NOW, THEREFORE, the Guarantor hereby guarantees that the Contractor shall use the advance for the purpose of above-mentioned Contract and if he fails and commits default in fulfilment of any of his obligations for which the advance payment is made, the Guarantor shall be liable to the Procuring Entity / Employer for payment not exceeding the aforementioned amount.

Notice in writing of any default, of which the Procuring Entity / Employer shall be the sole and final judge, on the part of the Contractor, shall be given by the Procuring Entity / Employer to the Guarantor, and on such first written demand, payment shall be made by the Guarantor of all sums then due under this Guarantee without any reference to the Contractor and without any objection.

This Guarantee shall remain in force until the advance is fully adjusted against payments from the Interim Payment Certificates of the Contractor or until \_\_\_\_\_ whichever is earlier.

(Date)

The Guarantor's liability under this Guarantee shall not in any case exceed the sum of Rupees \_\_\_\_\_ (Rs \_\_\_\_\_).

This Guarantee shall remain valid up to the aforesaid date and shall be null and void after the



aforesaid date or earlier if the advance made to the Contractor is fully adjusted against payments from Interim Payment Certificates of the Contractor provided that the Guarantor agrees that the aforesaid period of validity shall be deemed to be extended if on the above mentioned date the advance payment is not fully adjusted.

---

GUARANTOR

1. Signature \_\_\_\_\_
2. Name \_\_\_\_\_
3. Title \_\_\_\_\_

WITNESS

1. \_\_\_\_\_  
\_\_\_\_\_  
Corporate Secretary (Seal)

2. \_\_\_\_\_  
(Name Title & Address)

\_\_\_\_\_  
Corporate Guarantor(Seal)

## **CONDITIONS OF CONTRACT**

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

The Conditions of Contract comprise two parts:

- (a) Part I - General Conditions of Contract**
- (b) Part II- Particular Conditions of Contract**

The FIDIC Conditions of Contract are copyrighted and may not be copied, faxed, or reproduced. Without taking any responsibility of its being accurate, Pakistan Engineering Council with prior consent of FIDIC Secretariat, has reproduced herein the FIDIC General Conditions of Contract for reference purpose only which cannot be used by the users for preparing their bidding documents. The bidding document may include a purchased copy, the cost of which can be retrieved as part of the selling price of the bidding document. Alternatively, the FIDIC Conditions of Contract can be referred to in the bidding documents, and the bidders are advised to obtain copies directly from FIDIC.\*

\* Add the following text if the bidding documents, as issued, do not include a copy:

“Copies of the FIDIC Conditions of Contract can be obtained from:

FIDIC Secretariat

P.O. Box 86

1000 Lausanne 12

Switzerland

E-mail: [fidic.pub@fidic.org](mailto:fidic.pub@fidic.org) – [FIDIC.org/bookshop](http://FIDIC.org/bookshop)]

**GENERAL CONDITIONS OF  
CONTRACT  
PART - I**

## PART I - GENERAL CONDITIONS OF CONTRACT

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**PART I - GENERAL CONDITIONS****Definitions and Interpretation****Definitions**

- 1.1** In the Contract (as hereinafter defined) the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:
- (a) (i) "Procuring entity/Employer" means the person named as such in Part II of these Conditions and the legal successors in title to such person, but not (except with the consent of the Contractor) any assignee of such person.
- (ii) "Contractor" means the person whose tender has been accepted by the Procuring entity/Employer and the legal successors in title to such person, but not (except with the consent of the Procuring entity/Employer) any assignee of such person.
- (iii) "Subcontractor" means any person named in the Contract as a Subcontractor for a part of the Works or any person to whom a part of the Works has been subcontracted with the consent of the Engineer and the legal successors in title to such person, but not any assignee of any such person.
- (iv) "Engineer" means the person appointed by the Procuring entity/Employer to act as Engineer for the purposes of the Contract and named as such in Part II of these Conditions.
- (v) "Engineer's Representative" means a person appointed from time to time by the Engineer under Sub-Clause 2.2.
- (b) (i) "Contract" means these Conditions (Parts I and 11), the Specification, the Drawings, the Bill of Quantities, the Tender, the Letter of Acceptance, the Contract Agreement (if completed) and such further documents as may be expressly incorporated .in the Letter of Acceptance or Contract Agreement (if completed).
- (ii) "Specification" means the specification of the Works included in the Contract and any modification thereof or addition thereto made under Clause 51 or submitted by the Contractor and approved by the Engineer.
- (iii) "Drawings" means all drawings, calculations and technical information of a like nature provided by the Engineer to the Contractor under the Contract and all drawings, calculations, samples, patterns, models, operation and maintenance manuals and other technical information of a like nature submitted by the

Contractor and approved by the Engineer.

- (iv) "Bill of Quantities" means the priced and completed bill of quantities forming part of the Tender. .
  - (v) "Tender" means the Contractor's priced offer to the Procuring entity/Employer for the execution and completion of the Works and the remedying of any defects therein in accordance with the provisions of the Contract, as accepted by the Letter of Acceptance.
  - (vi) "Letter of Acceptance" means the formal acceptance by the Procuring entity/Employer of the Tender.
  - (vii) "Contract Agreement" means the contract agreement (if any) referred to in Sub-Clause 9.1.
  - (viii) "Appendix to Tender" means the appendix comprised in the form of Tender annexed to these Conditions.
- (c) (i) "Commencement Date" means the date upon which the Contractor receives the notice to commence issued by the Engineer pursuant to Clause 41.
- (ii) "Time for Completion" means the time for completing the execution of and passing the Tests on Completion of the Works or any Section or part thereof as stated in the Contract (or as extended under Clause 44) calculated from the Commencement Date.
- (d) (i) "Tests on Completion" means the tests specified in the Contract or otherwise agreed by the Engineer and the Contractor which are to be made by the Contractor before the Works or any Section or part thereof are taken over by the Procuring entity/Employer.
- (ii) "Taking-Over Certificate" means a certificate issued pursuant to Clause 48.
- (e) (i) "Contract Price" means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works and the remedying of any defects therein in accordance with the provisions of the Contract.
- (ii) "Retention Money" means the aggregate of all monies retained by the Procuring entity/Employer pursuant to Sub-Clause 60.2(a).
- (f) (i) "Works" means the Permanent Works and the Temporary Works or either of them as appropriate.
- (ii) "Permanent Works" means the permanent works to be executed

(including Plant) in accordance with the Contract.

(iii) "Temporary Works" means all temporary works of every kind (other than Contractor's Equipment) required in or about the execution and completion of the Works and the remedying of any defects therein.

(iv) "Plant" means machinery, apparatus and the like intended to form or forming part of the Permanent Works.

(v) "Contractor's Equipment" means all appliances and things of whatsoever nature (other, than Temporary Works) required for the execution and completion of the Works and the remedying of any defects therein, but does not include Plant, materials or other things intended to form or forming part of the Permanent Works.

(vi) "Section" means a part of the Works specifically identified in the Contract as a Section.

(vii) "Site" means the places provided by the Procuring entity/Employer where the Works are to be executed and any other places as may be specifically designated in the Contract as forming part of the Site.

(g) (i) "cost" means all expenditure properly incurred or to be incurred, whether on or off the Site, including overhead and other charges properly allocable thereto but does not include any allowance for profit.

(ii) "Day" means calendar day.

(iii) "Foreign currency" means a currency of a country other than that in which the Works are to be located.

(iv) "writing" means any hand-written, type-written, or printed communication, including telex, cable and facsimile transmission.

<b>Heading and Marginal Notes</b>	<b>1.2</b>	The heading and marginal notes in these Conditions shall not be deemed part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.
<b>Interpretation</b>	<b>1.3</b>	Words importing persons or parties shall include firms and corporations and any organization having legal capacity.
<b>Singular and Plural</b>	<b>1.4</b>	Words importing the singular only also include the plural and vice versa where the context requires.
<b>Notices, Consents,</b>	<b>1.5</b>	Wherever in the Contract provision is made for the giving or issue

**Approvals,  
Certificates and  
Determinations**

of any notice, consent, approval, certificate or determination by any person, unless otherwise specified such notice, consent, approval, certificate or determination shall be in writing and the words "notify", "certify" or "determine" shall be construed accordingly. Any such consent, approval, certificate or determination shall not unreasonably be withheld or delayed.

**Engineer and Engineer's Representative****Engineer's Duties  
and Authority**

- 2.1** (a) The Engineer shall carry out the duties specified in the Contract.
- (b) The Engineer may exercise the authority specified in or necessarily to be implied from the Contract, provided, however, that if the Engineer is required, under the terms of his appointment by the Procuring entity/Employer, to obtain the specific approval of the Procuring entity/Employer before exercising any such authority, particulars of such requirements shall be set out in Part II of these Conditions. Provided further that any requisite approval shall be deemed to have been given by the Procuring entity/Employer for any such authority exercised by the Engineer.
- (c) Except as expressly stated in the Contract, the Engineer shall have no authority to relieve the Contractor of any of his obligations under the Contract.

**Engineer's  
Representative**

- 2.2** The Engineer's Representative shall be appointed by and be responsible to the Engineer and shall carry out such duties and exercise such authority as may be delegated to him by the Engineer under Sub-Clause 2.3.

**Engineer's  
Authority to  
Delegate**

- 2.3** The Engineer may from time to time delegate to the Engineer's Representative any of the duties and authorities vested in the Engineer and he may at any time revoke such delegation. Any such delegation or revocation shall be in writing and shall not take effect until a copy thereof has been delivered to the Procuring entity/Employer and the Contractor.

Any communication given by the Engineer's Representative to the Contractor in accordance with such delegation shall have the same effect as though it had been given by the Engineer. Provided that:

(a) any failure of the Engineer's Representative to disapprove any work, materials or Plant shall not prejudice the authority of the Engineer to disapprove such work, materials or Plant and to give instructions for the rectification thereof;

(b) if the Contractor questions any communication of the Engineer's Representative he may refer the matter to the Engineer who shall

confirm, reverse or vary the contents of such communication.

**Appointment of Assistants**

**2.4** The Engineer or the Engineer's Representative may appoint any number of persons to assist the Engineer's Representative in the carrying out of his duties under Sub-Clause 2.2. He shall notify to the Contractor the names, duties and scope of authority of such persons. Such assistants shall have no authority to issue any instructions to the Contractor save in so far as such instructions may be necessary to enable them to carry out their duties and to secure their acceptance of materials, Plant or workmanship as being in accordance with the Contract, and any instructions given by any of them for those purposes shall be deemed to have been given by the Engineer's Representative.

**Instructions In Writing**

**2.5** Instructions given by the Engineer shall be in writing, provided that if for any reason the Engineer considers it necessary to give any such instruction orally, the Contractor shall comply with such instruction. Confirmation in writing of such oral instruction given by the Engineer, whether before or after the carrying out of the instruction, shall be deemed to be an instruction within the meaning of this Sub-Clause. Provided further that if the Contractor, within 7 days, confirms in writing to the Engineer any oral instruction of the Engineer and such confirmation is not contradicted in writing within 7 days by the Engineer, it shall be deemed to be an instruction of the Engineer.

The provisions of this Sub-Clause shall equally apply to instructions given by the Engineer's Representative and any assistants of the Engineer or the Engineer's Representative appointed pursuant to Sub-Clause 2.4.

**Engineer to Act Impartially**

**2.6** Wherever, under the Contract, the Engineer is required to exercise his discretion by:

(a) giving his decision, opinion or consent, or

(b) expressing his satisfaction or approval, or

(c) determining value, or

(d) otherwise taking action which may affect the rights and obligations of the Procuring entity/Employer or the Contractor

he shall exercise such discretion impartially within the terms of the Contract and having regard to all the circumstances. Any such decision, opinion, consent, expression of satisfaction, or approval, determination of value or action may be opened up, reviewed or

revised as provided in Clause 67.

### **Assignment and Subcontracting**

#### **Assignment of Contract**

**3.1** The Contractor shall not, without the prior consent of the Procuring entity/Employer (which consent, notwithstanding the provisions of Sub-Clause 1.5, shall be at the sole discretion of the Procuring entity/Employer), assign the Contract or any part thereof, or any benefit or interest therein or thereunder, otherwise than by:

(a) a charge in favour of the Contractor's bankers of any monies due or to become due under the Contract, or

(b) Assignment to the Contractor's insurers (in cases where the insurers have discharged the Contractor's loss or liability) of the Contractor's right to obtain relief against any other party liable.

#### **Subcontracting**

**4.1** The Contractor shall not subcontract the whole of the Works. Except where otherwise provided by the Contract, the Contractor shall not subcontract any part of the Works without the prior consent of the Engineer. Any such consent shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts, defaults and neglects of any Subcontractor, his agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agents, servants or workmen.

Provided that the Contractor shall not be required to obtain such consent for:

(a) The provision of labor, or

(b) The purchase of materials which are in accordance with the standards specified in the Contract, or

(c) The subcontracting of any part of the Works for which the Subcontractor is named in the Contract.

#### **Assignment of Subcontractors' Obligations**

**4.2** In the event of a Subcontractor having undertaken towards the Contractor in respect of the work executed, or the goods, materials, Plant or services supplied by such Subcontractor, any continuing obligation extending for a period exceeding that of the Defects Liability Period under the Contract, the Contractor shall at any time, after the expiration of such Period, assign to the Procuring entity/Employer, at the Procuring entity/Employer's request and cost, the benefit of such obligation for the unexpired duration thereof.

**Contract Documents****Language/s And Law**

**5.1** There is stated in Part II of these Conditions:

(a) the language or languages in which the Contract documents shall be drawn up, and

(b) the country or state the law of which shall apply to the Contract and according to which the Contract shall be construed.

If the said documents are written in more than one language, the language according to which the Contract shall be construed and interpreted is also stated in Part II of these Conditions, being therein designated the "Ruling language".

**Priority of Contract Documents**

**5.2** The several documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and adjusted by the Engineer who shall thereupon issue to the Contractor instructions thereon and In such event, unless otherwise provided in the Contract, the priority of the documents forming the Contract shall be as follows:

(1) The Contract Agreement (if completed);

(2) The letter of Acceptance;

(3) The Tender;

(4) Part II of these Conditions;

(5) Part I of these Conditions; and

(6) Any other document forming part of the Contract.

**Custody and Supply of Drawings and Documents**

**6.1** The Drawings shall remain in the sole custody of the Engineer, but two copies thereof shall be provided to the Contractor free of charge. The Contractor shall make at his own cost any further copies required by him. Unless it is strictly necessary for the purposes of the Contract, the Drawings, Specification and other documents provided by the Procuring entity/Employer or the Engineer shall not, without the consent of the Engineer, be used or communicated to a third party by the Contractor. Upon issue of the Defects Liability Certificate, the Contractor shall return to the Engineer all Drawings, Specification and other documents provided under the Contract.

The Contractor shall supply to the Engineer four copies of all



- Drawings, Specification and other documents submitted by the Contractor and approved by the Engineer in accordance with Clause 7, together with a reproducible copy of any material which cannot be reproduced to an equal standard by photocopying. In addition the Contractor shall supply such further copies of such Drawings, Specification and other documents as the Engineer may request in writing for the use of the Procuring entity/Employer, who shall pay the cost thereof.
- One Copy of Drawings to be Kept on site**      **6.2**      One copy of the Drawings, provided to or supplied by the Contractor as aforesaid, shall be kept by the Contractor on the Site and the same shall at all reasonable times be available for inspection and use by the Engineer and by any other person authorised by the Engineer in writing.
- Disruption of Progress**      **6.3**      The Contractor shall give notice to the Engineer, with a copy to the Procuring entity/Employer, whenever planning or execution of the Works is likely to be delayed or disrupted unless any further drawing or instruction is issued *by* the Engineer within a reasonable time. The notice shall include details of the drawing or instruction required and of why and by when it is required and of any delay or disruption likely to be suffered if it is late.
- Delay and Cost of Delay of Drawings**      **6.4**      If, by reason of any failure or inability of the Engineer to issue, within a time reasonable in all the circumstances, any drawing or instruction for which notice has been given by the Contractor in accordance with Sub-Clause 6.3, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine:
- (a) any extension of time to which the Contractor is entitled under Clause 44, and
- (b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer
- Failure by Contractor to Submit Drawings**      **6.5**      If the failure or inability of the Engineer to issue any drawings or instructions is caused in whole or in part by the failure of the Contractor to submit Drawings, Specification or other documents which he is required to submit under the Contract, the Engineer shall take such failure by the Contractor into account when making his determination pursuant to Sub-Clause 6.4.
- Supplementary Drawings and Instructions**      **7.1**      The Engineer shall have authority to issue to the Contractor, from time to time, such supplementary Drawings and instructions as shall be necessary for the purpose of the proper and adequate

execution and completion of the Works and the remedying of any defects therein. The Contractor shall carry out and be bound by the same.

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| <b>Permanent Works Designated by Contractor</b>    | <b>7.2</b> | <p>Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall submit to the Engineer, for approval:</p> <p>(a) such drawings, specifications, calculations and other information as shall be necessary to satisfy the Engineer as to the suitability and adequacy of that design, and</p> <p>(b) operation and maintenance manuals together with drawings of the Permanent Works as completed, in sufficient detail to enable the Procuring entity/Employer to operate, maintain, dismantle, reassemble and adjust the Permanent Works incorporating that design. The Works shall not be considered to be completed for the purposes of taking over in accordance with Clause 48 until such operation and maintenance manuals, together with drawings on completion, have been submitted to and approved by the Engineer.</p> |
| <b>Responsibility Unaffected by Approval</b>       | <b>7.3</b> | <p>Approval by the Engineer, in accordance with Sub-Clause 7.2, shall not relieve the Contractor of any of his responsibilities under the Contract.</p>   |
| <b>General Obligations</b>                         |            |   |
| <b>Contractor's General Responsibilities</b>       | <b>8.1</b> | <p>The Contractor shall, with due care and diligence, design (to the extent provided for by the Contract), execute and complete the Works and remedy any defects therein in accordance with the provisions of the Contract. The Contractor shall provide all superintendence, labor, materials, Plant, Contractor's Equipment and all other things, whether of a temporary or permanent nature, required in and for such design, execution, completion and remedying of any defects, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract.</p>  |
| <b>Site Operations and Methods of Construction</b> | <b>8.2</b> | <p>The Contractor shall take full responsibility for the adequacy, stability and safety of all Site operations and methods of construction. Provided that the Contractor shall not be responsible (except as stated hereunder or as may be otherwise agreed) for the design or specification of Permanent Works, or for the design or specification of any Temporary works not prepared by the Contractor. Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall be fully responsible for that part of such</p>  |

Works, notwithstanding any approval by the Engineer.

- Contract Agreement** 9.1 The Contractor shall, if called upon so to do, enter into and execute the Contract Agreement, to be prepared and completed at the cost of the Procuring entity/Employer, in the form annexed to these Conditions with such modification as may be necessary.
- Performance Security** 10.1 If the Contract requires the Contractor to obtain security for his proper performance of the Contract, he shall obtain and provide to the Procuring entity/Employer such security within 28 days after the receipt of the Letter of Acceptance, in the sum stated in the Appendix to Tender. When providing such security to the Procuring entity/Employer, the Contractor shall notify the Engineer of so doing. Such security shall be in the form annexed to these Conditions or in such other form as may be agreed between the Procuring entity/Employer and the Contractor. The institution providing such security shall be subject to the approval of the Procuring entity/Employer. The cost of complying with the requirements of this Clause shall be borne by the Contractor, unless the Contract otherwise provides.
- Period of Validity of Performance Security** 10.2 The performance security shall be valid until the Contractor has executed and completed the Works and remedied any defects therein in accordance with the Contract. No claim shall be made against such security after the issue of the Defects Liability Certificate in accordance with Sub-Clause 62.1 and such security shall be returned to the Contractor within 14 days of the issue of the said Defects Liability Certificate.
- Claims under Performance Security** 10.3 Prior to making a claim under the performance security the Procuring entity/Employer shall, in every case, notify the Contractor stating the nature of the default in respect of which the claim is to be made.
- Inspection of Site** 11.1 The Procuring entity/Employer shall have made available to the Contractor, before the submission by the Contractor of the Tender, such data on hydrological and sub-surface conditions as have been obtained by or on behalf of the Procuring entity/Employer from investigations undertaken relevant to the Works but the Contractor shall be responsible for his own interpretation thereof.

The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself (so far as is practicable, having regard to considerations of cost and time) before submitting his Tender, as to:

- (a) the form and nature thereof, including the sub-surface conditions,
- (b) the hydrological and climatic conditions,
- (c) the extent and nature of work and materials necessary for the execution and completion of the Works and the remedying of any defects therein, and
- (d) the means of access to the Site and the accommodation he may require and, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

The Contractor shall be deemed to have based his Tender on the data made available by the Procuring entity/Employer and on his own inspection and examination, all as aforementioned.

- Sufficiency of Tender**    **12.1**    The Contractor shall be deemed to have satisfied himself as to the correctness and sufficiency of the Tender and of the rates and prices stated in the Bill of Quantities, all of which shall, except insofar as it is otherwise provided in the Contract, cover all his obligations under the Contract (including those in respect of the supply of goods, materials, Plant or services or of contingencies for which there is a Provisional Sum) and all matters and things necessary for the proper execution and completion of the Works and the remedying of any defects therein.
- Adverse Physical Obstructions or Conditions**    **12.2**    If, however, during the execution of the Works the Contractor encounters physical obstructions or physical conditions, other than climatic conditions on the Site, which obstructions or conditions were, in his opinion, not foreseeable by an experienced contractor, the Contractor shall forthwith give notice thereof to the Engineer, with a copy to the Procuring entity/Employer. On receipt of such notice, the Engineer shall, if in his opinion such obstructions or conditions could not have been reasonably foreseen by an experienced contractor, after due consultation with the Procuring entity/Employer and the Contractor, determine:
- (a) any extension of time to which the Contractor is entitled under Clause 44, and
  - (b) the amount of any costs which may have been incurred by the Contractor by reason of such obstructions or conditions having been encountered, which shall be added to the Contract Price,

and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. Such determination shall take account of any instruction which the Engineer may issue to the Contractor in connection therewith, and any proper and reasonable measure acceptable to the Engineer which the Contractor may take in the absence of specific instructions from the Engineer.

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| <b>Work to be in Accordance with Contract</b>                | <b>13.1</b> | Unless it is legally or physically impossible, the Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the Contract to the satisfaction of the Engineer. The Contractor shall comply with and adhere strictly to the Engineer's instructions on any matter, whether mentioned in the Contract or not, touching or concerning the Works. The Contractor shall take instructions only from the Engineer or, subject to the provisions of Clause 2, from the Engineer's Representative. |
| <b>Programme to be Submitted</b>                             | <b>14.1</b> | The Contractor shall, within the time stated in Part II of these Conditions after the date of the Letter of Acceptance, submit to the Engineer for his consent a programme, in such form and detail as the Engineer shall reasonably prescribe, for the execution of the Works. The Contractor shall, whenever required by the Engineer, also provide in writing for his information a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works.                         |
| <b>Revised Programme</b>                                     | <b>14.2</b> | If at any time it should appear to the Engineer that the actual progress of the Works does not conform to the programme to which consent has been given under Sub-Clause 14.1, the Contractor shall produce, at the request of the Engineer, a revised programme showing the modifications to such programme necessary to ensure completion of the Works within the Time for Completion.  |
| <b>Cash Flow Estimate to be Submitted</b>                    | <b>14.3</b> | The Contractor shall, within the time stated in Part II of these Conditions after the date of the Letter of Acceptance, provide to the Engineer for his information a detailed cash flow estimate, in quarterly periods, of all payments to which the Contractor will be entitled under the Contract and the Contractor shall subsequently supply revised cash flow estimates at quarterly intervals, if required to do so by the Engineer.   |
| <b>Contractor not Relieved of Duties or Responsibilities</b> | <b>14.4</b> | The submission to and consent by the Engineer of such programmes or the provision of such general descriptions or cash flow estimates shall not relieve the Contractor of any of his duties or responsibilities under the Contract.   |
| <b>Contractor's</b>  | <b>15.1</b> | The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer   |

**Superintendence**

may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorized representative approved of by the Engineer, which approval may at any time be withdrawn, shall give his whole time to the superintendence of the Works. Such authorized representative shall receive, on behalf of the Contractor, instructions from the Engineer or, subject to the provisions of Clause 2, the Engineer's Representative

If approval of the representative is withdrawn by the Engineer, the Contractor shall, as soon as is practicable, having regard to the requirement of replacing him as hereinafter mentioned, after receiving notice of such withdrawal, remove the representative from the Works and shall not thereafter employ him again on the Works in any capacity and shall replace him by another representative approved by the Engineer.

**Contractor's Employees**

**16.1** The Contractor shall provide on the Site in connection with the execution and completion of the Works and the remedying of any defects therein

(a) only such technical assistants as are skilled and experienced in their respective callings and such foremen and leading hands as are competent to give proper superintendence of the Works, and

(b) such skilled, semi-skilled and unskilled labor as is necessary for the proper and timely fulfilling of the Contractor's obligations under the Contract.

**Engineer at Liberty to Object**

**16.2** The Engineer shall be at liberty to object to and require the Contractor to remove forthwith from the Works any person provided by the Contractor who, in the opinion of the Engineer, misconducts himself, or is incompetent or negligent in the proper performance of his duties, or whose presence on Site is otherwise considered by the Engineer to be undesirable, and such person shall not be again allowed upon the Works without the consent of the Engineer. Any person so removed from the Works shall be replaced as soon as possible.

**Setting-Out**

**17.1** The Contractor shall be responsible for:

(a) the accurate setting-out of the Works in relation to original points, lines and levels of reference given by the Engineer in writing,

(b) the correctness, subject as above mentioned. of the position, levels, dimensions and alignment of all parts of the Works, and

(c) the provision of all necessary instruments, appliances and labor in connection with the foregoing responsibilities.

If, at any time during the execution of the Works, any error appears in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required so to do by the Engineer; shall, at his own cost, rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer, in which case the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

The checking of any setting-out or of any line or level by the Engineer shall not in any way relieve the Contractor of his responsibility for the accuracy thereof and the Contractor shall carefully protect and preserve all bench-marks, sight-rails, pegs and other things used in setting-out the Works.

**Boreholes and  
Exploratory  
Excavation**

**18.1** If, at any time during the execution of the Works, the Engineer requires the Contractor to make boreholes or to carry out exploratory excavation, such requirement shall be the subject of an instruction in accordance with Clause 51, unless an item or a Provisional Sum in respect of such work is included in the Bill of Quantities.

**Safety, Security and  
Protection of the  
Environment**

**19.1** The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein:

(a) have full regard for the safety of all persons entitled to be upon the Site and keep the Site (so far as the same is under his control) and the Works (so far as the same are not completed or occupied by the Procuring entity/Employer) in an orderly state appropriate to the avoidance of danger to such persons, and

(b) provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the Works or for the safety and convenience of the public or others, and

(c) take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

- Procuring entity/Employer's Responsibilities**
- 19.2** If under Clause 31 the Procuring entity/Employer shall carry out work on the Site with his own workmen he shall, in respect of such work:
- (a) have full regard to the safety of all persons entitled to be upon the Site, and
- (b) keep the Site in an orderly state appropriate to the avoidance of danger to such persons.
- If under Clause 31 the Procuring entity/Employer shall employ other contractors on the Site he shall require them to have the same regard for safety and avoidance of danger.
- Care of Works**
- 20.1** The Contractor shall take full responsibility for the care of the Works and materials and Plant for incorporation therein from the Commencement Date until the date of issue of the Taking-Over Certificate for the whole of the Works, when the responsibility for the said care shall pass to the Procuring entity/Employer, Provided that:
- (a) if the Engineer issues a Taking-Over Certificate for any Section or part of the Permanent Works the Contractor shall cease to be liable for the care of that Section or part from the date of issue of the Taking-Over Certificate, when the responsibility for the care of that Section or part shall pass to the Procuring entity/Employer, and
- (b) the Contractor shall take full responsibility for the care of any outstanding Works and materials and Plant for incorporation therein which he undertakes to finish during the Defects Liability Period until such outstanding Works have been completed pursuant to Clause 49.
- Responsibility to Rectify Loss or Damage**
- 20.2** If any loss or damage happens to the Works, or any part thereof, or materials or Plant for incorporation therein, during the period for which the Contractor is responsible for the care thereof, from any cause whatsoever, other than the risks defined in Sub-Clause 20.4, the Contractor shall, at his own cost, rectify such loss or damage so that the Permanent Works conform in every respect with the provisions of the Contract to the satisfaction of the Engineer. The Contractor shall also be liable for any loss or damage to the Works occasioned by him in the course of any operations carried out by him for the purpose of complying with his obligations under Clauses 49 and 50.
- Loss or Damage Due to Procuring**
- 20.3** In the event of any such loss or damage happening from any of the risks defined in Sub-Clause 20.4, or in combination with other risks,



**entity/Employer's  
Risks**

the Contractor shall, if and to the extent required by the Engineer, rectify the loss or damage and the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. In the case of a combination of risks causing loss or damage any such determination shall take into account the proportional responsibility of the Contractor and the Procuring entity/Employer.

**Procuring  
entity/Employer's  
Risks****20.4** The Procuring entity/Employer's risks are:

(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,

(b) rebellion, revolution, insurrection, or military or usurped power, or civil war,

(c) Ionizing radiations, or contamination by radio-activity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosive, or other hazardous properties of any explosive nuclear assembly or nuclear component thereof,

(d) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,

(e) riot, commotion or disorder, unless solely restricted to employees of the Contractor or of his Subcontractors and arising from the conduct of the Works,

(f) loss or damage due to the use or occupation by the Procuring entity/Employer of any Section or part of the Permanent Works, except as may be provided for in the Contract,

(g) loss or damage to the extent that it is due to the design of the Works, other than any part of the design provided by the Contractor or for which the Contractor is responsible,

(h) any operation of the forces of nature against which an experienced contractor could not reasonably have been expected to take precautions.

**Insurance of Works  
and Contractor's  
Equipment****21.1** The Contractor shall, without limiting his or the Procuring entity/Employer's obligations and responsibilities under Clause 20, insure:

- (a) the Works, together with materials and Plant for incorporation therein, to the full replacement cost
- (b) an additional sum of 15 per cent of such replacement cost, or as may be specified in Part II of these Conditions, to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature
- (c) the Contractor's Equipment and other things brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.
- Scope of Cover**      **21.2**      The insurance in paragraphs (a) and (b) of Sub-Clause 21.1 shall be in the joint names of the Contractor and the Procuring entity/Employer and shall cover:
- (a) the Procuring entity/Employer and the Contractor against all loss or damage from whatsoever cause arising, other than as provided in Sub-Clause 21.4, from the start of work at the Site until the date of issue of the relevant Taking-Over Certificate in respect of the Works or any Section or part thereof as the case may be, and
- (b) the Contractor for his liability:
- (i) during the Defects Liability Period for loss or damage arising from a cause occurring prior to the commencement of the Defects Liability Period, and
- (ii) for loss or damage occasioned by the Contractor in the course of any operations carried out by him for the purpose of complying with his obligations under Clauses 49 and 50.
- Responsibility for Amounts not Recovered**      **21.3**      Any amounts not insured or not recovered from the insurers shall be borne by the Procuring entity/Employer or the Contractor in accordance with their responsibilities under Clause 20.
- Exclusions**      **21.4**      There shall be no obligation for the insurances in Sub-Clause 21.1 to include loss or damage caused by
- (a) war, hostilities (where war be declared or not), invasion, act of foreign enemies,
- (b) rebellion, revolution, insurrection, or military or usurped power, or civil war,
- (c) Ionizing radiations, or contamination by radio-activity from any

nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosive, or other hazardous properties of any explosive nuclear assembly or nuclear component thereof,

(d) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds.

**Damage to Persons and Property**

**22.1** The Contractor shall, except if and so far as the Contract provides otherwise, indemnify the Procuring entity/Employer against all losses and claims in respect of:

(a) death of or injury to any person, or

(b) loss of or damage to any property (other than the Works),

Which may arise out of or in consequence of the execution and completion of the Works and the remedying of any defects therein, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, subject to the exceptions defined in Sub-Clause 22.2.

**Exceptions**

**22.2** The "exceptions" referred to in Sub-Clause 22.1 are:

(a) The permanent use or occupation of land by the Works, or any part thereof.

(b) the right of the Procuring entity/Employer to execute the Works, or any part thereof, on, over, under, in or through any land,

(c) damage to property which is the unavoidable result of the execution and completion of the Works, or the remedying of any defects therein, in accordance with the Contract,

(d) death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Procuring entity/Employer, his agents, servants or other contractors, not being employed by the Contractor, or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or, where the injury or damage was contributed to by the Contractor, his servants or agents, such part of the said injury or damage as may be just and equitable having regard to the extent of the responsibility of the Procuring entity/Employer, his servants or agents or other contractors for the injury or damage.

**Indemnity by Procuring entity/Employer**

**22.3** The Procuring entity/Employer shall indemnify the Contractor against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the exceptions

defined in Sub-Clause 22.2.

- |   |             |  |
|---|-------------|--|
| <b>Third Party Insurance (Including Procuring entity/Employer's Property)</b> | <b>23.1</b> | The Contractor shall, without limiting his or the Procuring entity/Employer's obligations and responsibilities under Clause 22, insure, in the joint names of the Contractor and the Procuring entity/Employer, against liabilities for death of or injury to any person (other than as provided in Clause 24) or loss of or damage to any property (other than the Works) arising out of the performance of the Contract, other than the exceptions defined in paragraphs (a), (b) and (c) of Sub-Clause 22.2.  |
| <b>Minimum Amount of Insurance</b>  | <b>23.2</b> | Such insurance shall be for at least the amount stated in the Appendix to Tender.  |
| <b>Cross Liabilities</b>  | <b>23.3</b> | The insurance policy shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Procuring entity/Employer as separate insureds  |
| <b>Accident or injury to Workmen</b>  | <b>24.1</b> | The Procuring entity/Employer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any Subcontractor, other than death or injury resulting from any act or default of the Procuring entity/Employer, his agents or servants. The Contractor shall indemnify and keep indemnified the Procuring entity/Employer against all such damages and compensation, other than those for which the Procuring entity/Employer is liable as aforesaid and against all claims, proceedings, damages, costs, charges, and expenses whatsoever in respect thereof or in relation thereto.   |
| <b>Insurance Against Accident to Workmen</b>                                  | <b>24.2</b> | The Contractor shall insure against such liability and shall continue such insurance during the whole of the time that any persons are employed by him on the Works. Provided that, in respect of any persons employed by any Subcontractor, the Contractor's obligations to insure as aforesaid under this Sub-Clause shall be satisfied if the Subcontractor shall have insured against the liability in respect of such persons in such manner that the Procuring entity/Employer is indemnified under the policy, but the Contractor shall require such Subcontractor to produce to the Procuring entity/Employer, when required, such policy of insurance and the receipt for the payment of the current premium. |
| <b>Evidence and Terms of Insurances</b>                                       | <b>25.1</b> | The Contractor shall provide evidence to the Procuring entity/Employer prior to the start of work at the Site that the insurances required under the Contract have been effected and shall, within 84 days of the commencement Date, provide the insurance policies to the Procuring entity/Employer. When providing such  |

evidence and such policies to the Procuring entity/Employer, the Contractor shall notify the Engineer of so doing. Such insurance policies shall be consistent with the general terms agreed prior to the issue of the Letter of Acceptance. The Contractor shall effect all insurances for which he is responsible with insurers and in terms approved by the Procuring entity/Employer.

**Adequacy of Insurances**

**25.2** The Contractor shall notify the insurers of changes in the nature, extent or programme for the execution of the Works and ensure the adequacy of the insurances at all times in accordance with the terms of the Contract and shall, when required, produce to the Procuring entity/Employer the insurance policies in force and the receipts for payment of the current premiums.

**Remedy on Contractor's Failure to Insure**

**25.3** If the Contractor fails to effect and keep in force any of the insurances required under the Contract, or fails to provide the policies to the Procuring entity/Employer within the period required by Sub-Clause 25.1, then and in any such case the Procuring entity/Employer may effect and keep in force any such insurances and pay any premium as may be necessary for that purpose and from time to time deduct the amount so paid from any monies due or to become due to the Contractor, or recover the same as a debt due from the Contractor.

**Compliance with Policy Conditions**

**25.4** In the event that the Contractor or the Procuring entity/Employer fails to comply with conditions imposed by the insurance policies effected pursuant to the Contract, each shall indemnify the other against all losses and claims arising from such failure.

**Compliance with Statutes, Regulations**

**26.1** The Contractor shall conform in all respects, including by the giving of all notices and the paying of all fees, with the provisions of:

(a) any National or State Statute, Ordinance, or other Law, or any regulation, or bye-law of any local or other duly constituted authority in relation to the execution and completion of the Works and the remedying of any defects therein, and

(b) the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works, and the Contractor shall keep the Procuring entity/Employer indemnified against all penalties and liability of every kind for breach of any such provisions. Provided always that the Procuring entity/Employer shall be responsible for obtaining any planning, zoning or other similar permission required for the Works to proceed and shall indemnify the Contractor in accordance with Sub-Clause 22.3.

- Fossils**
- 27.1** All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall, as between the Procuring entity/Employer and the Contractor, be deemed to be the absolute property of the Procuring entity/Employer. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Engineer's instructions for dealing with the same. If, by reason of such instructions, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine:
- (a) any extension of time to which the Contractor is entitled under Clause 44, and
- (b) the amount of such costs, which shall be added to the Contract Price,
- and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.
- Patent Rights**
- 28.1** The Contractor shall save harmless and indemnify the Procuring entity/Employer from and against all claims and proceedings for or on account of infringement of any patent rights, design trademark or name or other protected rights in respect of any Contractor's Equipment, materials or Plant used for or in connection with or for incorporation in the Works and from and against all damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, except where such infringement results from compliance with the design or Specification provided by the Engineer.
- Royalties**
- 28.2** Except where otherwise stated, the Contractor shall pay all tonnage and other royalties, rent and other payments or compensation, if any, for getting stone, sand, gravel, clay or other materials required for the Works.
- Interference with Traffic and Adjoining Properties**
- 29.1** All operations necessary for the execution and completion of the Works and the remedying of any defects therein shall, so far as compliance with the requirements of the Contract permits, be carried on so as not to interfere unnecessarily or improperly with:
- (a) the convenience of the public, or
- (b) the access to, use and occupation of public or private roads and footpaths to or of properties whether in the possession of the

Procuring entity/Employer or of any other person.

The Contractor shall save harmless and indemnify the Procuring entity/Employer in respect of all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of, or in relation to, any such matters insofar as the Contractor is responsible therefor.

**Avoidance of  
Damage to Roads**

**30.1** The Contractor shall use every reasonable means to prevent any of the roads or bridges communicating with or on the routes to the Site from being damaged or injured by any traffic of the Contractor or any of his Subcontractors and, in particular, shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of materials, Plant, Contractor's Equipment or Temporary Works from and to the Site shall be limited, as far as reasonably possible, and so that no unnecessary damage or injury may be occasioned to such roads and bridges.

**Transport of  
Contractor's  
Equipment or  
Temporary Works**

**30.2** Save insofar as the Contract otherwise provides, the Contractor shall be responsible for and shall pay the cost of strengthening any bridges or altering or improving any road communicating with or on the routes to the Site to facilitate the movement of Contractor's Equipment or Temporary Works and the Contractor shall indemnify and keep indemnified the Procuring entity/Employer against all claims for damage to any such road or bridge caused by such movement, including such claims as may be made directly against the Procuring entity/Employer, and shall negotiate and pay all claims arising solely out of such damage.

**Transport of  
Materials or Plant**

**30.3** If, notwithstanding Sub-Clause 30.1, any damage occurs to any bridge or road communicating with or on the routes to the Site arising from the transport of materials or Plant, the Contractor shall notify the Engineer with a copy to the Procuring entity/Employer, as soon as he becomes aware of such damage or as soon as he receives any claim from the authority entitled to make such claim. Where under any law or regulation the haulier of such materials or Plant is required to indemnify the road authority against damage the Procuring entity/Employer shall not be liable for any costs, charges or expenses in respect thereof or in relation thereto. In other cases the Procuring entity/Employer shall negotiate the settlement of and pay all sums due in respect of such claim and shall indemnify the Contractor in respect thereof and in respect of all claims, proceedings, damages, costs, charges and expenses in relation thereto. Provided that if and so far as any such claim or part thereof is, in the opinion of the Engineer, due to any failure on the part of the Contractor to observe and perform his obligations under Sub-Clause 30.1, then the amount, determined by the Engineer, after

due consultation with the Procuring entity/Employer and the Contractor, to be due to such failure shall be recoverable from the Contractor by the Procuring entity/Employer and may be deducted by the Procuring entity/Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. Provided also that the Procuring entity/Employer shall notify the Contractor whenever a settlement is to be negotiated and, where any amount may be due from the Contractor, the Procuring entity/Employer shall consult with the Contractor before such settlement is agreed

**Waterborne  
Traffic**

**30.4** Where the nature of the Works is such as to require the use by the Contractor of waterborne transport the foregoing provisions of this Clause shall be construed as though "road" included a lock, dock, sea wall or other structure related to a waterway and "vehicle" included craft, and shall have effect accordingly.

**Opportunities for  
Other Contractors**

**31.1** The Contractor shall, in accordance with the requirements of the Engineer, afford all reasonable opportunities for carrying out their work to:

- (a) any other contractors employed by the Procuring entity/Employer and their workmen,
- (b) the workmen of the Procuring entity/Employer, and
- (c) the workmen of any duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any contract which the Procuring entity/Employer may enter into in connection with or ancillary to the Works.

**Facilities for Other  
Contractors**

**31.2** If, however, pursuant to Sub-Clause 31.1 the Contractor shall, on the written request of the Engineer:

- (a) make available to any such other contractor, or to the Procuring entity/Employer or any such authority, any roads or ways for the maintenance of which the Contractor is responsible, or
- (b) permit the use, by any such, of Temporary Works or Contractor's Equipment on the Site, or
- (c) provide any other service of whatsoever nature for any such,

the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor



accordingly, with a copy to the Procuring entity/Employer.

- Contractor to Keep Site Clear**    **32.1**    During the execution of the Works the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment and surplus materials and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required.
- Clearance of Site on Completion**    **33.1**    Upon the issue of any Taking-Over Certificate the Contractor shall clear away and remove from that part of the Site to which such Taking-Over Certificate relates all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike condition to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period.
- Labor
- Engagement of Staff and Labor**    **34.1**    The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labor, local or other, and for their payment, housing, feeding and transport.
- Materials, Plant and Workmanship
- Quality of Materials, Plant and Workmanship**    **36.1**    All materials, Plant and workmanship shall be
- (a) of the respective kinds described in the Contract and in accordance with the Engineer's instructions, and
- (b) subjected from time to time to such tests as the Engineer may require at the place of manufacture, fabrication or preparation, or on the Site or at such other place or places as may be specified in the Contract, or at all or any of such places.
- The Contractor shall provide such assistance, labor, electricity, fuels, stores, apparatus and instruments as are normally required for examining, measuring and testing any materials or Plant and shall supply samples of materials, before incorporation in the Works, for testing as may be selected and required by the Engineer.
- Cost of Samples**    **36.2**    All samples shall be supplied by the Contractor at his own cost if the supply thereof is clearly intended by or provided for in the Contract.

- Cost of Tests**                      **36.3**    The cost of making any test shall be borne by the Contractor if such test is
- (a) clearly intended by or provided for in the Contract, or
- (b) particularized in the Contract (in cases only of a test under load or of a test to ascertain whether the design of any finished or partially finished work is appropriate for the purposes which it was intended to fulfil) in sufficient detail to enable the Contractor to price or allow for the same in his Tender.
- Cost of Tests not Provided for**                      **36.4**    If any test required by the Engineer which is
- (a) not so intended by or provided for, or
- (b) (in the cases above mentioned) not so particularised, or
- (c) (though so intended or provided for) required by the Engineer to be carried out at any place other than the Site or the place of manufacture, fabrication or preparation of the materials or Plant tested,
- shows the materials, Plant or workmanship not to be in accordance with the provisions of the Contract to the satisfaction of the Engineer, then the cost or such test shall be borne by the Contractor, but in any other case Sub-Clause 36.5 shall apply.
- Engineer's Determination where Tests not Provided for**                      **36.5**    Where, pursuant to Sub-Clause 36.4, this Sub-Clause applies the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine:
- (a) any extension of time to which the Contractor is entitled under Clause 44, and
- (b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.
- Inspection of Operations**                      **37.1**    The Engineer, and any person authorised by him, shall at all reasonable times have access to the Site and to all workshops and places where materials or Plant are being manufactured, fabricated or prepared for the Works and the Contractor shall afford every facility for and every assistance in obtaining the right to such access.
- Inspection and Testing**                      **37.2**    The Engineer shall be entitled, during manufacture, fabrication or preparation to inspect and test the materials and Plant to be supplied under the Contract. If materials or Plant are being manufactured, fabricated or prepared in workshops or places other than those of the

Contractor, the Contractor shall obtain permission for the Engineer to carry out such inspection and testing in those workshops or places. Such inspection or testing shall not release the Contractor from any obligation under the Contract.

**Dates for Inspection and Testing**     **37.3**

The Contractor shall agree with the Engineer on the time and place for the inspection or testing of any materials or Plant as provided in the Contract. The Engineer shall give the Contractor not less than 24 hours' notice of his intention to carry out the inspection or to attend the tests. If the Engineer, or his duly authorized representative, does not attend on the date agreed, the Contractor may, unless otherwise instructed by the Engineer, proceed with the tests, which shall be deemed to have been made in the presence of the Engineer. The Contractor shall forthwith forward to the Engineer duly certified copies of the test readings. If the Engineer has not attended the tests, he shall accept the said readings as accurate.

**Rejection**

**37.4**

If, at the time and place agreed in accordance with Sub-Clause 37.3, the materials or Plant are not ready for inspection or testing or if, as a result of the inspection or testing referred to in this Clause, the Engineer determines that the materials or Plant are defective or otherwise not in accordance with the Contract, he may reject the materials or Plant and shall notify the Contractor thereof immediately. The notice shall state the Engineer's objections with reasons. The Contractor shall then promptly make good the defect or ensure that rejected materials or Plant comply with the Contract. If the Engineer so requests, the tests of rejected materials or Plant shall be made or repeated under the same terms and conditions. All costs incurred by the Procuring entity/Employer by the repetition of the tests shall, after due consultation with the Procuring entity/Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Procuring entity/Employer and may be deducted from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Independent Inspection**

**37.5**

The Engineer may delegate inspection and testing of materials or Plant to an independent inspector. Any such delegation shall be effected in accordance with Sub-Clause 2.4 and for this purpose such independent inspector shall be considered as an assistant of the Engineer. Notice of such appointment (not being less than 14 days) shall be given by the Engineer to the Contractor.

**Examination of Work before Covering up**

**38.1**

No part of the Works shall be covered up or put out of view without the approval of the Engineer and the Contractor shall afford full opportunity for the Engineer to examine and measure any such part of the Works which is about to be covered up or put out of view and

to examine foundations before any part of the Works is placed thereon. The Contractor shall give notice to the Engineer whenever any such part of the Works or foundations is or are ready or about to be ready for examination and the Engineer shall, without unreasonable delay, unless he considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such part of the Works or of examining such foundations.

**Uncovering and  
Making Openings**

**38.2** The Contractor shall uncover any part of the Works or make openings in or through the same as the Engineer may from time to time instruct and shall reinstate and make good such part. If any such part has been covered up or put out of view after compliance with the requirement of Sub-Clause 38.1 and is found to be executed in accordance with the Contract, the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine the amount of the Contractor's costs in respect of such of uncovering, making openings in or through, reinstating and making good the same, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. In any other case all costs shall be borne by the Contractor.

**Removal of  
Improper Work,  
Materials or Plant**

**39.1** The Engineer shall have authority to issue instructions from time to time, for:

- (a) the removal from the Site, within such time or times as may be specified in the instruction, of any materials or Plant which, in the opinion of the Engineer, are not in accordance with the Contract,
- (b) the substitution of proper and suitable materials or Plant, and
- (c) the removal and proper re-execution, notwithstanding any previous test thereof or interim payment therefor, of any work which, in respect of
  - (i) materials, Plant or workmanship, or
  - (ii) design by the Contractor or for which he is responsible,is not, in the opinion of the Engineer, in accordance with the Contract.

**Default of  
Contractor in  
Compliance**

**39.2** In case of default on the part of the Contractor in carrying out such instruction within the time specified therein or, if none, within a reasonable time, the Procuring entity/Employer shall be entitled to employ and pay other persons to carry out the same and all costs consequent thereon or incidental thereto shall, after due consultation with the Procuring entity/Employer and the Contractor, be

determined by the Engineer and shall be recoverable from the Contractor by the Procuring entity/Employer, and may be deducted by the Procuring entity/Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

#### Suspension

- Suspension of Work**    **40.1**    The Contractor shall, on the instructions of the Engineer, suspend the progress of the Works or any part thereof for such time and in such manner as the Engineer may consider necessary and shall, during such suspension, properly protect and secure the Works or such part thereof so far as is necessary in the opinion of the Engineer. Unless such suspension is
- (a) otherwise provided for in the Contract, or
  - (b) necessary by reason of some default of or breach of contract by the Contractor or for which he is responsible, or
  - (c) necessary by reason of climatic conditions on the Site, or
  - (d) necessary for the proper execution of the Works or for the safety of the Works or any part thereof (save to the extent that such necessity arises from any act or default by the Engineer or the Procuring entity/Employer or from any of the risks defined in Sub-Clause 20.4), Sub-Clause 40.2 shall apply.
- Engineer's Determination following Suspension**    **40.2**    Where, pursuant to Sub-Clause 40.1, this Sub-Clause applies the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine
- (a) any extension of time to which the Contractor is entitled under Clause 44, and
  - (b) the amount, which shall be added to the Contract Price, in respect of the cost incurred by the Contractor by reason of such suspension, and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.
- Suspension lasting more than 84 Days**    **40.3**    If the progress of the Works or any part thereof is suspended on the written instructions of the Engineer and if permission to resume work is not given by the Engineer within a period of 84 days from the date of suspension then, unless such suspension is within paragraph (a), (b), (c) or (d) of Sub-Clause 40.1, the Contractor may give notice to the Engineer requiring permission, within 28 days from the receipt thereof, to proceed with the Works or that part

thereof in regard to which progress is suspended. If, within the said time, such permission is not granted, the Contractor may, but is not bound to, elect to treat the suspension, where it affects part only of the Works, as an omission of such part under Clause 51 by giving a further notice to the Engineer to that effect, or, where it affects the whole of the Works, treat the suspension as an event of default by the Procuring entity/Employer and terminate his employment under the Contract in accordance with the provisions of Sub-Clause 69.1, whereupon the provisions of Sub-Clauses 69.2 and 69.3 shall apply.

#### Commencement and Delays

- Commencement of Works**      **41.1**      The Contractor shall commence the Works as soon as is reasonably possible after the receipt by him of a notice to this effect from the Engineer, which notice shall be issued within the time stated in the Appendix to Tender after the date of the Letter of Acceptance. Thereafter, the Contractor shall proceed with the Works with due expedition and without delay.
- Possession of Site and Access Thereto**      **42.1**      Save insofar as the Contract may prescribe:
- (a) the extent of portions of the Site of which the Contractor is to be given possession from time to time, and
  - (b) the order in which such portions shall be made available to the Contractor and subject to any requirement in the Contract as to the order in which the Works shall be executed, the Procuring entity/Employer, will, with the Engineer's notice to commence the Works, give to the Contractor possession of
  - (c) so much of the Site, and
  - (d) such access as, in accordance with the Contract, is to be provided by the Procuring entity/Employer as may be required to enable the Contractor to commence and proceed with the execution of the Works in accordance with the programme referred to in Clause 14, if any, and otherwise in accordance with such reasonable proposals as the Contractor shall, by notice to the Engineer with a copy to the Procuring entity/Employer, make. The Procuring entity/Employer will, from time to time as the Works proceed, give to the Contractor possession of such further portions of the Site as may be required to enable the Contractor to proceed with the execution of the Works with due dispatch in accordance with such programme or proposals, as the case may be.
- Failure to Give Possession**      **42.2.**      If the Contractor suffers delay and/or incurs costs from failure on the part of the Procuring entity/Employer to give possession in accordance with the terms of Sub-Clause 42.1, the Engineer shall,

after due consultation with the Procuring entity/Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 44, and

(b) the amount of such costs, which shall be added to the Contract Price,

and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Wayleaves and  
Facilities**

**42.3** The Contractor shall bear all costs and charges for special or temporary way leaves required by him in connection with access to the Site. The Contractor shall also provide at his own cost any additional facilities outside the Site required by him for the purposes of the Works.

**Time for  
Completion**

**43.1** The whole of the Works and, if applicable, any Section required to be completed within a particular time as stated in the Appendix to Tender, shall be completed in accordance with the provisions of Clause 48, within the time stated in the Appendix to Tender 720 calendar days for the whole of the Works or the Section (as the case may be), calculated from the Commencement Date, or such extended time as may be allowed under Clause 44.

**Extension of Time  
for Completion**

**44.1** In the event of

(a) the amount or nature of extra or additional work, or

(b) any cause of delay referred to in these Conditions, or

(c) exceptionally adverse climatic conditions, or

(d) any delay, impediment or prevention by the Procuring entity/Employer, or

(e) other special circumstances which may occur, other than through a default of or breach of contract by the Contractor or for which he is responsible, being such as fairly to entitle the Contractor to an extension of the Time for Completion of the Works, or any Section or part thereof, the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine the amount of such extension and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Contractor to  
Provide Notification**

**44.2** Provided that the Engineer is not bound to make any determination

**and Detailed  
Particulars**

unless the Contractor has

(a) within 28 days after such event has first arisen notified the Engineer with a copy to the Procuring entity/Employer, and

(b) within 28 days, or such other reasonable time as may be agreed by the Engineer, after such notification submitted to the Engineer detailed particulars of any extension of time to which he may consider himself entitled in order that such submission may be investigated at the time.

**Interim  
Determination of  
Extension**

**44.3** Provided also that where an event has a continuing effect such that it is not practicable for the Contractor to submit detailed particulars within the period of 28 days referred to in Sub-Clause 44.2(b), he shall nevertheless be entitled to an extension of time provided that he has submitted to the Engineer interim particulars at intervals of not more than 28 days and final particulars within 28 days of the end of the effects resulting from the event. On receipt of such interim particulars, the Engineer shall, without undue delay, make an interim determination of extension of time and, on receipt of the final particulars, the Engineer shall review all the circumstances and shall determine an overall extension of time in regard to the event. In both such cases the Engineer shall make his determination after due consultation with the Procuring entity/Employer and the Contractor and shall notify the Contractor of the determination, with a copy to the Procuring entity/Employer. No final review shall result in a decrease of any extension of time already determined by the Engineer.

**Restriction on  
Working Hours**

**45.1** Subject to any provision to the contrary contained in the Contract, none of the Works shall, save as hereinafter provided, be carried on during the night or on locally recognised days of rest without the consent of the Engineer, except when work is unavoidable or absolutely necessary for the saving of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer. Provided that the provisions of this Clause shall not be applicable in the case of any work which it is customary to carry out by multiple shifts.

**Rate of Progress**

**46.1** If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the Works or any Section is at any time, in the opinion of the Engineer, too slow to comply with the Time for Completion, the Engineer shall so notify the Contractor who shall thereupon take such steps as are necessary, subject to the consent of the Engineer, to expedite progress so as to comply with the Time for Completion. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a



result of any notice given by the Engineer under this Clause, the Contractor considers that it is necessary to do any work at night or on locally recognized days of rest, he shall be entitled to seek the consent of the Engineer so to do. Provided that if any steps, taken by the Contractor in meeting his obligations under this Clause, involve the Procuring entity/Employer in additional supervision costs, such costs shall, after due consultation with the Procuring entity/Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Procuring entity/Employer, and may be deducted by the Procuring entity/Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Liquidated  
Damages for  
Delay**

**47.1** If the Contractor fails to comply with the Time for Completion in accordance with Clause 48, for the whole of the Works or, if applicable, any Section within the relevant time prescribed by Clause 43, then the Contractor shall pay to the Procuring entity/Employer the relevant sum stated in the Appendix to Tender as liquidated damages for such default and not as a penalty (which sum shall be the only monies due from the Contractor for such default) for every day or part of a day which shall elapse between the relevant Time for Completion and the date stated in a Taking-Over of whole of the Works or the relevant Section, subject to the applicable limit stated in the Appendix to Tender. The Procuring entity/Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract.

**Reduction of  
Liquidated  
Damages**

**47.2** If, before the Time for Completion of the whole of the Works or, if applicable, any Section, a Taking-Over Certificate has been issued for any part of the Works or of a Section, the liquidated damages for delay in completion of the remainder of the Works or of that Section shall, for any period of delay after the date stated in such Taking-Over Certificate, and in the absence of alternative provisions in the Contract, be reduced in the proportion which the value of the part so certified bears to the value of the whole of the Works or Section, as applicable. The Clause shall only apply to the rate of liquidated damages and shall not affect the limit thereof.

**Taking-Over  
Certificate**

**48.1** When the whole of the Works have been substantially completed and have satisfactorily passed any Tests on Completion prescribed by the Contract, the Contractor may give a notice to that effect to

the Engineer, with a copy to the Procuring entity/Employer, accompanied by a written undertaking to finish with due expedition any outstanding work during the Defects Liability Period. Such notice and undertaking shall be deemed to be a request by the Contractor for the Engineer to issue a Taking-Over Certificate in respect of the Works. The Engineer shall, within 21 days of the date of delivery of such notice, either issue to the Contractor, with a copy to the Procuring entity/Employer, a Taking-Over Certificate, stating the date on which, in his opinion, the Works were substantially completed in accordance with the Contract, or give instructions in writing to the Contractor specifying all the work which, in the Engineer's opinion, is required to be done by the Contractor before the issue of such Certificate. The Engineer shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the Works specified therein. The Contractor shall be entitled to receive such Taking-Over Certificate within 21 days of completion, to the satisfaction of the Engineer, of the Works so specified and remedying any defects so notified.

**Taking Over of Sections or Parts**

**48.2** Similarly, in accordance with the procedure set out in Sub-Clause 48.1, the Contractor may request and the Engineer shall issue a Taking-Over Certificate in respect of:

(a) any Section in respect of which a separate Time for Completion is provided in the Appendix to Tender, or

(b) any substantial part of the Permanent Works which has been both completed to the satisfaction of the Engineer and, otherwise than as provided for in the Contract, occupied or used by the Procuring entity/Employer, or

(c) any part of the Permanent Works which the Procuring entity/Employer has elected to occupy or use prior to completion (where such prior occupation or use is not provided for in the Contract or has not been agreed by the Contractor as a temporary measure).

**Substantial Completion of Parts**

**48.3** If any part of the Permanent Works has been substantially completed and has satisfactorily passed any Tests on Completion prescribed by the Contract, the Engineer may issue a Taking-Over Certificate in respect of that part of the Permanent Works before completion of the whole of the Works and, upon the issue of such Certificate, the Contractor shall be deemed to have undertaken to complete with due expedition any outstanding work in that part of the Permanent Works during the Defects Liability Period.

- Surfaces Requiring Reinstatement**      **48.4**      Provided that a Taking-Over Certificate given in respect of any Section or part of the Permanent Works before completion of the whole of the Works shall not be deemed to certify completion of any ground or surfaces requiring reinstatement, unless such Taking-Over Certificate shall expressly so state .
- Defects Liability**
- Defects Liability Period**      **49.1**      In these Conditions the expression "Defects Liability Period" shall mean the defects liability period named in the Appendix to Tender 365 calendar days, calculated from:
- (a) the date of completion of the Works certified by the Engineer in accordance with Clause 48, or
- (b) in the event of more than one certificate having been issued by the Engineer under Clause 48, the respective dates so certified
- and in relation to the Defects Liability Period the expression "the Works" shall be construed accordingly.
- Completion of Outstanding Work and Remedying Defects**      **49.2**      To the intent that the Works shall, at or as soon as practicable after the expiration of the Defects Liability Period, be delivered to the Procuring entity/Employer in the condition required by the Contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall:
- (a) complete the work, if any, outstanding on the date stated in the Taking-Over Certificate as soon as practicable after such date and
- (b) execute all such work of amendment, reconstruction, and remedying defects, shrinkages or other faults as the Engineer may, during the Defects Liability Period or within 14 days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration, instruct the Contractor to execute.
- Cost of Remedying Defects**      **49.3**      All work referred to in Sub-Clause 49.2 (b) shall be executed by the Contractor at his own cost if the necessity thereof is, in the opinion of the Engineer, due to:
- (a) the use of materials, Plant or workmanship not in accordance with the Contract, or
- (b) where the Contractor is responsible for the design of part of the Permanent Works, any fault in such design, or
- (c) the neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part

under the Contract.

If, in the opinion of the Engineer, such necessity is due to any other cause, he shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Contractor's Failure to Carry Out Instructions** 49.4

In case of default on the part of the Contractor in carrying out such instruction within a reasonable time, the Procuring entity/Employer shall be entitled to employ and pay other persons to carry out the same and if such work is work which, in the opinion of the Engineer, the Contractor was liable to do at his own cost under the Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Procuring entity/Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Procuring entity/Employer, and may be deducted by the Procuring entity/Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Contractor to Search**

**50.1**

If any defect, shrinkage or other fault in the Works appears at any time prior to the end of the Defects Liability Period, the Engineer may instruct the Contractor, with copy to the Procuring entity/Employer, to search under the directions of the Engineer for the cause thereof. Unless such defect, shrinkage or other fault is one for which the Contractor is liable under the Contract, the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine the amount in respect of the costs of such search incurred by the Contractor, which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. If such defect, shrinkage or other fault is one for which the Contractor is liable, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case remedy such defect, shrinkage or other fault at his own cost in accordance with the provisions of Clause 49.

**Alterations, Additions and Omissions**

**Variations**

**51.1**

The Engineer shall make any variation of the form, quality or quantity of the Works or any part thereof that may, in his opinion, be necessary and for that purpose, or if for any other reason it shall, in his opinion, be appropriate, he shall have the authority to instruct the Contractor to do and the Contractor shall do any of the following:

- (a) increase or decrease the quantity of any work included in the Contract,
- (b) omit any such work (but not if the omitted work is to be carried out by the Procuring entity/Employer or by another contractor),
- (c) change the character or quality or kind of any such work,
- (d) change the levels, lines, position and dimensions of any part of the Works,
- (e) execute additional work of any kind necessary for the completion of the Works,
- (f) change any specified sequence or timing of construction of any part of the Works.

No such variation shall in any way vitiate or invalidate the Contract, but the effect, if any, of all such variations shall be valued in accordance with Clause 52. Provided that where the issue of an instruction to vary the Works is necessitated by some default of or breach of contract by the Contractor or for which he is responsible, any additional cost attributable to such default shall be borne by the Contractor.

**Instructions for Variations**

**51.2** The Contractor shall not make any such variation without an instruction of the Engineer. Provided that no instruction shall be required for increase or decrease in the quantity of any work where such increase or decrease is not the result of an instruction given under this Clause, but is the result of the quantities exceeding or being less than those stated in the Bill of Quantities.

**Valuation of Variations**

**52.1** All variations referred to in Clause 51 and any additions to the Contract Price which are required to be determined in accordance with Clause 52 (for the purposes of this Clause referred to as "varied work"), shall be valued at the rates and prices set out in the Contract if, in the opinion of the Engineer, the same shall be applicable. If the Contract does not contain any rates or prices applicable to the varied work, the rates and prices in the Contract shall be used as the basis for valuation so far as may be reasonable, failing which, after due consultation by the Engineer with the Procuring entity/Employer and the Contractor, suitable rates or prices shall be agreed upon between the Engineer and the Contractor. In the event of disagreement the Engineer shall fix such rates or prices as are, in his opinion, appropriate and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine

provisional rates or prices to enable on-account payments to be included in certificates issued in accordance with Clause 60.

**Power of Engineer  
to Fix Rates**

**52.2**

Provided that if the nature or amount of any varied work relative to the nature or amount of the whole of the Works or to any part thereof, is such that, in the opinion of the Engineer, the rate or price contained in the Contract for any item of the Works is, by reason of such varied work, rendered inappropriate or inapplicable, then, after due consultation by the Engineer with the Procuring entity/Employer and the Contractor, a suitable rate or price shall be agreed upon between the Engineer and the Contractor. In the event of disagreement the Engineer shall fix such other rate or price as is, in his opinion, appropriate and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on-account payments to be included in certificates issued in accordance with Clause 60.

Provided also that no varied work instructed to be done by the Engineer pursuant to Clause 51 shall be valued under Sub-Clause 52.1 or under this Sub-Clause unless, within 14 days of the date of such instruction and, other than in the case of omitted work, before the commencement of the varied work, notice shall have been given either:

(a) by the Contractor to the Engineer of his intention to claim extra payment or a varied rate or price, or

(b) by the Engineer to the Contractor of his intention to vary a rate or price.

**Variations  
Exceeding 20  
percent**

**52.3**

If, on the issue of the Taking-Over Certificate for the whole of the Works, it is found that as a result of:

(a) all varied work valued under Sub-Clauses 52.1 and 52.2, and

(b) all adjustments upon measurement of the estimated quantities set out in the Bill of Quantities, excluding Provisional Sums, dayworks and adjustments of price made under Clause 70, but not from any other cause, there have been additions to or deductions from the Contract Price which taken together are in excess of 20 percent of the "Effective Contract Price" (which for the purposes of this Sub-Clause shall mean the Contract Price, excluding Provisional Sums and allowance for dayworks, if any) then and in such event (subject to any action already taken under any other Sub-Clause of this Clause), after due consultation by the Engineer with the Procuring entity/Employer and the Contractor, there shall be added to or deducted from the Contract Price such further sum as may be agreed

between the Contractor and the Engineer or, failing agreement, determined by the Engineer having regard to the Contractor's Site and general overhead costs of the Contract. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Procuring entity/Employer. Such sum shall be based only on the amount by which such additions or deductions shall be in excess of 20 percent of the Effective Contract Price.

**Daywork**

**52.4** The Engineer may, if in his opinion it is necessary or desirable, issue an instruction that any varied work shall be executed on a daywork basis. The Contractor shall then be paid for such varied work under the terms set out in the daywork schedule included in the Contract and at the rates and prices affixed thereto by him in the Tender.

The Contractor shall furnish to the Engineer such receipts or other vouchers as may be necessary to prove the amounts paid and, before ordering materials, shall submit to the Engineer quotations for the same for his approval.

In respect of such of the Works executed on a daywork basis, the Contractor shall, during the continuance of such work, deliver each day to the Engineer an exact list in duplicate of the names, occupation and time of all workmen employed on such work and a statement, also in duplicate, showing the description and quantity of all materials and Contractor's Equipment used thereon or therefor other than Contractor's Equipment which is included in the percentage addition in accordance with such daywork schedule. One copy of each list and statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor.

At the end of each month the Contractor shall deliver to the Engineer a priced statement of the labor, materials and Contractor's Equipment, except as aforesaid, used and the Contractor shall not be entitled to any payment unless such lists and statements have been fully and punctually rendered. Provided always that if the Engineer considers that for any reason the sending of such lists or statements by the Contractor, in accordance with the foregoing provision, was impracticable he shall nevertheless be entitled to authorise payment for such work, either as daywork, on being satisfied as to the time employed and the labor, materials and Contractor's Equipment used on such work, or at such value therefor as shall, in his opinion, be fair and reasonable.

**Procedure for Claims**

- Notice of Claims**      **53.1**      Notwithstanding any other provision of the Contract, if the Contractor intends to claim any additional payment pursuant to any Clause of these Conditions or otherwise, he shall give notice of his intention to the Engineer, with a copy to the Procuring entity/Employer, within 28 days after the event giving rise to the claim has first arisen.
- Contemporary Records**      **53.2**      Upon the happening of the event referred to in Sub-Clause 53.1, the Contractor shall keep such contemporary records as may reasonably be necessary to support any claim he may subsequently wish to make. Without necessarily admitting the Procuring entity/Employer's liability, the Engineer shall, on receipt of a notice under Sub-Clause 53.1, inspect such contemporary records and may instruct the Contractor to keep any further contemporary records as are reasonable and may be material to the claim of which notice has been given. The Contractor shall permit the Engineer to inspect all records kept pursuant to this Sub-Clause and shall supply him with copies thereof as and when the Engineer so instructs.
- Substantiation of Claims**      **53.3**      Within 28 days, or such other reasonable time as may be agreed by the Engineer, of giving notice under Sub-Clause 53.1, the Contractor shall send to the Engineer an account giving detailed particulars of the amount claimed and the grounds upon which the claim is based. Where the event giving rise to the claim has a continuing effect, such account shall be considered to be an interim account and the Contractor shall, at such intervals as the Engineer may reasonably require, send further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. In cases where interim accounts are sent to the Engineer, the Contractor shall send a final account within 28 days of the end of the effects resulting from the event. The Contractor shall, if required by the Engineer so to do, copy to the Procuring entity/Employer all accounts sent to the Engineer pursuant to this Sub-Clause.
- Failure to Comply**      **53.4**      If the Contractor fails to comply with any of the provisions of this Clause in respect of any claim which he seeks to make, his entitlement to payment in respect thereof shall not exceed such amount as the Engineer or any arbitrator or arbitrators appointed pursuant to Sub-Clause 67.3 assessing the claim considers to be verified by contemporary records (whether or not such records were brought to the Engineer's notice as required under Sub-Clauses 53.2 and 53.3).
- Payment of Claims**      **53.5**      The Contractor shall be entitled to have included in any interim payment certified by the Engineer pursuant to Clause 60



such amount in respect of any claim as the Engineer, after due consultation with the Procuring entity/Employer and the Contractor, may consider due to the Contractor provided that the Contractor has supplied sufficient particulars to enable the Engineer to determine the amount due. If such particulars are insufficient to substantiate the whole of the claim, the Contractor shall be entitled to payment in respect of such part of the claim as such particulars may substantiate to the satisfaction of the Engineer. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Procuring entity/Employer.

#### **Contractor's Equipment, Temporary Works and Materials**

- |  |             |  |
|--|-------------|--|
| <b>Contractor's Equipment<br/>Temporary Works<br/>and Materials;<br/>Exclusive Use for<br/>the Works</b> | <b>54.1</b> | All Contractor's Equipment, Temporary Works and materials, provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof, except for the purpose of moving it from one part of the Site to another, without the consent of the Engineer. Provided that consent shall not be required for vehicles engaged in transporting any staff, labor, Contractor's Equipment, Temporary Works, Plant or materials to or from the Site. |
| <b>Procuring<br/>entity/Employer not<br/>Liable for Damage</b>   | <b>54.2</b> | The Procuring entity/Employer shall not at any time be liable, save as mentioned in Clauses 20 and 65, for the loss of or damage to any of the said Contractor's Equipment, Temporary Works or materials.  |
| <b>Customs Clearance</b>   | <b>54.3</b> | The Procuring entity/Employer will use his best endeavours in assisting the Contractor, where required, in obtaining clearance through the Customs of Contractor's Equipment, materials and other things required for the Works.   |
| <b>Re-export of<br/>Contractor's<br/>Equipment</b>   | <b>54.4</b> | In respect of any Contractor's Equipment which the Contractor has imported for the purposes of the Works, the Procuring entity/Employer will use his best endeavours to assist the Contractor, where required, in procuring any necessary Government consent to the re-export of such Contractor's Equipment by the Contractor upon the removal thereof pursuant to the terms of the Contract.   |

- Conditions of Hire of Contractor's Equipment**      **54.5**      With a view to securing, in the event of termination under Clause 63, the continued availability, for the purpose of executing the Works, of any hired Contractor's Equipment, the Contractor shall not bring on to the Site any hired Contractor's Equipment unless there is an agreement for the hire thereof (which agreement shall be deemed not to include an agreement for hire purchase) which contains a provision that the owner thereof will, on request in writing made by the Procuring entity/Employer within 7 days after the date on which any termination has become effective, and on the Procuring entity/Employer undertaking to pay all hire charges in respect thereof from such date, hire such Contractor's Equipment to the Procuring entity/Employer on the same terms in all respects as the same was hired to the Contractor save that the Procuring entity/Employer shall be entitled to permit the use thereof by any other contractor employed by him for the purpose of executing and completing the Works and remedying any defects therein, under the terms of the said Clause 63.
- Costs for the Purpose of Clause 63**      **54.6**      In the event of the Procuring entity/Employer entering into any agreement for the hire of Contractor's Equipment pursuant to Sub-Clause 54.5, all sums properly paid by the Procuring entity/Employer under the provisions of any such agreement and all costs incurred by him (including stamp duties) in entering into such agreement shall be deemed, for the purpose of Clause 63, to be part of the cost of executing and completing the Works and the remedying of any defects therein.
- Incorporation of Clause in Subcontracts**      **54.7**      The Contractor shall, where entering into any subcontract for the execution of any part of the Works, incorporate in such subcontract (by reference or otherwise) the provisions of this Clause in relation to Contractor's Equipment, Temporary Works or materials brought on to the Site by the Subcontractor.
- Approval of Materials not Implied**      **54.8**      The operation of this Clause shall not be deemed to imply any approval by the Engineer of the materials or other matters referred to therein nor shall it prevent the rejection of any such materials at any time by the Engineer.
- Measurement**
- Quantities**      **55.1**      The quantities set out in the Bill of Quantities are the estimated quantities for the Works, and they are not to be taken as the actual and correct quantities of the Works to be executed by the Contractor in fulfillment of his obligations under the Contract.
- Works to be**      **56.1**      The Engineer shall, except as otherwise stated, ascertain and

**Measured**

determine by measurement the value of the Works in accordance with the Contract and the Contractor shall be paid that value in accordance with Clause 60. The Engineer shall, when he requires any part of the Works to be measured, give reasonable notice to the Contractor's authorised agent, who shall:

(a) forthwith attend or send a qualified representative to assist the Engineer in making such measurement, and

(b) supply all particulars required by the Engineer.

Should the Contractor not attend, or neglect or omit to send such representative, then the measurement made by the Engineer or approved by him shall be taken to be the correct measurement of such part of the Works. For the purpose of measuring such Permanent Works as are to be measured by records and drawings, the Engineer shall prepare records and drawings as the work proceeds and the Contractor as and when called upon to do so in writing, shall, within 14 days, attend to examine and agree such records and drawings with the Engineer and shall sign the same when so agreed. If the Contractor does not attend to examine and agree such records and drawings, they shall be taken to be correct. If, after examination of such records and drawings, the Contractor does not agree the same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor, within 14 days of such examination, lodges with the Engineer notice of the respects in which such records and drawings are claimed by him to be incorrect. On receipt of such notice, the Engineer shall review the records and drawings and either confirm or vary them.

**Method of Measurement**

**57.1** The Works shall be measured net, notwithstanding any general or local custom, except where otherwise provided for in the Contract.

**Breakdown of Lump Sum Items**

**57.2** For the purposes of statements submitted in accordance with Sub-Clause 60.1, the Contractor shall submit to the Engineer, within 28 days after the receipt of the Letter of Acceptance, a breakdown for each of the lump sum items contained in the Tender. Such breakdowns shall be subject to the approval of the Engineer.

**Provisional Sums****Definition of "Provisional Sum"**

**58.1** "Provisional Sum" means a sum included in the Contract and so designated in the Bill of Quantities for the execution of any part of the Works or for the supply of goods, materials, Plant or services, or for contingencies, which sum may be used, in whole or in part, or not at all, on the instructions of the Engineer. The Contractor shall be entitled to only such amounts in respect of the work, supply or

contingencies to which such Provisional Sums relate as the Engineer shall determine in accordance with this Clause. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Procuring entity/Employer.

**Use of Provisional Sums**      **58.2**      In respect of every Provisional Sum the Engineer shall have authority to issue instructions for the execution of work or for the supply of goods, materials, Plant or services by:

(a) the Contractor, in which case the Contractor shall be entitled to an amount equal to the value thereof determined in accordance with Clause 52,

(b) a nominated Subcontractor, as hereinafter defined, in which case the sum to be paid to the Contractor therefore shall be determined and paid in accordance with Sub-Clause 59.4.

**Production of Vouchers**      **58.3**      The Contractor shall produce to the Engineer all quotations, invoices, vouchers and accounts or receipts in connection with expenditure in respect of Provisional Sums, except where work is valued in accordance with rates or prices set out in the Tender.

#### **Nominated Subcontractors**

**Definition of "Nominated Subcontractors "**      **59.1**      All specialists, merchants, tradesmen and others executing anywork or supplying any goods, materials, Plant or services for which Provisional Sums are included in the Contract, who may have been or be nominated or selected or approved by the Procuring entity/Employer or the Engineer, and all persons to whom by virtue of the provisions of the Contract the Contractor is required to subcontract shall, in the execution of such work or the supply of such goods, materials, Plant or services, be deemed to be subcontractors to the Contractor and are referred to in this Contract as "nominated Subcontractors".

**Nominated Subcontractors; Objection to Nomination**      **59.2**      The Contractor shall not be required by the Procuring entity/Employer or the Engineer, or be deemed to be under any obligation, to employ any nominated Subcontractor, against whom the Contractor may raise reasonable objection, or who declines to enter into a subcontract with the Contractor containing provisions:

(a) that in respect of the work, goods, materials, Plant or services the subject of the subcontract, the nominated Subcontractor will undertake towards the Contractor such obligations and liabilities as will enable the Contractor to discharge his own obligations and liabilities towards the Procuring entity/Employer under the terms of

the Contract and will save harmless and indemnify the Contractor from and against the same and from all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of or in connection therewith, or arising out of or in connection with any failure to perform such obligations or to fulfill such liabilities, and

(b) that the nominated Subcontractor will save harmless and indemnify the Contractor from and against any negligence by the nominated Subcontractor, his agents, workmen and servants and from and against any misuse by him or them of any Temporary Works provided by the Contractor for the purposes of the Contract and from all claims as aforesaid.

**Design  
Requirements to be  
Expressly Stated**

**59.3** If in connection with any Provisional Sum the services to be provided include any matter of design or specification of any part of the Permanent Works or of any Plant to be incorporated therein, such requirement shall be expressly stated in the Contract and shall be included in any nominated Subcontract. The nominated Subcontract shall specify that the nominated Subcontractor providing such services will save harmless and indemnify the Contractor from and against the same and from all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of or in connection with any failure to perform such obligations or to fulfil such liabilities.

**Payments to  
Nominated  
Subcontractors**

**59.4** For all work executed or goods, materials, Plant or services supplied by any nominated Subcontractor, the Contractor shall be entitled to:

(a) the actual price paid or due to be paid by the Contractor, on the instructions of the Engineer, and in accordance with the subcontract;

(b) in respect of labor supplied by the Contractor, the sum, if any, entered in the Bill of Quantities or, if instructed by the Engineer pursuant to paragraph (a) of Sub-Clause 58.2, as may be determined in accordance with Clause 52;

(c) in respect of all other charges and profit, a sum being a percentage rate of the actual price paid or due to be paid calculated, where provision has been made in the Bill of Quantities for a rate to be set against the relevant Provisional Sum, at the rate inserted by the Contractor against that item or, where no such provision has been made, at the rate inserted by the Contractor in the Appendix to Tender and repeated where provision for such is made in a special item provided in the Bill of Quantities for such purpose.

**Certification of**

**59.5** Before issuing, under Clause 60, any certificate, which includes any

**Payments to  
Nominated  
Subcontractors**

payment in respect of work done or goods, materials, Plant or services supplied by any nominated Subcontractor, the Engineer shall be entitled to demand from the Contractor reasonable proof that all payments, less retentions, included in previous certificates in respect of the work or goods, materials, Plant or services of such nominated Subcontractor have been paid or discharged by the Contractor. If the Contractor fails to supply such proof then, unless the Contractor

(a) satisfies the Engineer in writing that he has reasonable cause for withholding or refusing to make such payments and

(b) produces to the Engineer reasonable proof that he has so informed such nominated Subcontractor in writing,

the Procuring entity/Employer shall be entitled to pay to such nominated Subcontractor direct, upon the certificate of the Engineer, all payments, less retentions, provided for in the nominated Subcontract, which the Contractor has failed to make to such nominated Subcontractor and to deduct by way of set-off the amount so paid by the Procuring entity/Employer from any sums due or to become due from the Procuring entity/Employer to the Contractor.

Provided that, where the Engineer has certified and the Procuring entity/Employer has paid direct as aforesaid, the Engineer shall, in issuing any further certificate in favour of the Contractor, deduct from the amount thereof the amount so paid, direct as aforesaid, but shall not withhold or delay the issue of the certificate itself when due to be issued under the terms of the Contract.

**Certificates and Payment****Monthly Statements 60.1**

The Contractor shall submit to the Engineer after the end of each month six copies, each signed by the Contractor's representative approved by the Engineer in accordance with Sub-Clause 15.1, of a statement, in such form as the Engineer may from time to time prescribe, showing the amounts to which the Contractor considers himself to be entitled up to the end of the month in respect of

(a) the value of the Permanent Works executed

(b) any other items in the Bill of Quantities including those for Contractor's Equipment, Temporary Works, dayworks and the like

(c) the percentage of the invoice value of listed materials, all as stated in the Appendix to Tender, and Plant delivered by the Contractor on the Site for incorporation in the Permanent Works but

not incorporated in such Works

(d) adjustments under Clause 70

(e) any other sum to which the Contractor may be entitled under the Contract.

**Monthly Payments**      **60.2**      The Engineer shall, within 28 days of receiving such statement, certify to the Procuring entity/Employer the amount of payment to the Contractor which he considers due and payable in respect thereof, subject:

(a) firstly, to the retention of the amount calculated by applying the Percentage of Retention stated in the Appendix to Tender (10%), to the amount to which the Contractor is entitled under paragraphs (a), (b), (c) and (e) of Sub-Clause 60.1 until the amount so retained reaches the Limit of Retention Money stated in the Appendix to Tender 5% of the contract price, and

(b) secondly, to the deduction, other than pursuant to Clause 47, of any sums which may have become due and payable by the Contractor to the Procuring entity/Employer.

Provided that the Engineer shall not be bound to certify any payment under this Sub-Clause if the net amount thereof, after all retentions and deductions, would be less than the Minimum Amount of Interim Certificates stated in the Appendix to Tender (Rs. 1.5 million).

Notwithstanding the terms of this Clause or any other Clause of the Contract no amount will be certified by the Engineer for payment until the performance security 10% of contract price, if required under the Contract, has been provided by the Contractor and approved by the Procuring entity/Employer.

**Payment of Retention Money**      **60.3**      (a) Upon the issue of the Taking-Over Certificate with respect to the whole of the Works, one half of the Retention Money, or upon the issue of a Taking-Over Certificate with respect to a Section or part of the Permanent Works only such proportion thereof as the Engineer determines having regard to the relative value of such Section or part of the Permanent Works, shall be certified by the Engineer for payment to the Contractor.

(b) Upon the expiration of the Defects Liability Period for the Works the other half of the Retention Money shall be certified by the Engineer for payment to the Contractor. Provided that, in the event of different Defects Liability Periods having become applicable to different Sections or parts of the Permanent Works

pursuant to Clause 48, the expression "expiration of the Defects Liability Period" shall, for the purposes of this Sub-Clause, be deemed to mean the expiration of the latest of such periods. Provided also that if at such time, there shall remain to be executed by the Contractor any work ordered, pursuant to Clauses 49 and 50, in respect of the Works, the Engineer shall be entitled to withhold certification until completion of such work of so much of the balance of the Retention Money as shall, in the opinion of the Engineer, represent the cost of the work remaining to be executed.

**Correction of  
Certificates**

**60.4** The Engineer may by any interim certificate make any correction or modification in any previous certificate which shall have been issued by him and shall have authority, if any work is not being carried out to his satisfaction, to omit or reduce the value of such work in any interim certificate.

**Statement at  
Completion**

**60.5** Not later than 84 days after the issue of the Taking-Over Certificate in respect of the whole of the Works, the Contractor shall submit to the Engineer a Statement at Completion with supporting documents showing in detail, in the form approved by the Engineer,

(a) the final value of all work done in accordance with the Contract up to the date stated in such Taking-Over Certificate

(b) any further sums which the Contractor considers to be due and

(c) an estimate of amounts which the Contractor considers will become due to him under the Contract.

The estimated amounts shall be shown separately in such Statement at Completion. The Engineer shall certify payment in accordance with Sub-Clause 60.2.

**Final Statement**

**60.6** Not later than 56 days after the issue of the Defects Liability Certificate pursuant to Sub-Clause 62.1, the Contractor shall submit to the Engineer for consideration a draft final statement with supporting documents showing in detail, in the form approved by the Engineer,

(a) the value of all work done in accordance with the Contract and

(b) Any further sums which the Contractor considers to be due to him under the Contract.

If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require and shall make such



changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed (for the purposes of these Conditions referred to as the "Final Statement").

- Discharge**                      **60.7**      Upon submission of the Final Statement, the Contractor shall give to the Procuring entity/Employer, with a copy to the Engineer, a written discharge confirming that the total of the Final Statement represents full and final settlement of all monies due to the Contractor arising out of or in respect of the Contract. Provided that such discharge shall become effective only after payment due under the Final Certificate issued pursuant to Sub-Clause 60.8 has been made and the performance security referred to in Sub-Clause 10.1, if any, has been returned to the Contractor.
- Final Certificate**                **60.8**      Within 28 days after receipt of the Final Statement, and the written discharge, the Engineer shall issue to the Procuring entity/Employer (with a copy to the Contractor) a Final Certificate stating
- (a) the amount which, in the opinion of the Engineer, is finally due under the Contract, and
- (b) after giving credit to the Procuring entity/Employer for all amounts previously paid by the Procuring entity/Employer and for all sums to which the Procuring entity/Employer is entitled under the Contract, other than Clause 47, the balance, if any, due from the Procuring entity/Employer to the Contractor or from the Contractor to the Procuring entity/Employer as the case may be.
- Cessation of Procuring entity/Employer's Liability**                      **60.9**      The Procuring entity/Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or execution of the Works, unless the Contractor shall have included a claim in respect thereof in his Final Statement and (except in respect of matters or things arising after the issue of the Taking-Over Certificate in respect of the whole of the Works) in the Statement at Completion referred to in Sub-Clause 60.5.
- Time for Payment**              **60.10**      The amount due to the Contractor under any interim certificate issued by the Engineer pursuant to this Clause, or to any other term of the Contract, shall, subject to Clause 47, be paid by the Procuring entity/Employer to the Contractor within 28 days after such interim certificate has been delivered to the Procuring entity/Employer, or, in the case of the Final Certificate referred to in Sub-Clause 60.8, within 56 days, after such Final Certificate has been delivered to the Procuring entity/Employer. In the event of the failure of the Procuring entity/Employer to make payment within the times stated, the

Procuring entity/Employer shall pay to the Contractor interest at the rate stated in the Appendix to Tender upon all sums unpaid from the date by which the same should have been paid. The provisions of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69.

**Approval only by Defects Liability Certificate**      **61.1**      Only the Defects Liability Certificate, referred to in Clause 62, shall be deemed to constitute approval of the Works.

**Defects Liability Certificate**      **62.1**      The Contract shall not be considered as completed until a Defects Liability Certificate shall have been signed by the Engineer and delivered to the Procuring entity/Employer, with a copy to the Contractor, stating the date on which the Contractor shall have completed his obligations to execute and complete the Works and remedy any defects therein to the Engineer's satisfaction. The Defects Liability Certificate shall be given by the Engineer within 28 days after the expiration of the Defects Liability Period, or, if different defects liability periods shall become applicable to different Sections or parts of the Permanent Works, the expiration of the latest such period, or as soon thereafter as any works instructed, pursuant to Clauses 49 and 50, have been completed to the satisfaction of the Engineer. Provided that the issue of the Defects Liability Certificate shall not be a condition precedent to payment to the Contractor of the second portion of the Retention Money in accordance with the conditions set out in Sub-Clause 60.3.

**Unfulfilled Obligations**      **62.2**      Notwithstanding the issue of the Defects Liability Certificate the Contractor and the Procuring entity/Employer shall remain liable for the fulfillment of any obligation incurred under the provisions of the Contract prior to the issue of the Defects Liability Certificate which remains unperformed at the time such Defects Liability Certificate is issued and, for the purposes of determining the nature and extent of any such obligation, the Contract shall be deemed to remain in force between the parties to the Contract.

#### **Remedies**

**Default of Contractor**      **63.1**      If the Contractor is deemed by law unable to pay his debts as they fall due, or enters into voluntary or involuntary bankruptcy, liquidation or dissolution (Other than a voluntary liquidation for the purposes of amalgamation or reconstruction), or becomes insolvent, or makes an arrangement with, or assignment in favour of, his creditors, or agrees to carry out the Contract under a committee of

inspection of his creditors, or if a receiver, administrator, trustee or liquidator is appointed over any substantial part of his assets, or if, under any law or regulation relating to reorganization, arrangement or readjustment of debts, proceedings are commenced against the Contractor or resolutions passed in connection with dissolution or liquidation or if any steps are taken to enforce any security interest over a substantial part of the assets of the Contractor, or if any act is done or event occurs with respect to the Contractor or his assets which, under any applicable law has a substantially similar effect to any of the foregoing acts or events, or if the Contractor has contravened Sub-Clause 3.1, or has an execution levied on his goods, or if the Engineer certifies to the Procuring entity/Employer, with a copy to the Contractor, that, in his opinion, the Contractor:

- (a) has repudiated the Contract, or
- (b) without reasonable excuse has failed
  - (i) to commence the Works in accordance with Sub-Clause 41.1, or
  - ii) to proceed with the Works, or any Section thereof, within 28 days after receiving notice pursuant to Sub-Clause 46.1, or
- (c) has failed to comply with a notice issued pursuant to Sub-Clause 37.4 or an instruction issued pursuant to Sub-Clause 39.1 within 28 days after having received it, or
- (d) despite previous warning from the Engineer, in writing, is otherwise persistently or flagrantly neglecting to comply with any of his obligations under the Contract, or
- (e) has contravened Sub-Clause 4.1,

then the Procuring entity/Employer may, after giving 14 days' notice to the Contractor, enter upon the Site and the Works and terminate the employment of the Contractor without thereby releasing the Contractor from any of his obligations or liabilities under the Contract, or affecting the rights and authorities conferred on the Procuring entity/Employer or the Engineer by the Contract, and may himself complete the Works or may employ any other contractor to complete the Works. The Procuring entity/Employer or such other contractor may use for such completion so much of the Contractor's Equipment, Temporary Works and materials as he or they may think proper.

**Valuation at Date of Termination 63.2**

The Engineer shall, as soon as may be practicable after any such entry and termination by the Procuring entity/Employer, fix and determine exparte, or by or after

reference to the parties or after such investigation or enquiries as he may think fit to make or institute, and shall certify:

(a) what amount (if any) had, at the time of such entry and termination, been reasonably earned by or would reasonably accrue to the Contractor in respect of work then actually done by him under the Contract, and

(b) the value of any of the said unused or partially used materials, any Contractor's Equipment and any Temporary Works.

**Payment after  
Termination**

**63.3** If the Procuring entity/Employer terminates the Contractor's employment under this Clause, he shall not be liable to pay to the Contractor any further amount (including damages) in respect of the Contract until the expiration of the Defects Liability Period and thereafter until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any) and all other expenses incurred by the Procuring entity/Employer have been ascertained and the amount thereof certified by the Engineer. The Contractor shall then be entitled to receive only such sum (if any) as the Engineer may certify would have been payable to him upon due completion by him after deducting the said amount. If such amount exceeds the sum which would have been payable to the Contractor on due completion by him, then the Contractor shall, upon demand, pay to the Procuring entity/Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Procuring entity/Employer and shall be recoverable accordingly.

**Assignment of  
Benefit of  
Agreement**

**63.4** Unless prohibited by law, the Contractor shall, if so instructed by the Engineer within 14 days of such entry and termination referred to in Sub-Clause 63.1, assign to the Procuring entity/Employer the benefit of any agreement for the supply of any goods or materials or services and/or for the execution of any work for the purposes of the Contract, which the Contractor may have entered into.

**Urgent Remedial  
Work**

**64.1** If, by reason of any accident, or failure, or other event occurring to, in, or in connection with the Works, or any part thereof, either during the execution of the Works, or during the Defects Liability Period, any remedial or other work is, in the opinion of the Engineer, urgently necessary for the safety of the Works and the Contractor is unable or unwilling at once to do such work, the Procuring entity/Employer shall be entitled to employ and pay other persons to carry out such work as the Engineer may consider necessary. If the work or repair so done by the Procuring

entity/Employer is work which, in the opinion of the Engineer, the Contractor was liable to do at his own cost under the Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Procuring entity/Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Procuring entity/Employer, and may be deducted by the Procuring entity/Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer. Provided that the Engineer shall as soon after the occurrence of any such emergency as may be reasonably practicable, notify the Contractor thereof.

### **Special Risks**

#### **No Liability for Special Risks**

**65.1** The Contractor shall be under no liability whatsoever in consequence of any of the special risks referred to in Sub-Clause 65.2, whether by way of indemnity or otherwise, for or in respect of:

(a) destruction of or damage to the Works, save to work condemned under the provisions of Clause 39 prior to the occurrence of any of the said special risks, or

(b) destruction of or damage to property, whether of the Procuring entity/Employer or third parties, or

(c) injury or loss of life.

#### **Special Risks**

**65.2** The special risks are:

(a) the risks defined under paragraphs (a), (c), (d) and (e) of Sub-Clause 20.4, and

(b) the risks defined under paragraph (b) of Sub-Clause 20.4 insofar as these relate to the country in which the Works are to be executed.

#### **Damage to Works by Special Risks**

**65.3** If the Works or any materials or Plant on or near or in transit to the Site, or any of the Contractor's Equipment, sustain destruction or damage by reason of any of the said special risks, the Contractor shall be entitled to payment in accordance with the Contract for any Permanent Works duly executed and for any materials or Plant so destroyed or damaged and, so far as may be required by the Engineer or as may be necessary for the completion of the Works. to payment for:

(a) rectifying any such destruction or damage to the Works, and

- (b) replacing or rectifying such materials or Contractor's Equipment
- and the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 (which shall in the case of the cost of replacement of Contractor's Equipment include the fair market value thereof as determined by the Engineer) and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.
- Projectile, Missile**      **65.4**      Destruction, damage, injury or loss of life caused by the explosion or impact, whenever and wherever occurring, of any mine, bomb, shell, grenade, or other projectile, missile, munitions, or explosive of war, shall be deemed to be a consequence of the said special risks.
- Increased Costs arising from Special Risks**      **65.5**      Save to the extent that the Contractor is entitled to payment under any other provision of the Contract, the Procuring entity/Employer shall repay to the Contractor any costs of the execution of the Works (other than such as may be attributable to the cost of reconstructing work condemned under the provisions of Clause 39 prior to the occurrence of any special risk) which are howsoever attributable to or consequent on or the result of or in any way whatsoever connected with the said special risks, subject however to the provisions in this Clause hereinafter contained in regard to outbreak of war, but the Contractor shall, as soon as any such cost comes to his knowledge, forthwith notify the Engineer thereof. The Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine the amount of the Contractor's costs in respect thereof which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.
- Outbreak of war**      **65.6**      If, during the currency of the Contract, there is an outbreak of war, whether war is declared or not, in any part of the world which, whether financially or otherwise, materially affects the execution of the Works, the Contractor shall, unless and until the Contract is terminated under the provisions of this Clause, continue to use his best endeavors to complete the execution of the Works. Provided that the Procuring entity/Employer shall be entitled, at any time after such outbreak of war, to terminate the Contract by giving notice to the Contractor and, upon such notice being given, the Contract shall, except as to the rights of the parties under this Clause and to the operation of Clause 67, terminate, but without prejudice to the rights of either party in respect of any antecedent breach thereof.
- Removal of**      **65.7**      If the Contract is terminated under the provisions of Sub-Clause

**Contractor's  
Equipment on  
Termination**

65.6, the Contractor shall, with all reasonable dispatch, remove from the Site all Contractor's Equipment and shall give similar facilities to his Subcontractors to do so.

**Payment if Contract  
Terminated 65.8**

If the Contract is terminated as aforesaid, the Contractor shall be paid by the Procuring entity/Employer, insofar as such amounts or items have not already been covered by payments on account made to the Contractor, for all work executed prior to the date of termination at the rates and prices provided in the Contract and in addition:

(a) The amounts payable in respect of any preliminary items referred to in the Bill of Quantities, so far as the work or service comprised therein has been carried out or performed, and a proper proportion of any such items which have been partially carried out or performed.

(b) The cost of materials, Plant or goods reasonably ordered for the Works which have been delivered to the Contractor or of which the Contractor is legally liable to accept delivery, such materials, Plant or goods becoming the property of the Procuring entity/Employer upon such payments being made by him.

(c) A sum being the amount of any expenditure reasonably incurred by the Contractor in the expectation of completing the whole of the Works insofar as such expenditure has not been covered by any other payments referred to in this Sub-Clause.

(d) Any additional sum payable under the provisions of Sub-Clauses 65.3 and 65.5.

(e) Such proportion of the cost as may be reasonable, taking into account payments made or to be made for work executed, of removal of Contractor's Equipment under Sub-Clause 65.7 and, if required by the Contractor, return thereof to the Contractor's main plant yard in his country of registration Or to other destination, at no greater cost.

(f) The reasonable cost of repatriation of all the Contractor's staff and workmen employed on or in connection with the Works at the time of such termination

Provided that against any payment due from the Procuring entity/Employer under this Sub-Clause, the Procuring entity/Employer shall be entitled to be credited with any outstanding balances due from the Contractor for advances in respect of Contractor's Equipment, materials and Plant and any other sums

which, at the date of termination, were recoverable by the Procuring entity/Employer from the Contractor under the terms of the Contract. Any sums payable under this Sub-Clause shall, after due consultation with the Procuring entity/Employer and the Contractor, be determined by the Engineer who shall notify the Contractor accordingly with a copy to the Procuring entity/Employer.

#### **Release from Performance**

#### **Payment in Event of Release from Performance**

**66.1** If any circumstance outside the control of both parties arises after the issue of the Letter of Acceptance which renders it impossible or unlawful for either party to fulfill his contractual obligations, or under the law governing the Contract the parties are released from further performance, then the sum payable by the Procuring entity/Employer to the Contractor in respect of the work executed shall be the same as that which would have been payable under Clause 65 if the Contract had been terminated under the provisions of Clause 65.

#### **Settlement of Disputes**

#### **Engineer's Decision**

**67.1** If a dispute of any kind whatsoever arises between the Procuring entity/Employer and the Contractor in connection with, or arising out of, the Contract or the execution of the Works, whether during the execution of the Works or after their completion and whether before or after repudiation or other termination of the Contract, including any dispute as to any opinion, instruction, determination, certificate or valuation of the Engineer, the matter in dispute shall, in the first place, be referred in writing to the Engineer, with a copy to the other party. Such reference shall state that it is made pursuant to this Clause. No later than the eighty-fourth day after the day on which he received such reference the Engineer shall give notice of his decision to the Procuring entity/Employer and the Contractor. Such decision shall state that it is made pursuant to this Clause.

Unless the Contract has already been repudiated or terminated, the Contractor shall, in every case, continue to proceed with the Works with all due diligence and the Contractor and the Procuring entity/Employer shall give effect forthwith to every such decision of the Engineer unless and until the same shall be revised, as hereinafter provided, in an amicable settlement or an arbitral award.

If either the Procuring entity/Employer or the Contractor be dissatisfied with any decision of the Engineer, or if the Engineer fails to give notice of his decision on or before the eighty-fourth day after the day on which he received the reference, then either the Procuring entity/Employer or the Contractor may, on or before the



seventieth day after the day on which he received notice of such decision, or on or before the seventieth day after the day on which the said period of 84 days expired, as the case may be, give notice to the other party, with a copy for information to the Engineer, of his intention to commence arbitration, as hereinafter provided, as to the matter in dispute. Such notice shall establish the entitlement of the party giving the same to commence arbitration, as hereinafter provided, as to such dispute and, subject to Sub-Clause 67.4, no arbitration in respect thereof may be commenced unless such notice is given.

If the Engineer has given notice of his decision as to a matter in dispute to the Procuring entity/Employer and the Contractor and no notice of intention to commence arbitration as to such dispute has been given by either the Procuring entity/Employer or the Contractor on or before the seventieth day after the day on which the parties received notice as to such decision from the Engineer, the said decision shall become final and binding upon the Procuring entity/Employer and the Contractor.

**Amicable  
Settlement**

**67.2** Where notice of intention to commence arbitration as to a dispute has been given in accordance with Sub-Clause 67.1, arbitration of such dispute shall not be commenced unless an attempt has first been made by the parties to settle such dispute amicably. Provided that, unless the parties otherwise agree, arbitration may be commenced on or after the fifty-sixth day after the day on which notice of intention to commence arbitration of such dispute was given, whether or not any attempt at amicable settlement thereof has been made.

**Arbitration**

**67.3** Any dispute in respect of which:

(a) the decision, if any, of the Engineer has not become final and binding pursuant to Sub-Clause 67.1, and

(b) amicable settlement has not been reached within the period stated in Sub-Clause 67.2

shall be finally settled, unless otherwise specified in the Contract, under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed under such Rules. The said arbitrator/s shall have full power to open up, review and revise any decision, opinion, instruction, determination, certificate or valuation of the Engineer related to the dispute.

Neither party shall be limited in the proceedings before such arbitrator/s to the evidence or arguments put before the Engineer for

the purpose of obtaining his said decision pursuant to Sub-Clause 67.1. No such decision shall disqualify the Engineer from being called as a witness and giving evidence before the arbitrator/s on any matter whatsoever relevant to the dispute.

Arbitration may be commenced prior to or after completion of the Works, provided that the obligations of the Procuring entity/Employer, the Engineer and the Contractor shall not be altered by reason of the arbitration being conducted during the progress of the Works.

- Failure to Comply with Engineer's Decision**      **67.4**      Where neither the Procuring entity/Employer nor the Contractor has given notice of intention to commence arbitration of a dispute within the period stated in Sub-Clause 67.1 and the related decision has become final and binding, either party may, if the other party fails to comply with such decision, and without prejudice to any other rights it may have, refer the failure to arbitration in accordance with Sub-Clause 67.3. The provisions of Sub-Clauses 67.1 and 67.2 shall not apply to any such reference.

#### **Notices**

- Notice to Contractor**      **68.1**      All certificates, notices or instructions to be given to the Contractor by the Procuring entity/Employer or the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the Contractor's principal place of business or such other address as the Contractor shall nominate for that purpose.
- Notice to Procuring entity/Employer and Engineer**      **68.2**      Any notice to be given to the Procuring entity/Employer or to the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the respective addresses nominated for that purpose in Part II of these Conditions.

- Change of Address**      **68.3**      Either party may change a nominated address to another address in the country where the Works are being executed by prior notice to the other party, with a copy to the Engineer, and the Engineer may do so by prior notice to both parties.

#### **Default of Procuring entity/Employer**

- Default of Procuring entity/Employer**      **69.1**      In the event of the Procuring entity/Employer:
- (a) failing to pay to the Contractor the amount due under any certificate of the Engineer within 28 days after the expiry of the time stated in Sub-Clause 60.10 within which payment is to be made, subject to any deduction that the Procuring entity/Employer is

entitled to make under the Contract, or

(b) interfering with or obstructing or refusing any required approval to the issue of any such certificate, or

(c) becoming bankrupt or, being a company, going into liquidation, other than for the purpose of a scheme of reconstruction or amalgamation, or

(d) giving notice to the Contractor that for unforeseen reasons, due to economic dislocation, it is impossible for him to continue to meet his contractual obligations

the Contractor shall be entitled to terminate his employment under the Contract by giving notice to the Procuring entity/Employer, with a copy to the Engineer. Such termination shall take effect 14 days after the giving of the notice.

**Removal of  
Contractor's  
Equipment**

**69.2** Upon the expiry of the 14 days' notice referred to in Sub-Clause 69.1, the Contractor shall, notwithstanding the provisions of Sub-Clause 54.1, with all reasonable despatch, remove from the Site all Contractor's Equipment brought by him thereon.

**Payment on  
Termination**

**69.3** In the event of such termination the Procuring entity/Employer shall be under the same obligations to the Contractor in regard to payment as if the Contract had been terminated under the provisions of Clause 65, but, in addition to the payments specified in Sub-Clause 65.8, the Procuring entity/Employer shall pay to the Contractor the amount of any loss or damage to the Contractor arising out of or in connection with or by consequence of such termination.

**Contractor's  
Entitlement to  
Suspend Work**

**69.4** Without prejudice to the Contractor's entitlement to interest under Sub-Clause 60.10 and to terminate under Sub-Clause 69.1, the Contractor may, if the Procuring entity/Employer fails to pay the Contractor the amount due under any certificate of the Engineer within 28 days after the expiry of the time stated in Sub-Clause 60.10 within which payment is to be made, subject to any deduction that the Procuring entity/Employer is entitled to make under the Contract, after giving 28 days' prior notice to the Procuring entity/Employer, with a copy to the Engineer, suspend work or reduce the rate of work.

If the Contractor suspends work or reduces the rate of work in accordance with the provisions of this Sub-Clause and thereby suffers delay or incurs cost the Engineer shall, after due consultation with the Procuring entity/Employer and the Contractor, determine

(a) any extension of time to which the Contractor is entitled under Clause 44, and

(b) the amount of such costs, which shall be added to the Contract Price,

and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Resumption of Work**

**69.5** Where the Contractor suspends work or reduces the rate of work, having given notice in accordance with Sub-Clause 69.4, and the Procuring entity/Employer subsequently pays the amount due, including interest pursuant to Sub-Clause 60.10, the Contractor's entitlement under Sub-Clause 69.1 shall, if notice of termination has not been given, lapse and the Contractor shall resume normal working as soon as is reasonably possible.

**Changes in Cost and Legislation**

**Increase or Decrease of Cost**

**70.1** There shall be added to or deducted from the Contract Price such sums in respect of rise or fall in the cost of labor and/or materials or any other matters affecting the cost of the execution of the Works as may be determined in accordance with Part II of these Conditions.

**Subsequent Legislation**

**70.2** If, after the date 28 days prior to the latest date for submission of tenders for the Contract there occur in the country in which the Works are being or are to be executed changes to any National or State Statute, Ordinance, Decree or other Law or any regulation or bye-law of any local or other duly constituted authority, or the introduction of any such State Statute, Ordinance, Decree, Law, regulation or bye-law which causes additional or reduced cost to the Contractor, other than under Sub-Clause 70.1, in the execution of the Contract, such additional or reduced cost shall, after due consultation with the Procuring entity/Employer and the Contractor, be determined by the Engineer and shall be added to or deducted from the Contract Price and the Engineer shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.

**Currency and Rates of Exchange**

**Currency Restrictions**

**71.1** If, after the date 28 days prior to the latest date for submission of tenders for the Contract, the Government or authorised agency of the Government of the country in which the Works are being or are to be executed imposes currency restrictions and/or transfer of currency restrictions in relation to the currency or currencies in

which the Contract Price is to be paid, the Procuring entity/Employer shall reimburse any loss or damage to the Contractor arising therefrom, without prejudice to the right of the Contractor to exercise any other rights or remedies to which he is entitled in such event.

- Rates of Exchange**      **72.1**      Where the Contract provides for payment in whole or in part to be made to the Contractor in foreign currency or currencies, such payment shall not be subject to variations in the rate or rates of exchange between such specified foreign currency or currencies and the currency of the country in which the Works are to be executed.
- Currency Proportions**      **72.2**      Where the Procuring entity/Employer has required the Tender to be expressed in a single currency but with payment to be made in more than one currency and the Contractor has stated the proportions or amounts of other currency or currencies in which he requires payment to be made, the rate or rates of exchange applicable for calculating the payment of such proportions or amounts shall, unless otherwise stated in Part II of these Conditions, be those prevailing, as determined by the Central Bank of the country in which the Works are to be executed, on the date 28 days prior to the latest date for the submission of tenders for the Contract, as has been notified to the Contractor by the Procuring entity/Employer prior to the submission of tenders or as provided for in the Tender.
- Currencies of Payment for Provisional Sums**      **72.3**      Where the Contract provides for payment in more than one currency, the proportions or amounts to be paid in foreign currencies in respect of Provisional Sums shall be determined in accordance with the principles set forth in Sub-Clauses 72.1 and 72.2 as and when these sums are utilized in whole or in part in accordance with the provisions of Clauses 58 and 59.

**PARTICULAR CONDITIONS OF  
CONTRACT  
PART - II**

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**PART II - PARTICULAR CONDITIONS OF CONTRACT****1.1 Definitions**

(a) (i) The Procuring entity/Employer is Director General of Small Dam to Govt. of Khyber Pakhtunkhwa, Irrigation Department Peshawar and with his Representative who is **Project Director** PSU Small Dam Merged Area, Directorate General Small Dam Irrigation Department Khyber Pakhtunkhwa Hayatabad Peshawar

(a) (ii) The Engineer is Project Director PSU Small Dam merged area Irrigation Department Khyber Pakhtunkhwa

Or any other competent person appointed by the Procuring Entity / Employer, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineers is to formulate his certifications/recommendations in relation to all outstanding matters, disputes and claims relating to the execution of the Works during his tenure

(a)(iii) Engineer Representative (Project manager supervisory Consultant)

(a)(iv) "Bidder or Tenderer" means any person or persons, company, corporation, firm or joint venture submitting a Bid or Tender.

(b)(i) The following is added at the end of the paragraph:

The word "Tender" is synonymous with "Bid" and the word "Tender Documents" with "Bidding Documents".

The following paragraph is added:

(b)(ii) "Programme" means the programme to be submitted by the Contractor in accordance with Sub-Clause 14.1 and any approved revisions thereto.

(e)(i) The text is deleted and substituted with the following:

“Contract Price” means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works subject to such additions thereto or deductions there from as may be made and remedying of any defects therein in accordance with the provisions of the Contract.

## 2.1 Engineer's Duties and Authority

With reference to Sub-Clause 2.1(b), the following provisions shall also apply;

The Engineer shall obtain the specific approval of the Procuring entity/Employer before carrying out his duties in accordance with the following Clauses:

- (i) Consenting to the sub-letting of any part of the Works under Sub-Clause 4.1 “Subcontracting”.
- (ii) Certifying additional cost determined under Sub-Clause 12.2 “Not Foreseeable Physical Obstructions or Conditions”.
- (iii) Any action under Clause 10 “Performance Security” and Clauses 21,23,24 & 25 “Insurance” of sorts.
- (iv) Any action under Clause 40 “Suspension”.
- (v) Any action under Clause 44 “Extension of Time for Completion”.
- (vi) Any action under Clause 47 “Liquidated Damages for Delay” or Payment of Bonus for Early Completion of Works (PCC Sub-Clause 47.3).
- (vii) Issuance of “Taking Over Certificate” under Clause 48.
- (viii) Issuing a Variation Order under Clause 51, except:
  - a) in an emergency\* situation, as stated here below, or
  - b) if such variation would increase the Contract Price by less than the amount stated in the Appendix-A to Bid.
- (ix) Fixing rates or prices under Clause 52.
- (x) Extra payment as a result of Contractor’s claims under Clause 53.
- (xi) Release of Retention Money to the Contractor under Sub-Clause 60.3 “Payment of Retention Money”.
- (xii) Issuance of “Final Payment Certificate” under Sub-Clause 60.8.
- (xiii) Issuance of “Defect Liability Certificate” under Sub-Clause 62.1.

- (xiv) Any change in the ratios of Contract currency proportions and payments thereof under Clause 72 “Currency and Rate of Exchange”.

(Note: Procuring entity/Employer may further vary according to need of the project)

\* (If in the opinion of the Engineer an emergency occurs affecting the safety of life or of the Works or of adjoining property, the Engineer may, without relieving the Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Procuring entity/Employer.)

## **2.2 Engineer’s Representative**

The following paragraph is added:

The Procuring entity/Employer shall ensure that the Engineer’s Representative is a professional engineer as defined in the Pakistan Engineering Council Act 1975 (V of 1976)

The following Sub-Clauses 2.7 and 2.8 are added:

## **2.7 Engineer Not Liable**

Approval, reviews and inspection by the Engineer of any part of the Works does not relieve the Contractor from his sole responsibility and liability for the supply of materials, plant and equipment for construction of the Works and their parts in accordance with the Contract and neither the Engineer's authority to act nor any decision made by him in good faith as provided for under the Contract whether to exercise or not to exercise such authority shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, any of their representatives or employees or any other person performing any portion of the Works.

## **2.8 Replacement of the Engineer**

“If the Procuring entity/Employer intends to replace the Engineer, the Procuring entity/Employer shall, not less than 14 days before the intended date of replacement, give notice to the Contractor, of the name, address and relevant experience of the intended replacement Engineer. The Procuring entity/Employer shall not replace the

Engineer with a person against whom the Contractor raises reasonable objection by notice to the Procuring entity/Employer, with supporting particulars.”

### **5.1 Language(s) and Law**

- (a) The Contract Documents shall be drawn up in the English language.
- (b) The Contract shall be subject to the Laws of Islamic Republic of Pakistan.

### **5.2 Priority of Contract Documents**

The documents listed at (1) to (6) of the Sub-Clause are deleted and substituted with the following:

- (1) The Contract Agreement (if completed);
- (2) The Letter of Acceptance;
- (3) The completed Form of Bid;
- (4) Special Stipulations (Appendix-A to Bid);
- (5) The Particular Conditions of Contract – Part II;
- (6) The General Conditions – Part I;
- (7) The priced Bill of Quantities (Appendix-D to Bid);
- (8) The completed Appendices to Bid (B, C, E to L);
- (9) The Drawings;
- (10) The Specifications; and
- (11) \_\_\_\_\_ (any other).

In case of discrepancies between drawings, those of larger scale shall govern unless they are superseded by a drawing of later date regardless of scale. All Drawings and Specifications shall be interpreted in conformity with the Contract and these Conditions. Addendum, if any, shall be deemed to have been incorporated at the appropriate places in the documents forming the Contract.

The following Sub-Clauses 6.6 and 6.7 are added:

### **6.6 Shop Drawings**

The Contractor shall submit to the Engineer for review 3 copies of all shop and erection drawings applicable to this Contract as per provision of relevant Sub-Clause of the Contract.

Review and approval by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory and that the Engineer's review or approval shall not relieve the Contractor of any of his responsibilities under the Contract.

#### **6.7 As-Built Drawings**

At the completion of the Works under the Contract, the Contractor shall furnish to the Engineer 6 copies and one **reproducible** of all drawings amended to conform with the Works as built. The price of such Drawings shall be deemed to be included in the Contract Price.

#### **10.1 Performance Security**

The text is deleted and substituted with the following:

The Contractor shall provide Performance Security to the Procuring entity/Employer in the prescribed form. The said Security shall be furnished or caused to be furnished by the Contractor within 28 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 10% of the Contract Price stated in the Letter of Acceptance. Such Security shall be in the form of bank guarantee from any Scheduled Bank in Pakistan.

The cost of complying with requirements of this Sub-Clause shall be borne by the Contractor.

The following Sub-Clause 10.4 is added:

#### **10.4 Performance Security Binding on Variations and Changes**

The Performance Security shall be binding irrespective of changes in the quantities or variations in the Works or extensions in Time for Completion of the Works which are granted or agreed upon under the provisions of the Contract.

#### **14.1 Programme to be submitted**

The programme shall be submitted within 42 days from the date of receipt of

Letter of Acceptance, which shall be in the form of:

- i) A bar Chart identifying the critical activities.

### **14.3 Cash Flow Estimate to be submitted**

The detailed Cash Flow Estimate shall be submitted within 21 days from the date of receipt of Letter of Acceptance

The following Sub-Clause 14.5 is added:

### **14.5 Detailed Programme and Monthly Progress Report**

- a) For purposes of Sub-Clause 14.1, the Contractor shall submit to the Engineer detailed programme for the following:

- (1) Execution of Works;
- (2) Labor Employment;
- (3) Local Material Procurement;
- (4) Material Imports, if any; and
- (5) Other details as required by the Engineer.

- (b) During the period of the Contract, the Contractor shall submit to the Engineer not later than the 8<sup>th</sup> day of the following month, 10 copies each of Monthly Progress Reports covering:

- (1) A Construction Schedule indicating the monthly progress in percentage;
- (2) Description of all work carried out since the last report;
- (3) Description of the work planned for the next 56 days sufficiently detailed to enable the Engineer to determine his programme of inspection and testing;
- (4) Monthly summary of daily job record;
- (5) Photographs to illustrate progress; and
- (6) Information about problems and difficulties encountered, if any, and proposals to overcome the same.

- (c) During the period of the Contract, the Contractor shall keep a daily record of the work progress, which shall be made available to the Engineer as and when requested. The daily record shall include particulars of weather conditions, number of men working, deliveries of materials, quantity, location and assignment of Contractor's equipment.

The following Sub-Clauses 15.2 and 15.3 are added:

### **15.2 Language Ability of Contractor's Representative**

The Contractor's authorized representative shall be fluent in the English language. Alternately an interpreter with ability of English language shall be provided by the Contractor on full time basis.

### **15.3 Contractor's Representative**

The Contractor's authorised representative and his other professional engineers working at Site shall register themselves with the Pakistan Engineering Council.

The Contractor's authorised representative at Site shall be authorised to exercise adequate administrative and financial powers on behalf of the Contractor so as to achieve completion of the Works as per the Contract.

The following Sub-Clauses 16.3 and 16.4 are added:

### **16.3 Language ability of Superintending Staff of Contractor**

A reasonable proportion of the Contractor's superintending staff shall have a working knowledge of the English language. If the Contractor's superintending staff is not fluent in English language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

### **16.4 Employment of Local Personnel**

The Contractor is encouraged, to the extent practicable and reasonable, to employ local staff and labor from sources within project area.

The following Sub-Clauses 19.3 and 19.4 are added:

### **19.3 Safety Precautions**

In order to provide for the safety, health and welfare of persons, and for prevention of damage of any kind, all operations for the purposes of or in connection with the Contract shall be carried out in compliance with the Safety Requirements of the Government of Pakistan with such modifications thereto as the Engineer may authorise or direct and the Contractor shall take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose.

The Contractor shall make, maintain and submit reports to the Engineer concerning safety, health and welfare of persons and damage to property, as the Engineer may from time to time prescribe.

### **19.4 Lighting Work at Night**

In the event of work being carried out at night, the Contractor shall at his own cost, provide and maintain such good and sufficient light as will enable the



work to proceed satisfactorily and without danger. The approaches to the Site and the Works where the night-work is being carried out shall be sufficiently lighted. All arrangement adopted for such lighting shall be to the satisfaction of the Engineer's Representative.

#### **20.4 Procuring entity/Employer's Risks**

The Procuring entity/Employer's risks are:

Delete the text and substitute with the following:

- (a) insofar as they directly affect the execution of the Works in Pakistan:
- (i) War and hostilities (whether war be declared or not), invasion, act of foreign enemies,
  - (ii) Rebellion, revolution, insurrection, or military or usurped power, or civil war,
  - (iii) ionizing radiations, or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof,
  - (iv) Pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,
  - (v) Riot, commotion or disorder, unless solely restricted to the employees of the Contractor or of his Subcontractors and arising from the conduct of the Works;
- (b) Loss or damage due to the use or occupation by the Procuring entity/Employer of any Section or part of the Permanent Works, except as may be provided for in the Contract;
- (c) loss or damage to the extent that it is due to the design of the Works, other than any part of the design provided by the Contractor or for which the Contractor is responsible; and
- (d) Any operation of the forces of nature (insofar as it occurs on the Site) which an experienced contractor:
- (i) could not have reasonably foreseen, or
  - (ii) could reasonably have foreseen, but against which he could not reasonably have taken at least one of the following measures:
    - (a) prevent loss or damage to physical property from occurring by taking appropriate measures, or

(b) insure against.

### **21.1 Insurance of Works and Contractor's Equipment and Staff**

(Sub-Clause 21.1 (b)): The Constructor may insure his additional cost as reflected in the sub-clause.

### **21.4 Exclusions**

The text is deleted and substituted with the following:

There shall be no obligation for the insurances in Sub-Clause 21.1 to include loss or damage caused by the risks listed under Sub-Clause 20.4 paras (a) (i) to (iv).

The following Sub-Clause 25.5 is added:

### **25.5 Insurance Company**

The Contractor shall be obliged to place all insurances relating to the Contract (including, but not limited to, the insurances referred to in Clauses 21, 23 and 24) with either National Insurance Company of Pakistan or any other insurance company operating in Pakistan and acceptable to the Procuring entity/Employer.

Costs of such insurances shall be borne by the Contractor.

The following Sub-Clause 31.3 is added:

### **31.3 Co-operation with other Contractors**

During the execution of the Works, the Contractor shall co-operate fully with other contractors working for the Procuring entity/Employer at and in the vicinity of the Site and also shall provide adequate precautionary facilities not to make himself a nuisance to local residents and other contractors.

The following Sub-Clauses 34.2 to 34.12 are added:

### **34.2 Rates of Wages and Conditions of Labor**

The Contractor shall pay rates of wages and observe conditions of labor not less favourable than those established for the trade or industry where the work is carried out. In the absence of any rates of wages or conditions of labors established, the Contractor shall pay rates of wages and observe conditions of labor which are not less favourable than the general level of wages and conditions observed by other Procuring entity/Employers whose general circumstances in the trade or in industry in which the Contractor is engaged are similar.

### **34.3 Employment of Persons in the Service of Others**

The Contractor shall not recruit his staff and labor from amongst the

persons in the services of the Procuring entity/Employer or the Engineer; except with the prior written consent of the Procuring entity/Employer or the Engineer, as the case may be.

#### **34.4 Housing for Labor**

Save insofar as the Contract otherwise provides, the Contractor shall provide and maintain such housing accommodation and amenities as he may consider necessary for all his supervisory staff and labor, employed for the purposes of or in connection with the Contract including all fencing, electricity supply, sanitation, cookhouses, fire prevention, water supply and other requirements in connection with such housing accommodation or amenities. On completion of the Contract, these facilities shall be handed over to the Procuring entity/Employer or if the Procuring entity/Employer so desires, the temporary camps or housing provided by the Contractor shall be removed and the Site reinstated to its original condition, all to the approval of the Engineer.

#### **34.5 Health and Safety**

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labor at all times throughout the period of the Contract. The Contractor shall further ensure that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygiene requirements.

#### **34.6 Epidemics**

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government, or the local medical or sanitary authorities, for purpose of dealing with and overcoming the same.

#### **34.7 Supply of Water**

The Contractor shall, so far as is reasonably practicable, having regard to local conditions, provide on the Site, to the satisfaction of the Engineer or his representative, adequate supply of drinking and other water for the use of his staff and labor.

#### **34.8 Alcoholic Liquor or Drugs**

The Contractor shall not, otherwise than in accordance with the Statutes, Ordinances and Government Regulations or Orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his Subcontractors, agents, staff or labor.

#### **34.9 Arms and Ammunition**

The Contractor shall not give, or otherwise dispose of to any person or persons, any arms or ammunition of any kind or permit or suffer the same as aforesaid.

#### **34.10 Festivals and Religious Customs**

The Contractor shall in all dealings with his staff and labor have due regard to all recognized festivals, days of rest and religious and other customs.

#### **34.11 Disorderly Conduct**

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst staff and labor and for the preservation of peace and protection of persons and property in the neighborhood of the Works against the same.

#### **34.12 Compliance by Subcontractors**

The Contractor shall be responsible for compliance by his Subcontractors of the provisions of this Clause.

The following Sub-Clauses 35.2 and 35.3 are added:

#### **35.2 Records of Safety and Health**

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

#### **35.3 Reporting of Accidents**

The Contractor shall report to the Engineer details of any accident as soon as possible after its occurrence. In the case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer immediately by the quickest available means.

The following Sub-Clause 36.6 is added:

#### **36.6 Use of Pakistani Materials and Services**

The Contractor shall , so far as may be consistent with the Contract, make the maximum use of materials, supplies, plant and equipment indigenous to or produced or fabricated in Pakistan and services, available in Pakistan provided such materials, supplies, plant, equipment and services shall be of required standard.

#### **41.1 Commencement of Works**

The text is deleted and substituted with the following:

The Contractor shall commence the Works on Site within the period named in Appendix-A to Bid from the date of receipt by him from the Engineer of a written Notice to Commence. Thereafter, the Contractor shall proceed with the Works with due expedition and without delay.

The following Sub-Clause 47.3 is added:

#### **48.2 Taking Over of Sections or Parts**

For the purposes of para (a) of this Sub-Clause, separate Times for Completion shall be provided in the Appendix-A to Bid “Special Stipulations”.

#### **51.2 Instructions for Variations**

At the end of the first sentence, after the word “Engineer”, the words “in writing “are added.

#### **52.1 Valuation of Variations**

In the tenth line, after the words “Engineer shall” the following is added:  
Within a period not exceeding one-eighth of the completion time subject to a minimum of 56 days from the date of disagreement whichever is later.

#### **53.4 Failure to Comply**

This Sub-Clause is deleted in its entirety.

#### **54.3 Customs Clearance**

Customs Clearance of the constructors/contractor’s equipment, materials, and other things required for the works will be responsibility of the constructors/contractor.

#### **54.5 Conditions of Hire of Contractor’s Equipment**

The following paragraph is added:

The Contractor shall, upon request by the Engineer at any time in relation to any item of hired Contractor’s Equipment, forthwith notify the Engineer in writing the name and address of the Owner of the equipment and shall certify that the agreement for the hire thereof contains a provision in accordance with the requirements set forth above.

The following Sub-Clauses 59.4 & 59.5 are added:

#### **59.4 Payments to Nominated Subcontractors**

The Contractor shall pay to the nominated Subcontractor the amounts which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with Clause 58 [Provisional Sums], except as stated in Sub-Clause 59.5 [Certification of Payments].

#### **59.5 Certification of Payments & Nominated Subcontractors**

Before issuing a Payment Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:

- a) Submits reasonable evidence to the Engineer, or
- b)
  - i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and
  - ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

then the Procuring entity/Employer may (at his sole discretion) pay direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in sub-paragraphs (a) or (b) above. The Contractor shall then repay, to the Procuring entity/Employer, the amount which the nominated Subcontractor was directly paid by the Procuring entity/Employer.

#### **60.1 Monthly Statements**

In the first line after the word "shall", the following is added:

"on the basis of the joint measurement of work done under Clause 56.1,"

In Para (c) the words "the Appendix to Tender" are deleted and substituted with the words " Sub-Clause 60.11 (a)(6) hereof".  
(in case Clause 60.11 is applicable)

#### **60.2 Monthly Payments**

In the first line, "28" is substituted by "14".

##### **60.10 Time for Payment**

The text is deleted and substituted with the following:

The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other terms of the Contract, shall , subject to Clause 47, be paid by the Procuring

entity/Employer to the Contractor within 30 days after such Interim Payment Certificate has been jointly verified by Procuring entity/Employer and Contractor, or, in the case of the Final Certificate referred to in Sub Clause 60.8, within 60 days after such Final Payment Certificate has been jointly verified by Procuring entity/Employer and Contractor; Provided that the Interim Payment shall be caused in 42 days and Final Payment in 60 days in case of foreign funded project. In the event of the failure of the Procuring entity/Employer to make payment within the times stated, the Procuring entity/Employer shall pay to the Contractor compensation at the 28 days rate of KIBOR+2% per annum for local currency and LIBOR+1% for foreign currency, upon all sums unpaid from the date by which the same should have been paid. The provisions of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69.

The following Sub-Clause 60.11 is added:

**60.11 Secured Advance on Materials**

- a) The Contractor shall be entitled to receive from the Procuring entity/Employer Secured Advance against an indemnity bond acceptable to the Procuring entity/Employer of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the Site but not yet incorporated in the Permanent Works provided that:
- (1) The materials are in accordance with the Specifications for the Permanent Works;
  - (2) Such materials have been delivered to the Site and are properly stored and protected against loss or damage or deterioration to the satisfaction of the Engineer but at the risk and cost of the Contractor;
  - (3) The Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records shall be available for inspection by the Engineer;
  - (4) The Contractor shall submit with his monthly statement the estimated value of the materials on Site together with such documents as may be required by the Engineer for the purpose of valuation of materials and providing evidence of ownership and payment therefor;
  - (5) Ownership of such materials shall be deemed to vest in the Procuring entity/Employer and these materials shall not be

removed from the Site or otherwise disposed of without written permission of the Procuring entity/Employer; and

- (6) The sum payable for such materials on Site shall not exceed 75 % of the (i) landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of locally manufactured or produced materials, or (iii) market price of other materials.
- (b) The recovery of Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis.

#### **60.12 Financial Assistance to Contractor**

Financial assistance shall be made available to the Contractor by the Procuring entity/Employer by adopting the following procedure:

- (a) An interest-free Mobilization Advance up to 10 % of the Contract Price stated in the Letter of Acceptance shall be paid by the Procuring entity/Employer to the Contractor in two equal parts upon submission by the Contractor of a Mobilization Advance Guarantee for the full amount of the Advance in the specified form from a Scheduled Bank in Pakistan.
- (1) First part within 14 days after signing of the Contract Agreement or date of receipt of Engineer's Notice to Commence, whichever is earlier; and
- (2) Second part within 42 days from the date of payment of the first part, subject to the satisfaction of the Engineer as to the state of mobilization of the Contractor.
- (b) This Advance shall be recovered in equal installments; first installment at the expiry of third month after the date of payment of first part of Advance and the last installment two months before the date of completion of the Works as per Clause 43 hereof.

#### **63.1 Default of Contractor**

The following para is added at the end of the Sub-Clause:

Provided further that in addition to the action taken by the Procuring entity/Employer against the Contractor under this Clause, the Procuring entity/Employer may also refer the case of default of the Contractor to Pakistan Engineering Council for punitive action under the Construction and Operation of Engineering Works Bye-Laws 1987, as amended from time to time

#### **65.2 Special Risks**

The text is deleted and substituted with the following:



The Special Risks are the risks defined under Sub-Clause 20.4 sub paragraphs (a) (i) to (a) (v).

### **67.3 Arbitration**

In the sixth to eight lines, the words "shall be finally settled ..... appointed under such Rules" are deleted and substituted with the following:  
shall be finally settled under the provisions of the Arbitration Act, 1940 as amended or any statutory modification or re-enactment thereof for the time being in force.

The following paragraph is added:

The place of arbitration shall be Peshawar, Pakistan.

### **68.1 Notice to Contractor**

The following paragraph is added:

For the purposes of this Sub-Clause, the Contractor shall, immediately after receipt of Letter of Acceptance, intimate in writing to the Procuring entity/Employer and the Engineer by registered post, the address of his principal place of business or any change in such address during the period of the Contract.

### **68.2 Notice to Procuring entity/Employer and Engineer**

For the purposes of this Sub-Clause, the respective address are:

#### **a) The Procuring entity/Employer:**

*Procuring entity/Employer: Director General Small Dam Irrigation  
Department Govt. of Khyber Pakhtunkhwa  
Peshawar.*

*Procuring entity/Employer's Representative: **Project Director***

*PSU Small Dam Merged Area, Directorate General  
Small Dam Irrigation Department Khyber Pakhtunkhwa  
Hayatabad Peshawar*

**b) The Engineer:** The Engineer is Project Director PSU Small Dam merged area  
Irrigation Department Khyber Pakhtunkhwa

*a) The Engineer's Representative: **Project Manager of Supervisory Consultant***

### **70.1 Increase or Decrease of Cost**

Sub-Clause 70.1 is deleted in its entirety, and substituted with the following:

The amounts payable to the Contractor, pursuant to Sub-Clause 60.1, shall be adjusted in respect of the rise or fall in the cost of labor, materials, and other inputs to the Works, by applying to such amount the formula prescribed in this Sub-Clause.

**(a) Other Changes in Cost**

To the extent that full compensation for any rise or fall in costs to the Contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other rise or fall of costs.

**(b) Adjustment Formula**

The adjustment to the monthly statements in respect of changes in cost shall be determined from the following formula:-

$$P_n = A + b \frac{L_n}{L_o} + c \frac{M_n}{M_o} + d \frac{E_n}{E_o} + \dots$$

Where:

$P_n$  is a price adjustment factor to be applied to the amount for the payment of the work carried out in the subject month, determined in accordance with Paragraph 60.1 (a), and with Paragraphs 60.1 (b) and (e), where any variations and daywork are not otherwise subject to adjustment;

$A$  is a constant, specified in Appendix-C to Bid, representing the nonadjustable portion in contractual payments;

$b, c, d, \text{ etc.}$ , are weight ages or coefficients representing the estimated proportion of each cost element (labor, cement and reinforcing steel etc.) in the Works or Sections thereof, net of Provisional Sums and Prime Cost; the sum of  $A, b, c, d, \text{ etc.}$ , shall be one;

$L_n, M_n, E_n, \text{ etc.}$ , are the current cost indices or reference prices of the cost elements for month "n", determined pursuant to Sub-Clause 70.1(d), applicable to each cost element; and

$L_o, M_o, E_o, \text{ etc.}$ , are the base cost indices or reference prices corresponding to the above cost elements at the date specified in Sub-Clause 70.1(d).

**(c) Sources of Indices and Weightages**

The sources of indices shall be those listed in Appendix-C to Bid, as approved by the Engineer. As the proposed basis for price adjustment, the Contractor shall have submitted with his bid the tabulation of Weightages and Source of Indices if different than those given in Appendix-C to Bid, which shall be subject to approval by the Engineer.

**(d) Base, Current, and Provisional Indices**

The base cost indices or prices shall be those prevailing on the day 28 days prior to the latest date for submission of bids. Current indices or prices shall be those prevailing on the day 28 days prior to the last day of the period to which a particular monthly statement is related. If at any time the current indices are not available, provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.

**(e) Adjustment after Completion**

If the Contractor fails to complete the Works within the Time for Completion prescribed under Clause 43, adjustment of prices thereafter until the date of completion of the Works shall be made using either the indices or prices relating to the prescribed time for completion, or the current indices or prices, whichever is more favorable to the Procuring entity/Employer, provided that if an extension of time is granted pursuant to Clause 44, the above provision shall apply only to adjustments made after the expiry of such extension of time.

**(f) Weightages**

The weightages for each of the factors of cost given in Appendix-C to Bid shall be adjusted if, in the opinion of the Engineer, they have been rendered unreasonable, unbalanced, or inapplicable as a result of varied or additional work executed or instructed under Clause 51. Such adjustment(s) shall have to be agreed in the variation order.

The following Sub-Clauses 73.1, 73.2, 74.1, 75.1, 76.1, 77.1 and 78.1 are added:

**73.1 Payment of Income Tax**

The Contractor, Subcontractors and their employees shall be responsible for payment of all their income tax, super tax and other taxes on income arising out of the Contract and the rates and prices stated in the Contract shall be deemed to cover all such taxes.

**73.2 Customs Duty & Taxes**

(Procuring entity/Employer may incorporate provisions where applicable)

**74.1 Integrity Pact**

If the Contractor or any of his Subcontractors, agents or servants is found to have violated or involved in violation of the Integrity Pact signed by the Contractor as Appendix-L to his Bid, then the Procuring entity/Employer shall be entitled to:

- (a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by the Contractor or any of his Subcontractors, agents or servants;
- (b) terminate the Contract; and

- (c) recover from the Contractor any loss or damage to the Procuring entity/Employer as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agents or servants.

The termination under Sub-Para (b) of this Sub-Clause shall proceed in the manner prescribed under Sub-Clauses 63.1 to 63.4 and the payment under Sub-Clause 63.3 shall be made after having deducted the amounts due to the Procuring entity/Employer under Sub-Para (a) and (c) of this Sub-Clause.

#### **75.1 Termination of Contract for Procuring entity/Employer's Convenience**

The Procuring entity/Employer shall be entitled to terminate the Contract at any time for the Procuring entity/Employer's convenience after giving 56 days prior notice to the Contractor, with a copy to the Engineer. In the event of such termination, the Contractor:

- (a) shall proceed as provided in Sub-Clause 65.7 hereof; and
- (b) shall be paid by the Procuring entity/Employer as provided in Sub-Clause 65.8 hereof.

#### **76.1 Liability of Contractor**

The Contractor or his Subcontractors or assigns shall follow strictly, all relevant labor laws including the Workmen's Compensation Act and the Procuring entity/Employer shall be fully indemnified for all claims, damages etc. arising out of any dispute between the Contractor, his Subcontractors or assigns and the labor employed by them.

#### **77.1 Joint and Several Liability**

If the Contractor is a joint venture of two or more persons, all such persons shall be jointly and severally bound to the Procuring entity/Employer for the fulfilment of the terms of the Contract and shall designate one of such persons to act as leader with authority to bind the joint venture. The composition or the constitution of the joint venture shall not be altered without the prior consent of the Procuring entity/Employer.

#### **78.1 Details to be Confidential**

The Contractor shall treat the details of the Contract as private and confidential, save in so far as may be necessary for the purposes thereof, and shall not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the prior consent in writing of the Procuring entity/Employer or the Engineer. If any dispute arises as to the necessity of any publication or disclosure for the purpose of the Contract, the same shall be referred to the decision of the Engineer whose award shall be

final.

# **SPECIFICATION- SPECIAL PROVISION**

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## **1. SPECIFICATIONS- SPECIAL PROVISIONS**

### **1.1 GENERAL**

The Specifications contained herein define in detail the requirements of the Procuring entity/Employer in terms of materials incorporated in the works, the dimensional accuracy of the finished works and the workmanship practiced on the works must be of a standard that guarantees project operational safety, functional efficiency and longevity. All equipment incorporated in the works and/or purchased for the Procuring entity/Employer under this Contract must be approved by the Procuring entity/Employer.

### **1.2 DESCRIPTION OF THE GHOZHEZAI DAM PROJECT**

The Ghozhezai Dam is proposed on Ghozhezai Algad and is 4km downstream of Ghorobo and Ghozhezai Algads a tributary of GalarahNullah. The dam site is located 2km upstream of village Sheikhan and Kunkare. The proposed Ghozhezai Dam falls in the Survey of Pakistan (SoP) Topo sheet No. 38 L/01, 02,05,06 and falls on latitude and longitude i.e.,32°27'13"N, 70°19'29"E respectively. Ghozhezai Algad carries run-off produced solely by rainfall and the dam will store water for irrigation and drinking purposes.

### **1.3 SCOPE OF THE CONTRACT WORKS**

- 1.3.1 This specification relates to Ghozhezai Small Dam and its allied structures covering earth core rock fill dam and related structures including the permanent access bridge.

The scope of the contract works covers:

- Pre-construction and construction works.

The construction works and their sequence of completion are shown in the Drawings (Volume II) issued as part of the Tender Documents.

#### **1.3.2 Pre-construction and Construction Works**

For the dam and related structures, the works include, but are not limited to, the following:

- Basic material testing of coarse aggregates, sand, pozzolanic materials, cement, fly ash and slag.
- Trial mix design tests of reinforced concrete.
- Comprehensive trial fills of CC with evaluation.
- Construction of a Conventional concrete (CC) gravity dam with an approximate compressive strength of 2000 PSI and overlapped with specified thickness of RCC, of compressive strength of 4000 PSI maximum height of about 105 Ft.
- Construction of a concrete spillway.
- Construction of a sediment flushing gated outlet through the body of dam at the given level.

- Construction of permanent access bridge.
- Construction of permanent access roads to the above works within the project area.
- Water Supply System complete with storage tanks, treatment plant, conveyance pipes, connecting with existing system and the new one as per drawings.

### 1.3.3 Meeting Sectional Completion Dates

The Contractor is required to complete Sections of the Works within the periods specified in the Conditions of Contract (see Particular Conditions of Contract). Quality maintenance of these Sections of the Works shall remain the responsibility of the Contractor until the issue of the last Taking over Certificate, as defined in the Conditions of Contract.

### 1.3.4 Other Works

The Contractor shall fulfil other contractual obligations in respect of, inter alia, such matters as design, construction, maintenance and removal of all temporary works, programming, construction and quality control, training, medical, safety, environmental and liaison requirements.

## 1.4 CONDITIONS IN AND AROUND THE SITE

The conditions in and around the Site are summarized in the following Sections. The Sections hereunder and the documents of "Factual Reports", present facts, measurements, the results of analyses and interpretations prepared on behalf of the Procuring entity/Employer by professionally qualified parties. The facts, measurements, results and interpretations contained therein do not relieve the Contractor of his responsibility to carefully assess the local site conditions and plan and execute his work accordingly.

### 1.4.1 Location of the Site

The Ghozhezai Small Dam will be constructed on Ghozhezai Algad, about 2km upstream of village Sheikhan Killi and Kunkare,

Latitude: 32°27'12.99"N, Longitude: 70°19'28.97" E.

### 1.4.2 Geology and Seismicity

Complex discontinuity pattern in conjunction with steep slopes and advanced stress relief has locally left the slopes in delicate condition of stability, resulting in rock fall and creep. This condition will call for stabilization of natural and cut slopes in the course of the construction works.

### 1.4.3 Construction Materials

Sources of fill material are the responsibility of contractor. The sand aggregate can be managed from excavated rock. The contractor shall have to produce test results for suitability of material.

In Pakistan the following cements are produced in accordance with BS specifications:

- |  |         |
|--|---------|
| • Ordinary Portland Cement                 | BS 12   |
| • Sulphate-resisting Portland Cement       | BS 4027 |
| • Portland – Blast Furnace Cement          | BS 146  |
| • Low Heat Portland – Blast furnace Cement | BS 4246 |
| • Super Sulphate Cement                    | BS 4248 |

There are a large number of cement production plants in Pakistan which could supply the necessary amount of cement of acceptable quality. The cement factories are located Kohat & Lakki Marwat nearest to Dam Site.

#### 1.4.4 Access to the Site

The information presented does not relieve the Contractor of his responsibility to carefully assess the access conditions and to plan and execute his work accordingly. The Contractor shall be responsible for investigating and determining, as necessary for the execution of the Works, the locations, availability, capacity and condition of all access, transport, handling and storage facilities as necessary including roads, railways, harbours, airports, border crossings and the like.

### 1.5 THE SITE AND ITS USE BY THE CONTRACTOR

#### 1.5.1 Ownership of Natural Materials and Structures on Site

Earth, stone, gravel and sand, and all other materials existing on, or excavated from, the Site shall be at the disposal of the Contractor only in so far as they are approved for use in the Works. The said materials are not (and will not become) the property of the Contractor. Existing structures on the Site shall remain the property of the Procuring entity/Employer and, except as and to the extent required elsewhere in the Contract, shall not be interfered with by the Contractor in any way.

#### 1.5.2 Regulations Regarding Roads and Walkways

All roads and vehicle tracks within the Site shall be deemed to be public highways for all purposes related to road and traffic law, public and third party liability, insurance and related considerations.

#### 1.5.3 Property outside the Site

The Contractor shall not trespass upon private or Government land outside the Site without written approval from the Engineer and the owner and/or occupier of the land.

The Contractor shall take all practicable measures in coordination with the appropriate authorities or private owners of the land in the immediate vicinity of the Contractor's working sites or site establishment areas to ensure that no member of his workforce or person or persons connected in any way with or intending to conduct any business with members of his workforce erects or situates any temporary accommodation, shelter, trading stall, or other type of settlement or establishment on this land unless

such person or persons have obtained written permission from the appropriate authorities or private owners of the land for the erection or situation of such settlement or establishment.

#### 1.5.4 Existing Rights Of Way

Any existing rights of way, footpaths or roads running through the Site shall be conveyed through or diverted around the Site and fenced off in such a way as to prevent unauthorized persons or animals from inadvertently entering the Site. Such rights of way, footpaths or roads shall be kept open at all times except for short periods when construction activities such as surface blasting could require closure for safety reasons.

#### 1.5.5 Graves Tombs

Access will not be permitted to any areas within the Site which contain graves and/or tombs unless written authorization to enter such areas has been obtained from the responsible local authority. A copy of each letter of authorization shall be submitted to the Engineer before the area is entered.

Separate payment will not be made for complying with the requirements of this Clause and all costs shall be deemed to be included in the rates in the Bill of Quantities.

#### 1.5.6 Protection of Natural Environment

The Contractor's attention is drawn to the special natural environment of the Ghozhezai Dam Valley in general and the Ghozhezai Dam area in particular, and he shall take special care at all times to protect and maintain this natural environment within the confines of the Site except in so far as is absolutely necessary for the execution of the Works.

### **1.6 FACILITIES PROVIDED BY THE PROCURING ENTITY/EMPLOYER**

#### 1.6.1 General

Certain facilities as detailed below will be provided by the Procuring entity/Employer. Such facilities will be provided, maintained and operated by the Procuring entity/Employer or shall be provided by the Procuring entity/Employer and maintained and operated by the Contractor, as specified.

Where a facility is provided, maintained and operated by the Procuring entity/Employer, or others under the control of the Procuring entity/Employer, the use of such facilities is generally free of charge unless rates are stated in the Bill of Quantities or unless otherwise stipulated in the Contract.

The Contractor shall be fully responsible for extending, expanding or upgrading any facility provided by the Procuring entity/Employer as the Contractor deems necessary, subject to the Engineer's consent, including any additional maintenance which this may require. This responsibility shall include liaison with the relevant Government authorities and bearing all the respective charges without additional payment.

Where a facility is provided by the Procuring entity/Employer and maintained and operated by the Contractor, all costs incurred by the Contractor in maintenance and

operation shall be deemed to be included in the Contract rates and prices, unless otherwise provided for in the Contract or approved by the Engineer.

In all cases the Contractor shall take all necessary precautions to ensure that the facilities are used in a proper and orderly fashion and that resources supplied are not wasted.

#### 1.6.2 The Site

The areas comprising the Site, as defined above, will be provided by the Procuring entity/Employer free of all charges to the Contractor for the duration of the Contract. The Site shall be maintained and operated by the Contractor.

#### 1.6.3 Procuring entity/Employer's Equipment

The Procuring entity/Employer will not make available any equipment (apparatus, machinery and vehicles) for the use of the Contractor in the execution of the Works.

#### 1.6.4 Compensation to Others

Compensation amounts payable to others for disturbance to buildings, property, other infrastructure, crops and trees as a result of approved construction activities by the Contractor will be paid by the Procuring entity/Employer.

Construction of the Works in any particular area shall not commence until the amount of such compensation for disturbance in that area has been determined and agreed between the Procuring entity/Employer and the responsible local authority.

## CONTRACTOR'S QUALITY ASSURANCE AND QUALITY CONTROL

### 2.1 GENERAL

The Contractor is responsible for controlling and assuring the quality of the Work in accordance with the requirements of the Contract and Standard Specifications.

#### 2.1.1 Quality Control Manager

The Contractor shall designate a Quality Control Manager with authority to develop and enforce the Contractor Quality Assurance Program and Quality Control activities as well as coordination with the Engineer.

#### 2.1.2 Quality Assurance Program

The Contractor shall develop a Quality Assurance Program defining Quality Control activities such as testing, inspection and procedures for scheduling and managing submittals and reporting in accordance with the Contract.

It will clearly describe the Quality Control organization showing lines of authorities and individual qualifications, duties, responsibilities and authorities. The Program shall propose an Inspection Plan for the Engineer's approval. It will outline sampling techniques, sample size, and inspection methods. Verification inspection shall be performed independently by personnel whose primary responsibility is quality assurance and not production.

The final Quality Assurance Program will be incorporated in the Quality Management Plan established by the Engineer.

The Contractor shall perform sufficient inspections and tests of all items of work, including those of subcontractors, to ensure compliance with the Contract. This includes, but is not limited to inspection and tests specified in the Contract. While carrying out its own CQC (Contractor Quality Control) as specified, the Contractor shall provide the Engineer with all facilities for inspecting the work, witnessing required tests and analyzing test results.

### 2.2 STANDARDS AND CODES

#### 2.2.1 Standard Specifications and Codes

In general the construction and testing works shall be governed by the relevant standard specifications and codes of practice which apply in the United States of America.

Certain specifications and codes issued by national or other widely recognised bodies are also referred to in this Specification. All such specifications and codes shall be defined and referred to hereinafter as Standard Specifications and shall be the latest edition of such Standard Specifications and Codes valid at the time of signing the Contract Agreement.

The Contractor may propose that the materials and workmanship be defined in accordance with the requirements of other equivalent specifications and the Contractor may execute the Works in accordance with such other specification as may be

approved by the Engineer. Copies of such documents, which shall be complete, unabridged and written in English, shall be submitted to the Engineer with any such request.

The DIN codes shall be used for stability calculations and for reinforced concrete dimensioning. The use of DIN 1045 with Supplement 400 includes the methods for crack width limitation for application to water retaining structures. Concrete dimensioning according to DIN shall be applied in the Engineer's and the Contractor's design. In other than design issues, and so far as not specified as binding herein, codes can be applied as appropriate subject to the approval of the Engineer. The concurrent application (or mixing) of standards of different origin shall require the prior approval of the Engineer.

In referring to the Standard Specifications the following abbreviations are used:

<b>Initials</b>	<b>Organization Name</b>	<b>www address</b>
<b>AASHTO</b>	American Association of State Highway and Transportation Officials;	aashto.org
<b>ACI</b>	American Concrete Institute;	aci-int.net
<b>AFNOR</b>	Association Francaise de Normalisation, France;	afnor.fr
<b>AISC</b>	American Institute of Steel Construction;	aisc.org
<b>ANSI</b>	American National Standards Institute;	ansi.org
<b>APAVE</b>	Groupement des Associations de Proprietaires d'Appareil a Vapeur et Electriques, France;	apave.com
<b>API</b>	American Petroleum Institute;	api.org
<b>ASA</b>	American Standards Association;	
<b>ASCE</b>	American Society of Civil Engineers;	asce.org
<b>ASHRAE</b>	American Society of Heat, Refrigerating and Air Conditioning Engineers	ashrae.org
<b>ASME</b>	American Society of Mechanical Engineers;	asme.org
<b>ASTM</b>	American Society for Testing and Materials;	astm.org
<b>AWS</b>	American Welding Society;	aws.org
<b>AWWA</b>	American Water Works Society;	awwa.org
<b>BAW</b>	Bundesanstalt für Wasserbau, Germany	
<b>BS</b>	British Standard;	bsi.org.uk
<b>BSCP</b>	British Standard Code of Practice;	
<b>CEE</b>	International Commission of Rules for the Approval of Electrical Equipment;	
<b>DIN</b>	Deutsches Institut für Normung, e.V., Germany;	din.de
<b>EMAS</b>	Eco-Management and Audit Scheme, European Community,	
<b>EN</b>	Euronorm	euronorm.de
<b>FEM</b>	Federation Europeenne de la Manutention, France;	
<b>HSE</b>	Health & Safety Executive, United Kingdom,	open.gov.uk/hse
<b>IEC</b>	International Electrotechnical Commission;	iec.ch
<b>IEE</b>	Institution of Electrical Engineers, United Kingdom;	iee.org.uk



<b>Initials</b>	<b>Organization Name</b>	<b>www address</b>
<b>IEEE</b>	Institute of Electrical and Electronic Engineers, United States of America;	ieee.org
<b>ISO</b>	International Organisation for Standardisation, Switzerland;	iso.ch
<b>NEMA</b>	National Electrical Manufacturer's Association;	nema.org
<b>NF</b>	Norme Francaise, France;	afnor.fr
<b>RAL</b>	RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V., Germany;	
<b>S&amp;H</b>	Safety and Health in Building and Civil Engineering Work of the International Labor Organization (Geneva)	
<b>USACE</b>	United States Army Corps of Engineers;	usace.army.mil
<b>USBR</b>	United States Bureau of Reclamation;	usbr.gov
<b>VDE</b>	Verband Deutscher Elektrotechniker Ingenieure	vde.de
<b>VDI</b>	Verein Deutscher Ingenieure Essen	vdi.de
<b>UVV</b>	Unfallverhütungsvorschriften	
<b>VDMA</b>	German Machinery and Plant Manufacturer's Association	vdma.de
<b>SIS</b>	Sveriges Standardiserings Kommission	

The Contractor shall supply and maintain in his main office on the site at least one complete set of all Standard Specifications and Codes referred to in the Specification and all other approved specifications. This set shall be made available for the use of the Engineer on request.

When the Contract Documents contain particular specifications or more restrictive specifications than required in Standard Specifications and Codes, the Contract Documents will always prevail.

In case of lack of precise requirements in the Specifications and even if no reference to any Standard Specification or Code is made, Standards Specifications and Codes shall be used as reference.

### 2.2.2 Standards For The Plant

All materials and works shall be designed, erected or installed and tested in conformance with the latest issues of the relevant internationally recognised standards and codes. However, any specific requirement of the Contract Documents shall prevail.

All plant and equipment supplied under this Contract shall be proven in service and/or references from users of similar plant and equipment shall be made available to the Engineer by the Contractor, if so required.

A complete set of the selected codes and standards to which the works shall be carried out shall be supplied by the Contractor to the Engineer, whenever requested. The codes and standards shall be printed or translated in English.

## SYSTEM OF UNITS

The International System of Units (SI) ("System International Unités" in French) shall be the contractual system of measurements. All calculations, measurements, drawings, specifications, etc. shall be based on this system of measurements. The following basic units of measurement and abbreviations are recommended:

<b>Unit</b>	<b>Abbreviation</b>	<b>Unit</b>	<b>Abbreviation</b>
Millimeter	mm	kilogram	kg
meter	m	metric ton (1,000 kg)	t
kilometer	km	Newton	N
square millimeter	mm <sup>2</sup> or sq mm	Pascal	Pa
square metre	m <sup>2</sup> or sq m	second	s or sec
Hectare	ha	hour	h or hr
square kilometer	km <sup>2</sup>	day	d or dy
litre	l	week	wk
cubic metre	m <sup>3</sup> or cu m	month	mon
number	no	year	yr or a
Lump sum	sum		

## 2.3 PROGRAMMING REQUIREMENTS

### 2.3.1 Construction Schedule

The Contractor shall employ resources, sufficient in terms of qualified staff and computer hard- and software, for the preparation and updating of schedules and progress reports. Schedules shall be realistic and adequately detailed and shall be used by the Engineer as a base for the schedule of issuing working drawings to the Contractor and for monitoring progress.

The Construction Schedule shall be submitted and shall be based on updating and expansion of the Tender Construction Schedule.

The Schedule shall be computerized using "Primavera", "Microsoft Project" or equivalent software for use on a Personal Computer.

The Schedule shall include as a minimum:

- A network diagram indicating critical activities,
- A tabular listing of:
  - early starts and finishes,
  - late starts and finishes,
  - free and total floats,
- Computer generated bar charts,
- Periods required for work to be carried out by other contractors and subcontractors,
- Information on assumed shutdown periods, vacation days and other non-working time.

Where access must be given to subcontractors or other contractors for the erection of plant and equipment while his own operations are still in progress, the Contractor shall

program the work in such a manner that the erection operations can be carried out in safety and without undue obstruction and hindrance.

The Construction Schedule shall be in sufficient detail to show when the main components of each section of the Works will be constructed and commissioned. Periods when construction will not take place shall be clearly shown. The Schedule shall incorporate the Sectional Completion Dates set out in the Tender Schedule, or such variations as may be agreed with the Engineer, and any other key dates as specified by the Engineer for the proper monitoring of progress.

The Schedule shall show the order and interdependence of activities planned by the Contractor and shall be time scaled according to calendar dates. Activities shown shall consist not only of the actual construction operations but shall include also the submittal and approval of shop drawings and samples, procurement of materials and equipment, and installation and testing of major and critical items. Activities of the Engineer or other contractors (or manufacturers) that may affect the progress of the Works, such as approval and deliveries of equipment furnished by others shall also be shown. Related activities shall be grouped for easier identification.

The critical path shall be clearly delineated on the Schedule.

In addition, a statement of the planned type, number and output of resources and manpower shall be submitted to substantiate each activity duration.

The Contractor shall also submit, with the Schedule, proposed excavation, both types of concrete placement and embankment fill summation graphs for each section of the Works against which progress will be monitored.

Until such time as the Schedule has been agreed and accepted, work shall commence and proceed and progress shall be monitored against the Tender Schedule as amended at the award of Contract. During the progress of the Works, the Contractor shall monitor the activities relative to the Schedule or an approved Revised Schedule and progress shall be reported on a monthly basis. All variances shall be promptly reported. The future impact of major variances shall be determined and analyzed by the Contractor, and necessary corrective measures established, subject to the consent of the Engineer.

### 2.3.2 Progress Meetings

The Contractor shall be required to attend regular Site Progress Meetings with the Engineer where the progress of construction will be reviewed. Such meetings shall normally be held monthly and may be attended by representatives of the Procuring entity/Employer. The Contractor shall present a report on progress to the Engineer before the meeting at a time to be agreed for circulation to participants by the Engineer.

The progress meeting agenda will include approval of the minutes of previous meetings, a report on progress of construction in relation to the construction Schedule, matters arising from any difficulties encountered in the construction of the Works and specific items on safety and accidents, community and labor relations and environmental management.

When the minutes of the meeting prepared by the Engineer have been accepted by the other participants, the minutes will be deemed to be a true record of the declarations, instructions and decisions taken during the meeting.

When requested by the Engineer, the Contractor shall also attend a weekly meeting with the Engineer and provide, four working hours before each meeting, detailed Schedules showing separately the excavation, support, grouting, instrumentation, reinforcement, formwork, conventional concreting and other work anticipated over the forthcoming two week period as well as the progress achieved over the preceding week.

The Contractor will be required to attend other meetings from time to time on special subjects.

## 2.4 DRAWINGS

The Drawings referred to in the Conditions of Contract are those issued with the Tender Documents and such further drawings as shall be supplied under the Contract.

The Tender Drawings issued with the Tender Documents are of a general nature only but are considered to be sufficient for the purpose of tendering. Tender Drawings shall not be used for construction or ordering materials.

Further drawings, of a detail sufficient for construction and/or ordering materials, will be supplied by the Engineer to the Contractor for civil engineering construction purposes in accordance with the Conditions of Contract.

The Contractor shall agree with the Engineer a schedule showing dates of submission of detailed construction drawings by the Engineer to the Contractor to suit the construction Schedule. Whenever agreed changes to the construction Schedule affect the Engineer's Schedule of production of construction drawings, the Contractor shall give one month's advance notice in writing of the changes to allow the Engineer to similarly modify the drawing Schedule.

### 1.4.1 Diagrammatic Mechanical and Electrical Drawings

Some mechanical and electrical Drawings are diagrammatic and indicate the general arrangement of the work. The Contractor shall refer to the structural and other appropriate detail drawings for information as to the location of fixtures and equipment. Where additional information is required, the Contractor shall request this information from the Engineer in writing.

### 1.4.2 As-Built Drawings

When Permanent Works are designed by the Engineer, As-Built Drawings shall be prepared by the Engineer.

In the case of those parts of the Permanent Works designed or detailed by the Contractor, As-Built Drawings shall be prepared by him.

The Contractor's As-Built drawings shall be to a standard of draughtsmanship equal to that of the Drawings provided by the Engineer and to the satisfaction of the Engineer.

The Contractor's As-Built Drawings shall be prepared from electronic versions of drawings submitted by the Contractor and approved by the Engineer. The Contractor's As-Built drawings will be reviewed and approved by the Engineer and included in the Project set of As-Built drawings.

Electronic and paper versions of each As-Built Drawings shall be submitted by the Contractor within one month of the date of completion of the relevant part of the Works shown on the drawing and in any case not later than the date of completion of the whole of the Works.

All costs of the preparation, reproduction, review, corrections and obtaining of the Engineer's approval for the Contractor's As-Built Drawings are deemed to be included in the Contractor's rates.

## 1.5 CONSTRUCTION METHODS

### 2.5.1 General

Unless otherwise confirmed in writing, acceptance of the Tender will not signify acceptance of the Contractor's proposed methods of construction or materials, nor will it in any way relieve the Contractor of any of his responsibilities for the Works. Further it will not be accepted as a basis for claiming additional compensation where the proposed methods of construction, its end results, or the proposed materials do not comply with the Specification and are not approved.

Unless otherwise directed, the Contractor shall submit to the Engineer for consent full details concerning the methods, equipment and quality assurance procedures proposed for each section of the work, including temporary offices, buildings, access roads, Contractor's Equipment, power arrangements, aggregate storage, cement handling, concrete mixing and handling plant, laboratory, quarry operations, method of excavation, embankment fill construction, dealing with water, diversion and environmental mitigation. These shall be referred to as Method Statements and details shall be submitted sufficiently in advance before the Scheduled commencement of work in the area concerned.

The Engineer will give his consent or comment on the proposals within two weeks of receipt.

The Engineer's consent will not be unreasonably withheld, provided the methods and equipment proposed may be expected to produce an acceptable end result, but such consent shall not relieve the Contractor of his responsibilities for safety, adherence to the Schedule, compliance with the Specification and Drawings or any other requirements of the Contract.

After operations have commenced, it is possible that modifications to the construction methods originally agreed upon will be found desirable and such modifications will be made from time to time by agreement in writing between the Engineer and the Contractor. If any equipment, appliances, types or quality of scaffolding, forms, and the like are, in the opinion of the Engineer, either unsafe or unsuitable for accurate and efficient construction, the Engineer may instruct the Contractor to replace or modify the item or items concerned, whether or not the Contractor is in agreement with such opinion, and the Contractor shall forthwith make the required alterations without any additional payment.

### 2.5.2 Approval, Consent, Agreement Etc.

Any approval, consent, acceptance or agreement, by the Engineer of Contractor's Equipment or its operations, or of any construction procedure, or of any materials to be used in construction or of any temporary work will not imply any relaxation of the Clauses of the Specification governing the quality of the materials or of any requirement of the Contract.

### 2.5.3 Contractor's Design

Where an alternative design is initiated by the Contractor he shall be responsible for the timely acquisition of any design criteria from the Engineer.

### 2.5.4 Training and Testing Of Workmen

#### 2.5.4.1 General

If required by the Engineer, the competence of personnel required to undertake operations involving particular skills, such as spray concreting, steel fixing, welding, electrical work and the like shall be demonstrated to the Engineer by means of tests arranged by the Contractor that adhere to the Standards/Requirements of the Government of Pakistan or those specified by the Engineer. Should the competence of any member of the Contractor's workforce be in doubt, the Engineer may order any retesting he considers necessary at any stage throughout the Contract. Suitable means of identification of different skills and training levels of workmen by way of badges, or the like, shall be instituted.

#### 2.5.4.2 Training and Testing Policy

The Contractor shall institute and operate a comprehensive policy towards recruitment testing, training and employment of citizens of the project area. The Contractor will, before the commencement of the contract, make known to the Procuring entity/Employer and the relevant Federal or Provincial Department of Labor his labor needs both in numbers and categories. As part of that policy Contractor shall:

- provide opportunities for trainees to obtain job site experience;
- provide opportunities for trainees, to be tested and promoted;
- throughout the Contract identify and make known to the Engineer those skill categories and numbers which could be upgraded to foremen, skilled and semi-skilled status;
- throughout the Contract make known to the Procuring entity/Employer and Engineer those skill categories and numbers which will be tested at specific times;
- submit to the Engineer a written report, as part of his monthly progress report, on the training and testing Schedule;
- pay all trainees their normal wage while undergoing training and testing.

For the purpose of implementing the training and testing Schedule, the Contractor shall nominate a permanent professional Training Officer, whose appointment shall be subject to the approval of the Engineer.

#### 2.5.4.3 Inspection

Whenever training and/or testing is to be done at night, or at any other time when training and testing is not usually carried out, the Engineer shall be given prior written notice of 24 hours. Inspection of the training and testing facilities shall be carried out by the Engineer and others as deemed relevant by the Engineer.

## 2.6 MATERIALS AND PLANT TO BE INCORPORATED IN THE WORKS

### 2.6.1 Quarried and Processed Materials

The Contractor shall be fully responsible for the provision of the coarse and fine aggregates for concrete and rock and embankment fill for road construction and other purposes as specified and required for the Works in accordance with the Contract.

The Contractor shall obtain material which is required in addition to that obtained from the excavation for the Permanent Works, from quarries and borrow pits approved by the Engineer. All quarries and borrow pit areas have to be selected and verified by the Contractor.

The investigation results for some potential material sources are described in the Tender Documents. These sources will yield material which, after proper processing, is suitable for incorporation into the Permanent Works. The investigations however, do not imply any right or the obligation of making use of material from any of the described sites.

The approval of the Engineer for the use of the sources of such materials will be dependent on the Contractor demonstrating to the satisfaction of the Engineer that the maximum practicable use of materials available from excavations for the Permanent Works has been made and that appropriate provisions have been made for the health, safety and welfare of workers at that source in accordance with the Contract.

When the Engineer is not satisfied that adequate measures are being taken at any such source of rock, aggregates or granular materials to ensure appropriate levels of health, safety and welfare, he may order an immediate review of the situation by the Health and Safety Committee or direct that corrective measures be taken at the Contractor's expense or reject materials from that source.

The Contractor shall explore, locate, investigate and develop such quarries that he may require to meet his requirements under the Contract. Such development of quarries shall include, where applicable, construction, operation and maintenance of the required access roads and docks, shipping and haulage arrangements, and removal and stockpiling of overburden material.

### 2.6.2 Approval of Materials and Plant

**2.6.2.1** Manufacturer's Certificate of Compliance

In the case of standard labeled stock products of quality assured manufacture which have a record of satisfactory performance in similar work over a period of not less than 2 years, the Engineer may accept a notraised statement from the Manufacturer certifying that the product conforms to the applicable Specifications.

**2.6.2.2** Mill Certificates

In the case of materials for which such practice is usual, the Engineer may accept the manufacturer's certified mill and laboratory certificate.

**2.6.2.3** Timber Certificates

Any new timber used by the Contractor whether for temporary or permanent purposes may be rejected by the Engineer unless originating from a managed renewable resource and certified as such by an independent inspection agency accredited by the Forest Stewardship Council.

**2.6.2.4** Suppliers Environmental Certification

Where materials and equipment of equal quality are available from more than one supplier, preference shall be given to those suppliers certified as implementing environmental management systems under ISO 14000, BS 7750, or EMAS.

**2.6.3** Assembly Shop Cleaning, Painting And Marking

After shop assembly and inspection, all parts of the Plant shall be cleaned and painted in accordance with the Specifications.

All parts or units of shop assemblies shall be marked or tagged with piece marks. Marks shall be in accordance with approved erection drawings, shall be clearly legible and so placed as to be readily visible when the part is being erected in the field. Before dismantling for shipment, connecting parts assembled in the shop shall be match marked to facilitate erection in the field and marked so as to identify each part with the assembly to which it belongs. The location of the match marks shall be clearly indicated on erection drawings. All parts or assembly of parts shall also be so marked as to identify them with this Contract.

**2.6.4** Nameplates

Each major and auxiliary item of Plant shall have a nameplate permanently affixed thereto in the English language, or as directed, showing in a legible and durable manner the serial number, name and address of the manufacturer, rating data, electrical and mechanical characteristics, and other significant information, as applicable. Nameplate of distributing agents only will not be acceptable.

**2.6.5** MARKINGS

Each crate or package shall contain a packing list in a waterproof envelope and copies of the packing list shall be forwarded to the engineer prior to delivery of the goods. All items of materials shall be clearly marked for easy identification against the packing list. All cases, packages etc., shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate delivery



documents. All stencil marks on the outside of casing shall be either of a waterproof material or protected by shellac or varnish to prevent obliteration in transit.

#### 2.6.6 CONTAINERS AND PACKING MATERIALS

The non-reusable containers and packing material related to the items procured shall become the property of the Procuring entity/Employer.

#### 2.6.7 PERMISSION TO DELIVER PLANT TO SITE

The Contractor shall apply in writing to the Engineer for permission to deliver any Plant to the site. No Plant may be delivered to the site without the Engineer's written permission. The Contractor shall be responsible for the reception on site of the Plant.

- i) Inspection certificate, issued by the nominated inspection agency and the Contractor's factory inspection report
- ii) Certificate of Origin
- iii) Procuring entity/Employer's Certificate stating that the goods have been completely manufactured, inspected, tested, and ready for shipment

#### 2.7 OPERATION AND MAINTENANCE MANUALS

The Operation and Maintenance Manuals required in the Specifications shall be of A4 format, in loose sheets so they can be incorporated in the all-encompassing Operation and Maintenance manuals to be prepared by the Engineer. Drawings shall be folded or reduced to the format of the manual.

The sections of the manuals shall be arranged in the following order:

- Title page,
- Table of contents,
- Section 1: Operations,
- Section 2: Maintenance,
- Section 3: Dismantling,
- Section 4: Spare Parts,
- Publications,
- Drawings, diagrams etc.

#### 2.8 SPARE PARTS

The Contractor shall provide the spare parts required by the Specifications and as recommended by the Manufacturer of the Plant. All spare parts shall be duplicates of the original parts furnished and interchangeable therewith.

Spare parts shall be clearly designated and referenced in Section 4 of the Operation and Maintenance Manuals with sketches of each part with the part number and the designation of the part cross-indexed with the assembly drawings.

#### 2.9 CONTRACTOR'S SUBMISSIONS AND RETURNS

Wherever the Specification requires that the Contractor shall make a submission to the Engineer, the Engineer will consider such submission and reply to the Contractor in accordance with the relevant provision of the Conditions of Contract. Unless a defined period of time is stated in the Specification, each submission shall be made by dates to be agreed with the Engineer. The Engineer will either approve or comment on submissions from the Contractor expeditiously but no later than 28 days after receipt except where otherwise stated in the Contract. Where, in the opinion of the Engineer, substantial checking or calculation work would be required before the Engineer would be able to approve or comment on the Contractor's submission, the Contractor shall not unreasonably withhold his agreement to a longer period of time as requested by the Engineer.

Documents submitted, other than drawings and manufacturer's literature, shall be A4 in size. All documents shall be in English and any abbreviations shall be explained. All calculations and technical information shall be in units conforming to the System of Units of the Contract.

All drawings shall be A1 or A3 folded to A4 size. Notes shall be in English. All drawings shall have the appropriate scales drawn on them. All dimensions and all weights shall be in the System of Units of the Contract. All drawings shall include the title of the Contract at the bottom of the drawing followed by the title of the drawings concerned.

#### 2.9.1 DAILY RECORDS OF WORK PERFORMED

When requested by the Engineer in writing, the Contractor shall submit to the Engineer by midday of the following day accurate records detailing work carried out the previous day on Permanent and Temporary Works. This record shall include the following for each portion of the Works, separately and in sufficient detail to establish the man-hours and equipment-hours expended:

- Extent of work done;
- The time and duration of any significant delays or breakdowns of any Contractor's Equipment;
- Any other events relevant to the progress of the Works.

The reports shall be in a format acceptable to the Engineer.

Notwithstanding the foregoing, the Engineer may employ members of his own staff to record some or all of the above data in addition to the Contractor's records. The Contractor shall also provide such further information as may be requested by the Engineer.

#### 2.9.2 RETURNS OF LABOR AND EQUIPMENT

##### 2.9.2.1 Weekly

The Contractor shall maintain a weekly record detailing for each portion of the Works separately the numbers of the various classes of workmen employed by him on the Site, the Contractor's Equipment on Site and any other information that may reasonably be required.

The number of days Contractor's Equipment is out of order shall be noted.

When requested by the Engineer in writing, these weekly records shall be submitted to the Engineer.

#### 2.9.2.2 Monthly

The Contractor shall maintain a monthly, or at shorter intervals as required, record of principal materials ordered and stocks on Site and further Contractor's Equipment to be delivered to the Site. The returns shall be in a format agreed with the Engineer.

When requested by the Engineer in writing, these monthly records shall be submitted to the Engineer.

#### 2.9.2.3 Day work and Similar Records

In accordance with the Conditions of Contract, records shall be kept of labor, materials and Contractor's Equipment where there is an agreement to pay by day works. Such records shall be valid only when signed by both the Contractor and the Engineer.

In cases where there is any dispute or uncertainty on payment procedure, sheets shall be signed daily by both parties, as an agreed record of work done, but shall not imply any commitment concerning payment. These sheets shall be annotated "For Record Purposes Only".

#### 2.9.3 Monthly Progress Reports

Within 7 days from the end of each calendar month, the Contractor shall submit copies of a draft monthly progress report, in a format previously approved by the Engineer, which shall contain the information required in the General Conditions of Contract.

Within two working days following the progress meeting specified in the Contract, the Engineer will return to the Contractor one copy marked for amendment including any separate comment for correction or addition to the draft report.

Within 2 working days of receipt of the Engineer's comments the Contractor shall submit copies of the final monthly progress report which will include all the corrections, additions and amendments requested by the Engineer.

The report shall contain, but not be limited to, the following:

- a) General description of the work performed during the reporting period, including any problems encountered and countermeasures proposed.
- b) Overall percentage of works to be completed according to the Contractual Construction Schedule and those effectively performed, with explanation of differences if any. A statement detailing the status of the progress and how to regain any lost time or setbacks which may have occurred shall be included.
- c) Percentage of each main work activity completed as well as the total percentage of each main activity scheduled during the reporting period, with appropriate description to explain any differences.
- d) List of activities including tests scheduled to be started within the next 2 months, with expected starting and completion dates. Should these dates be

different from those in the Contractual Construction Schedule, an explanation shall be included.

- e) List of all equipment located at site, and that which has arrived and is in the process of being transportation all inoperable equipment shall be listed and action proposed and/or being taken to get it back in operation explained.
- f) Total quantities of main items (e.g. excavation, concrete, tonnage of reinforcement placed, length of holes drilled and quantities grouted, etc.) performed during the reporting period.
- g) Main items of Temporary works performed during the reporting period.
- h) Weather conditions during the reporting period, including daily rainfall (in mm), river levels (in m with reference to Site established benchmark), minimum and maximum temperatures and relative humidity.
- i) Statement concerning the effectiveness of the safety program and a list of all accidents involving hospitalisation or death of persons. Also a list of any accidents involving equipment, and any fires which occurred.
- j) List of the amount and date of each payment received during the reporting period, and the amount of any invoice submitted but not yet paid.
- k) List of any claims submitted during the reporting period, including claimed amounts.
- l) Statement about consumption of major materials, including electric energy during the reporting period.
- m) List of documents, correspondence, and instruction received from or submitted to the Engineer during the reporting period.
- n) Colour photographs of all significant aspects of construction works during the reporting period with brief description of the subject and date taken. A minimum of 10 photos of 15 x 10 cm shall be included.

## **2.10 HEALTH AND SAFETY**

### **2.10.1 GENERAL**

The Contractor shall take full responsibility for the prevention of unhealthy or unsafe conditions and practices and for the promotion of healthy and safe working practices at the Site. Nothing specified herein shall relieve the Contractor of any obligation or responsibility in this regard.

Suitable clothing, footwear, helmets, cap-lamps, waterproofs, safety glasses, ear protectors, dust masks, gloves, goggles, harnesses, "self rescuer" apparatus, breathing apparatus, etc., appropriate to the work being undertaken, shall be issued free of charge to and worn by all workmen on and from the day of commencement of work. The workmen shall be trained in the use of all such equipment before entering working areas or relevant designated areas.

The Contractor shall erect and maintain all necessary temporary fencing, barricades, barriers, signs and lights for the prevention of accidents or unsafe practices to the satisfaction of the Engineer. Signs shall include but not be limited to standard road

signs, warning signs, danger signs, control signs and direction signs in addition to the safety notices specified elsewhere in this Clause. All such signs shall be clearly legible in both Urdu and English, to the approval of the Engineer, and the Contractor shall maintain them in a clean and legible condition for the duration of the works.

The Contractor shall provide and maintain all temporary gangways, ladders, staging and covers for protection against falling objects and debris on and about the Site necessary for the purposes of the Contract and shall remove such gangways, ladders, staging and protective covers when no longer required.

The Contractor shall conduct safety awareness programmes and campaigns throughout the duration of the Contract, including the use of prominent and strategically placed posters, audio-visual methods, etc.

#### 2.10.2 HEALTH AND SAFETY POLICY

The Contractor shall implement a health and safety policy on Site. The Health and Safety Plan shall specifically recognise and make provision for health and safety at all locations from which the Contractor obtains rock fill, coarse and fine aggregates and other granular materials for the works, whether directly operated by him or not. For the purpose of implementing the health and safety policy, the Contractor shall constitute a duly empowered committee designated as the Health and Safety Committee, which shall convene monthly and which shall include, but not be limited to:

- (i) Medical Officer
- (ii) The Safety Officer
- (iii) One senior representative of the Contractor's supervisory staff
- (iv) Three representatives of the labor force representing the various categories of workmen and laborers.

The procedures described in the Health and Safety Plan shall not be less than those required by the Laws and Regulations of the Federal and/or Provincial Government of Pakistan and will include but not be limited to:

#### 2.10.3 FIRST AID TRAINING

The Contractor shall, through the auspices of the Health and Safety Committee, institute and operate a basic first aid training programme to ensure that each foreman or work crew leader in control of 20 or more workmen is trained in first aid and possesses a valid certificate to that effect issued by the Red Crescent Society of Pakistan, or equivalent qualification, within 3 months of his appointment. All First Aid qualified personnel will be identified to the Engineer and will be issued with a green and white sticker to be worn on their hard hat. Alternatively, other workmen with aptitude shall be similarly trained, so that there is at least one person qualified in first-aid present on site within each group of 20 workmen.

#### 2.10.4 FIRST AID PROVISIONS

The Contractor shall provide and maintain in ready condition boxes of first aid materials together with stretchers at prominently marked locations within 100 metres

of each working site on the surface or as required by the Engineer. The contents of each first aid box shall include but not be limited to:

- wound cleaner (500 ml) - 6 roller bandages (80 mm x 5 m)
- swabs for cleaning wounds - 6 roller bandages (100 mm x 5 m)
- cotton wool for padding (250 g) - 2 rolls elastic adhesive (25 mm x 3 m)
- sterile gauze (5 packets) - 2 anti-allergenic adhesive strip (25 mm)
- 1 pair forceps (for splinters) - 2 packets adhesive dressing strips
- 1 pair scissors (100 mm) - 6 large dressings (75 mm x 100 mm)
- 2 cards of 6 safety pins - 6 shell dressings (150 mm x 200 mm)
- 24 triangular bandages - 4 straight splints
- sterile eyewash - eyepads
- 3 pairs disposable gloves

#### 2.10.5 TRANSPORT OF LABOR

The Contractor shall be responsible for, and make provision for, the safe vehicular transport of all residential laborers between their accommodation area and their work areas, and vice versa. Under no circumstances shall labor be transported on flat bed trucks, rail or similar vehicles without acceptable form of side restraints and adequate seating. Weather proof covers shall be available for use at all times. The Contractor shall prevent overloading of vehicles.

#### 2.10.6 SAFETY OF PUBLIC

Where the Public could be exposed to danger by any of the Site activities the Contractor shall as appropriate provide suitable flagmen, barriers and/or warning signs in Urdu and English and close off access all to the approval of the Engineer.

Where shown on the Drawings or instructed by the Engineer the Contractor shall provide alternative safe access routes.

#### 2.10.7 EXPLOSIVES AND BLASTING

The handling, storage and use of explosives shall be in accordance with the requirements of the regulations and ordinances of the relevant Federal and/or Provincial Authorities.

The Contractor shall install and operate a siren of sufficient volume to be easily heard above the general site noise from all points within a radius of 1.0 km of surface blasts, including by those persons operating construction vehicles and machinery.

The Contractor shall submit details of his blasting procedures to the Engineer for consent and shall ensure that such procedures are adhered to at all times. Relevant aspects of the procedures shall be agreed with the local authorities and disseminated as widely as possible amongst the local population.

The Contractor shall in particular adopt precautions when using explosives which will prevent scattering of rocks, stumps or other objects or debris outside the work area.

#### 2.10.8 LIGHTNING

The Contractor shall take precautions against lightning with regard to earthing of metal work and conductors on site. Use shall be made of lightning warning equipment if electrically sensitive detonators are used for blasting.

#### 2.10.9 SAFETY NOTICES, SIGNS, POSTERS AND INFORMATION NOTICE BOARDS

The Contractor shall erect and maintain notice boards for the dissemination of relevant safety information and safe work procedures. Notices should be published both in Urdu and English.

The Contractor shall keep the notice boards in good repair and order with legible notices for the duration of working in any given contract area.

At least one notice board shall be erected in each of five locations to be designated by the Engineer

### 2.11 LABOR RELATIONS

#### 2.11.1 General

The Contractor's labor relations arrangements and procedures shall not be less than those required by the relevant regulations and ordinances of the Federal and/or Provincial Governments of Pakistan.

Particular attention shall be given by the Contractor to aspects such as contracts of employment, company rules and regulations, conditions of employment, payment of wages, disciplinary procedures, grievance and dispute settlements, redundancy/retrenchment procedures, etc.

#### 2.11.2 Contracts of Employment

All employees of the Contractor shall be issued with an employment contract in Urdu and English which is to be signed by the employee and the Contractor. All employees shall attend an induction programme at which their terms of employment, site safety procedures, and environmental policies will be addressed.

The Employment Contract shall cover the following:

- Personal particulars, job title, probation period, employment period, wages, overtime, deductions, payment method, hours of work, leave arrangements (paid/unpaid, public holidays), sick leave provisions, accommodation provisions, free meal or food allowance provisions, transport provisions, company rules, regulations and procedures, termination of employment and agreement clause.

#### 2.12 ENVIRONMENTAL PROTECTION

The Contractor shall exercise care to protect the natural landscape and shall conduct his construction operations so as to prevent any unnecessary destruction, scarring or defacing of the natural surroundings in the vicinity of works. Except where clearing is required for Permanent Works, approved construction roads and temporary works, and for excavation operations, all trees and native vegetation shall be preserved and

shall be protected from damage which may be caused by the Contractor's construction operations and equipment. On completion of the works, all work areas shall be smoothed and graded in manner to conform to the natural appearance of the landscape. Where unnecessary destruction, scarring, damage or defacing may occur as a result of Contractor's operations, it shall be repaired, replaced, or otherwise corrected as directed by the Engineer at the Contractor's expense.

The Contractor shall take appropriate measures to manage storm water originating in and flowing across and from the Site so as to avoid causing damage to the works or to other property whether by runoff or flooding or erosion or sedimentation, such property to include fields, water channels, dwellings and other tangible assets. The Contractor shall repair any such damage at his own cost to the satisfaction of the Engineer and pay full compensation to any affected party.

#### 2.12.1 Restoration of the Site

On completion of construction works in any part of the Site the Contractor shall clear away all his temporary facilities including but not limited to offices, camps, storage and holding yards, footings, slabs, tanks, pipe work, fencing and other unnatural materials, and restore the area to at least its previous condition and in the case of formerly agricultural land, restore it to a similar potential productivity, unless otherwise instructed or permitted in advance by the Engineer. Restoration shall include but not be limited to removal and disposal of all wastes, metallic and concrete debris and any soil contaminated by diesel, bitumen or other polluting substances, disinfection of sewage systems, ripping to a minimum depth of 600 mm to relieve compaction, grading, and replacement of Agricultural Soil.

The Engineer reserves the right to inspect the site of any facilities established or used by the Contractor in connection with the Works and to undertake any corrective measures necessary to restore the land, and to recover the cost from monies due or to become due to the Contractor.



### **3 FACILITIES AND SERVICES PROVIDED BY THE CONTRACTOR**

#### **3.1 GENERAL SITE INFRASTRUCTURE**

##### **3.1.1 General**

The Procuring entity/Employer will provide areas as shown in the relevant drawings or as directed by the Engineer free of charge to the Contractor for his site installations and for accommodation for his staff and labor.

The Contractor shall construct, administer and maintain all facilities and infrastructure related to his accommodation on the designated area or areas.

Buildings, electricity transmission and distribution lines, pipelines and equipment to be provided by the Contractor shall be erected in positions approved by the Engineer.

Bushes and trees shall not be cut except where necessary and then only after the approval of the Engineer has been obtained. Surplus spoil and debris shall be disposed of in the designated spoil tips.

Unless approved otherwise by the Engineer internal pathways, roads and parking areas shall be paved and drained in order to reduce dust.

When directed by the Engineer, in writing the Contractor shall dismantle and remove from the Site all buildings and facilities provided under this Clause and which are no longer required by the Engineer or the Contractor, except that buried pipelines may be abandoned if approved by the Engineer. After such removal the ground shall be reinstated to a condition similar to adjacent natural areas, if necessary by means of the spreading of topsoil and replanting grass and/or trees, all to the approval of the Engineer.

The Contractor shall be responsible for keeping his site establishment areas and temporary buildings in a clean, sanitary and orderly condition and to the satisfaction of the Engineer.

The Contractor shall fence off all his designated site establishment areas and shall be responsible for the security of all buildings, equipment and materials within these areas.

The site establishment facilities shall be subject to the approval of the Engineer, who shall have full access to them at all reasonable times. Site buildings shall be maintained in good condition and appearance for the duration of the Contract. Fuel shall be stored in properly constructed tanks which shall be coded and certified as such. Fuel installations shall be secure against unauthorised persons.

The Contractor shall take all precautions necessary to ensure that natural water courses, groundwater and the natural ground soils are not contaminated by fuel, oil or other substances being handled or stored in any of his site establishment areas. The Contractor shall submit details of the measures he will institute for the prevention and control of spillages in these areas to the Engineer for approval.

Whenever the Contractor is engaged in night, the Contractor shall provide and maintain in good condition adequate high powered flood lighting for all portions of the work in progress and the accesses thereto. This shall include the stockpile and spoil areas if machinery is operating in any of these areas. If, in the opinion of the Engineer, the resulting illumination is not adequate for the safe and efficient execution

of the work, additional lighting shall be provided by the Contractor without additional payment.

The Contractor shall provide and maintain all temporary gangways, ladders, staging and covers for protection against falling objects and debris on and about the Site necessary for the purposes of the Contract and shall remove such gangways, ladders, staging and protective covers when no longer required.

### 3.1.2 Access on Site

#### **Temporary Roads**

The Contractor shall be responsible for the construction and maintenance of any required temporary roads within his working areas and for the haul roads to spoil areas. The Contractor will make every effort to minimise the use of existing roads and tracks in and around the Site. If used, then the Contractor shall repair and maintain these roads and tracks.

When temporary haulage and construction roads are no longer required the Contractor shall plough to break up hardened surfaces, remove all imported material and shall reinstate and replace the surface and topsoil of the areas disturbed by such roads and rehabilitate to a natural condition, which may include replanting grass and / or trees, unless otherwise directed by the Engineer.

If at any stage the Contractor requires additional access, or if the use of existing access is curtailed, the Contractor shall submit details to the Engineer, who will then seek the approval of the relevant authorities through the Procuring entity/Employer. No separate payment will be made to the Contractor for the construction and the maintenance of such roads and the costs thereof shall be deemed to be included in other rates.

### 3.1.3 Direction Signs and Boards

The Contractor shall construct, erect, maintain and remove on completion road signs to guide visitors and suppliers to the correct locations. These signs shall be removed at the time of issue of the Taking-Over Certificate or as otherwise agreed between the Contractor and the Engineer.

### 3.1.4 Telecommunications

The Contractor shall provide and maintain suitable voice communications around the Site. The Main offices, the Main Clinic, the Field First Aid Stations, the work sites, other major installations and site facilities shall be served by a telephone network and a radio communications network. The Contractor shall make his own arrangements with the authorities for fixed and mobile communication systems.

The Contractor shall be solely responsible for the payment to the relevant authorities of any deposits, connection fees and all other charges in accordance with the regulations in connection with telecommunications.

### 3.1.5 Security Facilities and Services

#### 3.1.5.1 Security Facilities

The Contractor shall establish a security system or systems, sufficient to prevent unauthorized entry (by persons or animals) and/or removal of any material and/or plant and/or article, as follows:

- Around all his various materials and plant storage areas.
- Around his accommodation camps.
- Around the power generating facilities, including the meters.
- Around the Site offices of the Procuring entity/Employer/Engineer.
- Around the Main Clinic and Field First Aid Stations.
- Around his working areas.

#### 3.1.5.2 Security Services

The Contractor shall operate the security system or systems on a 24-hour, 7 day basis during the entire Contract Period. He shall cooperate with the local political agents and comply with the Engineer's requirements on all matters relating to security of the Works.

The Contractor shall institute emergency evacuation procedures at the work sites and site establishment area. These procedures shall be tested at least four times per year on a random basis.

The services provided by the Contractor shall ensure the following:

- No unauthorized person or persons enter the Site.
- No unauthorized plant and/or material and/or article are removed from the Site.
- No unauthorised firearms are brought on to the Site.
- No alcohol or illegal drugs are brought on to the Site.
- No consumption of alcoholic beverages or illegal drugs takes place within the Site.

#### 3.1.6 Contractor's Staff and Labor Camps

The Contractor shall construct, administer, operate and maintain all the housing, labor accommodation and related infrastructure for his own staff and labor throughout the duration of the Contract. The Procuring entity/Employer will provide areas as shown in the relevant drawings or as directed by the Engineer free of charge to the Contractor for his camp facilities and related infrastructure. The Contractor shall be responsible for obtaining any building permits that may be required and the payment of any related fees for all buildings to be constructed at no additional cost to the Procuring entity/Employer.

On completion of the Contract, the Contractor shall remove all temporary accommodation from the Site and reinstate the area to match its natural surroundings.

### 3.1.7 Contractor's Site Offices, Stores, Warehouses, Materials Yards

The Contractor shall make his own arrangements regarding site offices, stores, warehouses, and materials yards.

The location of all facilities shall be subject to the approval of the Engineer, who shall have full access to them at all reasonable times. Site buildings shall be maintained in good condition and appearance for the duration of the Contract. Fuel shall be stored according to the requirements of the applicable codes in properly constructed tanks certified as such. Fuel installations shall be secured against unauthorised persons.

The Contractor shall make his own arrangements for the shipment, import, internal transportation, storage and use of explosives in accordance with the laws and regulations of Pakistan and international best practice.

The Contractor shall provide a written procedure for the import, transport, storage, use and general safety of any explosives.

The import, transport, storage, use and general safety of all explosives and the construction and location of stores for them, shall be subject to the Engineer's written agreement. Where blasting is permitted, it must be carried out strictly in accordance with arrangement previously agreed in writing by the Engineer.

Explosives, blasting caps, and fuses shall be stored in places and in a manner that will ensure safety against accidents and protection against damage and theft.

No separate payment will be made to the Contractor for the facilities and services provided by the contractor and the cost thereof shall be deemed to be included in the rates of applicable items in the Bill of Quantities.

## **3.2 FACILITIES AND SERVICES FOR THE PROCURING ENTITY/EMPLOYER AND ENGINEER**

### 3.2.1 General

The Contractor shall provide, maintain and repair the facilities specified in this Clause for the sole use of the Procuring entity/Employer and the Engineer for the duration of the Contract. If, at any time, the Contractor decides that maintenance or repair of any facility is uneconomic, then he shall replace that facility at no additional cost to the Procuring entity/Employer.

The Procuring entity/Employer/Engineer's compound will contain the Procuring entity/Employer's Office, the Engineer's Office, and car parking facilities, vehicle manoeuvring space and footpaths as required. The Procuring entity/Employer/Engineer's compound shall be surrounded by a security fence with vehicle and pedestrian gateways and a permanently manned guard hut at the vehicle gate. Bushes and trees shall not be cut except where necessary and then only after approval of the Engineer has been obtained.

The office buildings and associated facilities shall be regularly cleaned, disinfected and maintained throughout the duration of their use. When directed by the Engineer,

the Contractor shall dismantle and remove from the Site all buildings and associated facilities provided under this Clause and which are no longer required by the Engineer.

3.2.1(i) Contractor will provide 4x4 Toyota pickup to client staff during execution period including POL

maintenance etc. No separate payment will be made for vehicles.

3.2.2 Office Communication and Computer Equipment

**Telephone and Facsimile**

The Contractor shall provide normal PABX telephone services to the Procuring entity/Employers' offices and to the Consultant's offices as specified hereafter. All service shall be tone dialing. PABX's shall be fully electronic stored program controlled. Reed relays, mini-switches, cross point switching and cross bar technologies are not acceptable.

**Radiotelephone**

The Contractor shall provide and maintain in constant fully operable condition a radiotelephone communications system for the exclusive use of the Procuring entity/Employer, the Engineer and persons authorized by them. This system shall consist of hand-held transceivers and shall be capable of providing satisfactory communication between any two points within the extent of the Site, irrespective of the topographical nature of the area. The system shall use a dedicated radio frequency which cannot be received by any communications system operated by the Contractor or to which the Contractor has ordinary access. The Contractor shall provide a base station at the Consultant's Main Office and 12 handsets each complete with battery and one (1) spare battery. A battery charging unit sufficient simultaneously for eight handsets shall be provided at the Main Office.

The Contractor shall be responsible for obtaining all permissions, licenses etc. from the relevant Federal and/or Provincial authorities and any other relevant authorities for the establishment and operation of the radiotelephone system, and for the payment of all deposits, fees and charges which may be levied by the authorities in this connection.

### 3.3 FACILITIES And SERVICES SHARED WITH OR PROVIDED FOR OTHER CONTRACTORS

#### 3.3.1 Permanent Access Road

The Contractor shall be solely responsible for repairing and maintaining the permanent access roads which shall be used by his own heavy traffic and that of any other contractors exclusively for the construction of project works. Immediately prior to completion of the project works the contractor shall reinstate the permanent access roads as new.

#### 3.3.2 Temporary River Crossing

The Contractor shall design, construct and maintain in service a temporary river crossing across the JalerAlgad for his own use and for the use of the Contractors.

#### 3.3.3 Water Supply

The Contractor shall be responsible for the collection and storage of all settled raw water (for concrete and other construction uses) and potable water requirements for his own use and for the use of the Procuring entity/Employer, the Engineer and the Contractors throughout the duration of the Contract. The quantities of water, for parties other than himself, will be adequate to the requirements:

He shall also be responsible for:

- the distribution of raw settled and potable water to his own work (including laboratory) and camp site as required.
- The distribution of potable water to the Main Office of the Procuring entity/Employer and Engineer and to the Main Clinic and Field First Aid Statistics.

The Contractor shall ensure that there is an adequate supply of potable water at various locations throughout the site for the use of his employees and the employees of the Procuring entity/Employer and the Engineer.

The Contractor shall be permitted to extract water from the following sources up to the limits specified below, but only from points approved by the Engineer:

- Groundwater at any location and without limit.
- The Ghozhezai Algad at any location

Quantities of water extracted from the approved sources shall be such that the requirements of the local population in respect of water for drinking, cooking and sanitary purposes, irrigation etc., are not interfered with.

The Contractor shall satisfy himself that the points of extraction and any other sources of water supply which he selects and which is approved by the Engineer will provide sufficient water to meet the anticipated demand particularly during periods of drought and low flow. He shall design and construct appropriate storage facilities to overcome drought periods without interruptions to the Works assuming the minimum expected flows in any of the surface rivers concerned or, where appropriate, the minimum expected yield from groundwater sources.

The Contractor shall provide storage sufficient to supply three full days of water (both settled raw and potable) to all consumers.

The quality of the potable water supply shall comply with the standards proposed by the World Health Organization (WHO) and by the Pakistan Standard Institution, as follows:

#### Quality of Potable Water proposed by the WHO

1.	Temperature:	22°C
2.	pH:	6.5 - 8.5
3.	Conductivity:	1,000 $\mu\text{S cm}^{-1}$
4.	Dissolved oxygen:	> 70%
5.	Nitrate:	25 mg/l
6.	Alkalinity (as $\text{CaCO}_3$ ):	500 mg/l
7.	Solids -	
	A: Total Suspended Solids:	25 mg/l
	B: Total Dissolved Solids:	1,000 mg/l
8.	Total coliforms per 100 ml:	None
9.	Faecal coliforms per 100 ml:	None

#### Quality of Potable Water proposed by the Pakistan Standard Institution

##### A. Physical Requirements

No.	Characteristics	Unit	Desirable	Permissible
1.	Turbidity	NTU	5	25
2.	Colour	TCU	5	50
3.	Taste & Odour		Unobjectionable	
4.	pH		7.0-8.5	6.5- 9.2

##### B. Chemical Requirements

1.	Total Dissolved Solids	mg/l	1000	1500
2.	Chloride (Cl)	mg/l	200	600
3.	Sulfate ( $\text{SO}_4$ )	mg/l	200	400
4.	Nitrate ( $\text{NO}_3$ )	mg/l	-	45
5.	Total Hardness ( $\text{CaCO}_3$ )	mg/l	20	500
6.	Nitrite ( $\text{NO}_2$ )	mg/l	Nil	Nil
7.	Total Ammonia	mg/l	0.1	0.5
8.	Hydrogen Sulfide	mg/l	Undetectable odor	
9.	Fluoride (F)	mg/l	-	1.5
10.	Iron (Fe)	mg/l	0.3	1.0
11.	Zinc (Zn)	mg/l	5.0	15.0
12.	Manganese (Mn)	mg/l	0.1	0.5
13.	Copper (Cu)	mg/l	1.0	1.5

14.	Calcium (Ca)	mg/l	75	200
15.	Magnesium (Mg)	mg/l	50	150
16.	Phenolic Substances	mg/l	0.001	0.002
17.	Alkyl Benzyl Sulfates	mg/l	0.5	1.0
18.	Carbon Chloroform Extract	mg/l	0.2	0.5

### C. Limits of Toxic Substances

1.	Arsenic (As)	mg/l	0.05	-
2.	Cadmium (Cd)	mg/l	0.01	-
3.	Chromium (Cr)	mg/l	0.05	-
4.	Cyanide (Cn)	mg/l	0.20	-
5.	Lead (Pb)	mg/l	0.05	-
6.	Selenium (Se)	mg/l	0.20	-
7.	Radionaclider	Uo/l	1000	-

### D. Biological Requirements (Chemical Indicators of Pollution)

1.	Chemical Oxygen Demand (COD)	mg/l	10	-
2.	Biochemical Oxygen Demand (BOD)	mg/l	6	-
3.	Ammonia (NH <sub>3</sub> )	mg/l	0.5	-
4.	Grease	mg/l	1	-

The Contractor shall carry out weekly tests of total and faecal bacteria in samples of drinking water collected at the inlet of the distribution system. Sampling and analyses shall be carried out by competent qualified personnel in the Materials Testing Laboratory. Copies of the results of the bacteriological determinations shall be handed over to the Procuring entity/Employer. The Contractor shall keep accurate records of the bacteriological analyses and of any other analyses. If at any time the water quality testing by the Contractor is judged unreliable or deficient by the Engineer, then the Contractor shall arrange at his expense for immediate checks at an independent laboratory of all the quality criteria listed in the above tables.

### 3.3.4 Fire Control Equipment and Services

The Contractor shall take all reasonable precautions against outbreaks of fire. The Contractor shall provide fire control equipment and services throughout the construction period. The fire control equipment and services will cover the entire Site, including the areas assigned to the Procuring entity/Employer and Engineer and the areas and work fronts assigned to the Contractors. The fire control equipment and services shall comply fully with all relevant regulations of the Federal and Provincial



Authorities of Pakistan specifically in relation to staffing levels and fire fighting equipment standards.

**No separate payment will be made for the above facilities and services which shall be deemed to be in the rates of applicable items in the Bill of Quantities.**

## 4 SURVEYING AND SETTING OUT

### 4.1 GENERAL

The Contractor shall render all services for geodetic survey, setting out and measurements as required for the performance of the Works.

Based on the Drawings and directions given by the Engineer these services shall cover the establishment of basic datum points, benchmarks and permanent survey monuments; the establishment of axes, centre lines, alignments of structures and features; the setting out for construction purposes including all monitoring and checking surveys for correct location, dimensions and elevations; and all surveys required for measurements to permit quantity calculations for invoicing.

Such surveys shall be based on and referred to a local grid of triangulation points established in the vicinity of the project area. This grid shall be the sole basis of reference for all survey works and measurements.

The Drawings are referenced to the local grid established in the vicinity of the project area.

Further details, such as local projection origin and projection type, descriptions of triangulation points, coordinates and elevations, shall be handed over to the Contractor by the Engineer prior to the commencement of works at Site.

For the execution of the survey works the Contractor shall employ and provide experienced professionals and auxiliary staff familiar with modern survey techniques and instruments. All survey and measurement works shall be recorded in accordance with best modern professional practice.

The Contractor shall provide, maintain, adjust where required and operate the required survey and auxiliary equipment for the performance of the Works.

The Contractor shall submit to the Engineer for approval prior to the commencement of the survey works a proposal on the required survey works, giving the following detailed information:

- information on and professional records of his responsible survey staff;
- all necessary information to establish the origin of the main reference survey points/benchmarks to which the Contractor's survey work shall refer;
- the survey methodologies intended to be applied, including the locations of all main reference survey points/benchmarks to be established throughout the Site based on the triangulation point grid;
- details and technical data on the surveying instruments, equipment and auxiliaries;
- details on the accuracy's obtainable/guaranteed for all types of survey work to be performed considering the methodologies to be applied and the instruments which will be used.

Methodologies, equipment and auxiliaries to be used shall be suitable for and meet the requirements of the survey work to be done.

All survey and measurement activities shall be recorded in maps and field books in the English Language as directed and approved by the Engineer. Where required, the production of drawings and maps shall be deemed to be part of the Works.

All survey works performed by the Contractor shall be subject to approval by the Engineer.

## **4.2 HANDING OVER OF THE SURVEY DATA**

Prior to the commencement of the Works at Site the Engineer will hand over to the Contractor all information and data of the existing local grid and/or triangulation points to which the Contractor's survey work shall refer.

Upon handing-over the Contractor shall review this information and all relevant data and shall verify the existence of the triangulation points by field checks.

Should field checks reveal that points have been damaged or displaced, the Contractor shall forthwith inform the Engineer of this fact, and the Engineer shall confirm other reference points to be used if necessary? If no objections have been raised against the basic grid and related data within three months after handing-over of the data, the reference points and the data are considered accepted by the Contractor.

## **4.3 HORIZONTAL CONTROL MONUMENTS AND BENCHMARKS**

### **4.3.1 General**

Additional horizontal control monuments and benchmarks established by the Contractor for the convenience of his works and required as part of the Works shall meet the accuracy required. The accuracy and reliability of additional horizontal control monuments and benchmarks shall be established upon performance of at least five series measurements and two closed level loops respectively, with the required analyses and mean value calculations.

### **4.3.2 Permanent Survey Markers**

The Contractor shall survey, using precision survey methods, and establish Permanent Survey Markers at locations selected in accordance with USACE Engineer Manual EM 1110-1-1002. The Contractor shall then derive the coordinates and elevations of the Markers. The Permanent Survey Markers shall be constructed in accordance with the requirements of EM 1110-1-1002 surmounted by Leica pattern theodolite pillar stands (or equivalent compatible with the survey instruments furnished).

The Contractor may elect to establish the Permanent Survey Markers at the start of the Works for use during construction. The Contractor shall be entirely responsible for the maintenance and protection of these markers during construction, and shall regularly perform full check surveys to confirm that they have not been affected by construction activities or in any other way disturbed or damaged.

On completion of the Works the Contractor shall carry out a complete check survey to confirm that the locations and elevations of the Permanent Survey Markers have remained unaltered since their establishment. The Contractor shall be entirely responsible for the correctness of the Permanent Survey Markers and for any direct or indirect effects of any error or change in their locations or elevations.

### **4.3.3 Contractor's Benchmarks and Survey Markers**

The report to be submitted by the Contractor prior to the commencement of the survey works shall include details and maps showing the locations of all survey markers and benchmarks to be established by the Contractor throughout the Site as the basis for the subsequent survey work required for the performance of the Works.

The Contractor shall also establish reference markers for center lines and line control of structures which need frequent and extended control surveys.

If, in the opinion of the Engineer, additional survey markers or benchmarks are required in order to ensure an accurate and satisfactory coverage of the Site for the performance of the Works, he may instruct the Contractor to amend the location of some points or establish additional points and the Contractor shall comply with such instruction at no additional cost.

The Contractor shall be entirely responsible for the correctness of his survey markers and benchmarks and for any direct or indirect effects of any error or change in their locations or elevations.

The Contractor shall submit to the Engineer all data for each of the Contractor's survey markers and benchmarks, including a description of the point and its physical situation together with a sketch, its coordinates and elevation, within three days of having established the point ready for use. The Engineer may use such points established by the Contractor for his independent survey control at any time thereafter.

The Contractor shall be responsible for the maintenance and protection of these survey markers and benchmarks during construction, and shall regularly perform full check surveys to confirm that they have not been affected by construction activities or in any other way disturbed or damaged.

#### **4.4 APPROVAL OF CONTRACTOR'S SURVEY**

At least seven days prior to any survey work the Contractor shall inform the Engineer of his intention to commence these works. The Contractor shall indicate the purpose of the survey, the area where the survey work will take place, the structure or facilities involved, the methods to be applied, and the time requirements. This information is required to permit the Engineer to coordinate survey works with other ongoing works, including those of third parties.

Following the receipt of all such required information the Engineer will within two days give his approval to proceed if there are no particular constraints. However should constraints exist, the Engineer will advise the Contractor accordingly and determine the commencement date of the related field works.

Prior to completion of a partial survey task or upon completion of setting out the Contractor shall inform the Engineer accordingly so that the Engineer has the opportunity to carry out the necessary checks and inspections. This shall be particularly applicable for structures which will be covered up and/or are of a temporary nature.

Notwithstanding the above the Engineer shall have the right to check at his discretion performance, accuracy, stations, etc., and all survey results, measurements and calculations as well as conformity with plans and drawings related to the survey work.

The Contractor shall without delay provide to the Engineer any assistance and auxiliary services required to permit him to carry out control surveys and measurements.

The Contractor shall keep and maintain professional records of all field surveys and measurements in the English Language, the related computations and calculations, manuscripts, plans, drawings and maps and shall make them available to the Engineer whenever requested.

If, in the opinion of the Engineer, deficiencies and/or inaccuracies in field or office work have been found, such work shall be repeated and made good to the satisfaction of the Engineer without entitling the Contractor to extra payment.

Any control of the Contractor's surveying works by the Engineer shall not relieve the Contractor from his responsibility for the accuracy of location, position, dimension, measurements, etc., of any type of structure or facility or part thereof.

#### 4.5 SURVEY INSTRUMENTS AND EQUIPMENT

The Contractor shall provide, maintain and operate suitable and appropriate instruments and auxiliary equipment and materials commensurate with the various tasks and precision requirements of the survey works.

The type and accuracy of the survey equipment to be used by the Contractor for the performance of his work shall correspond to the nature of the construction/erection works and the construction technique.

All equipment, instruments, materials and auxiliary equipment shall be in perfect operational condition. Prior to the start of survey activities, in particular precision surveys, equipment, instruments, etc., shall be checked as to their proper function and accuracy by the Contractor.

During the construction period the survey instruments shall be checked and if necessary adjusted at regular intervals by the Contractor.

Instruments and equipment which have suffered from use, damage or accidents to a degree making them unfit for further use at the Site shall be removed from the Site and replaced immediately. The Engineer shall be informed accordingly. Any delay in the progress of survey or construction works resulting from the non-availability of suitable instruments, equipment, etc. shall be at the Contractor's expense and shall not be cause for any extension of time.

#### 4.6 SURVEY OF GROUND PROFILES

##### 4.6.1 Original Ground Profiles

The Contractor shall inform the Engineer, at least 14 days prior to commencing such work, of his intention to perform any work which will result in a change to the existing topography of the Site whether such work be for the Permanent Works to be constructed on the Site or for Temporary Works which the Contractor intends to execute for his own convenience. Thereupon, before commencing any work, the Contractor shall survey the original topography to the approval of the Engineer over the entire area to be occupied or disturbed. Such survey may again be required after removal of vegetation, topsoil or other overburden.

The information so obtained shall be recorded by the Contractor on a drawing or drawings which shall each be signed by both the Contractor and the Engineer. The Contractor shall then provide the Engineer copies of each drawing to serve as a permanent record for the purpose of determining both the quantities of excavation and earthworks carried out in the construction of the Permanent Works and the extent to which Temporary Works shall be removed or temporary excavations shall be refilled upon completion of the Works.

##### 4.6.2 Excavated and Final Ground Profiles

The Contractor shall survey all excavated, intermediate and final surfaces as required by the Engineer for the purpose of recording as-built details, for the measurement of quantities and the monitoring of stability:

- (i) On completion of excavation and prior to commencement of placing backfill, concrete or other work,

- (ii) On completion of placing backfill, concrete or other work, or
- (iii) At any time or times during construction.

The information shall be agreed and recorded as specified in Section 4.6.1.



#### **4.7 Setting Out Of Works**

The Contractor shall perform all setting out and check surveying of the Works in accordance with methods approved by the Engineer before work commences. The methods and program of checking shall be such as to ensure the construction of every part of the Works to the correct line and level. The Engineer may at any time request the Contractor to submit proof that his own setting out has been satisfactorily checked, and the Contractor shall comply immediately with any such request.

The number of points required for setting out as well as the spacing between these points shall be determined by the Contractor together with the Engineer in accordance with the type of the work. In addition to any coordinated points and datum levels the Contractor establishes for his own use, the Engineer may require that certain or all of the given points and datum levels be clearly marked during construction in such a way that the marks can be retained after completion of the construction. Where this is not possible for any reason, the Contractor shall inform the Engineer in writing and an alternative position shall be agreed with the Engineer and confirmed in writing.

The Contractor shall not amend the approved methods of survey control without the approval of the Engineer.

#### **4.8 Survey Records and Documentation**

The Contractor shall keep records of all survey activities such as sketches, field books, calculations, etc. in the English Language for the duration of the entire construction period. The Contractor shall upon request of the Engineer put at the Engineer's disposal all records and documentation or provide copies thereof.

For interim invoicing purposes for items of earth or rock excavation works, embankment fill construction, road construction, concrete works, etc., where survey results have been used for quantity calculations, the related plans and drawings together with the relevant calculations, etc., shall be presented to the Engineer as supporting documents for each invoice.

## 5 MATERIAL TESTING LABORATORY

### 5.1 GENERAL

The Contractor shall construct, furnish, operate and maintain for the duration of the Contract one Materials Testing Laboratory. The location of the laboratory shall be selected by the Engineer on receipt of the Contractor's proposals for the location of his other buildings and site establishment facilities.

The equipment to be supplied and installed in the laboratory shall be proposed by the Contractor in his Tender based on the list below. The Contractor shall carefully review this equipment list and amend it as he deems necessary for carrying out the specified tests. The Contractor shall supplement equipment and installations which become unusable due to normal wear and tear without additional cost to the Procuring entity/Employer.

All personnel and labor for testing, operation and maintenance of the Contractor's laboratory shall be provided by the Contractor. The Contractor shall provide and employ for performance of the testing and sampling:

- Only such technical assistants or personnel as are skilled and experienced in their respective fields and such sub-agents and foremen as are competent to give proper supervision to the work they are required to supervise and to carry out, and
- Such skilled, semi-skilled and unskilled labor as is necessary for proper and timely execution of the sampling and testing works and associated services.

The laboratory will be used and shall be equipped for the tests, measurements and analyses specified in these Technical Specifications, such as, but not limited to the following:

- Rockfill and riprap:** Bulk density, unconfined compressive strength, point load test, apparent gravity, porosity, water absorption, soundness, abrasion loss, wetting and drying, crushing test, particle size analysis, particle mass distribution.
- Non-cohesive soil:** Identification, particle size analysis, specific gravity, soundness, permeability coefficient, maximum and minimum dry density, in-situ density, CBR tests.
- Cohesive soil:** Identification, particle size analysis, natural moisture content, Atterberg limits, permeability coefficient, proctor density and optimum moisture content, in-situ density, direct shear strength.
- Agricultural soils:** Dry bulk density, particle size distribution.
- Concrete aggregates:** Particle size analysis, particle shape analysis, deleterious substances, flakiness coefficient, soundness, aggregate crushing value, water absorption, clay lumps and friable particles, lightweight pieces, moisture content, strength, soundness, sand equivalent, abrasion loss, alkali reactivity, chloride content, sulphate content, petrographic analysis, specific gravity, fineness modulus, organic impurities.

<b>Cement:</b>	Specific surface, setting time, stability, shrinkage, chemical analysis, heat of hydration, compressive and tensile strength, alkali reactivity.
<b>Pozzolan/Fly ash</b>	Pozzolanic activity, chemical analysis (total alkali, silicon dioxide, aluminium oxide, iron oxide, sulphur oxide, calcium oxide, magnesium oxide), moisture content, wet sieve analysis, hydrometer analysis, Atterberg limits, strength activity index, loss of ignition, sulphate content, mortar expansion, soundness, fineness, specific gravity, autoclave expansion, alkali content.
<b>Concrete:</b>	Mix design, workability, compression and tensile strength, permeability, temperature, heat of hydration, modulus of elasticity, specific gravity, absorption, voids, in-situ compression, air entrained.
<b>Bentonite slurry:</b>	Mix design, density, viscosity, sand contents.
<b>Plastic concrete:</b>	Mix design, workability, compression and tensile strength in uniaxial test, shear in triaxial cell, permeability in triaxial cell, modulus of elasticity in triaxial compressive test, erodability.
<b>Grout:</b>	Design and performance testing of grout materials and grout mixtures. Compression and tensile strength, permeability, stability, setting time, shrinkage.
<b>Admixtures:</b>	Performance tests.
<b>Water:</b>	Chemical analysis (chloride, sulphate content), pH, aggressiveness to concrete, dissolved oxygen, hardness, total and faecal coliform count, turbidity, electrical conductivity, suspended sediment, temperature.
<b>Asphalt pavement:</b>	Aggregate tests, voids in aggregates, quantitative extraction of bitumen, penetration, viscosity, specific gravity, stability and flow, air voids, density.
<b>Meteorology:</b>	Temperature, rainfall, humidity, evaporation, wind speed.
<b>Air quality:</b>	Particulate content.
<b>Noise:</b>	Noise levels around the site.

The laboratory will be used, and correspondingly equipped, for storing rock cores. In this regard, the core store shall have an identification system and custom made shelving such that any individual core box can be quickly identified, extracted and fully opened for inspection without disturbing other core boxes. The identification system will be organised and maintained by the Contractor as will the removal/replacement of core boxes as and when required by the Engineer.

## 5.2 FURNITURE FOR THE LABORATORY

A laboratory bench approximately 1 meter wide shall be provided along the walls of the laboratory and shall have at least one power point per meter run of length over and above any others provided in the laboratory. Furniture and appliances shall be new and of good quality and to the approval of the Engineer as follows:

1) Materials and Concrete Personnel's Offices:

- 2 desks & 2 executive office chairs
- 2 chairs
- 1 meeting table
- 4 book shelves
- 2 wardrobes
- 2 book cases

2) Offices for Laboratory Personnel:

- 2 writing tables
- 4 chairs
- 4 shelves for documents
- 2 wardrobes
- 2 book cases

3) Laboratory:

- 2 wooden work benches
- 1 concrete work bench
- working places and special tables for all testing machines and instruments
- shelf systems for concrete samples and mortar samples
- 6 cupboards each with 4 door leaves
- 6 storage shelves
- 6 hanging cupboards
- 8 chairs
- 1 ladder

4) Miscellaneous

- 2 No. fire resisting lockable steel filing cabinets with 4 drawers;
- 1 No. steel cabinet, capacity approximately 0.8 m<sup>3</sup>, lockable with adjustable shelving;
- 2 No. pin boards size 1 m x 1.5 m fixed to walls;
- 3 No. metal waste paper baskets and 1 No. metal dustbin;
- 1 No. water chillers of capacity suitable for 10 persons;
- 1 No. electric refrigerator of minimum 0.2 m<sup>3</sup> capacity;
- 1 No. electric kettle;
- 2 No. office IN/OUT trays.

### 5.3 EQUIPMENT FOR THE LABORATORY

The list of equipment to be supplied and installed in each laboratory shall be proposed by the Contractor in his Tender based on the specified tests and test frequencies.

The laboratory buildings shall be removed and the area reinstated in accordance with the relevant specifications at the completion of construction works on the approval of the Engineer. Furniture shall be handed over to the Procuring entity/Employer in its actual condition at that time. The equipment will remain the property of the Contractor and shall be taken back if no longer required, except that the meteorological measuring equipment shall be handed over to the Procuring entity/Employer in full working order as established within the fenced area and no separate payment will be made on this account to the Contractor.

No separate payment will be made for establishing of the laboratory and for purchase of the equipment proposed by the contractor which is deemed to include in other rates of BOQ.

#### 5.4 DAYWORKS

Payment for works executed on a day work basis will be made as follows:-

(a) Labor

The cost of each class of labor as entered in the Schedule of Day works which shall be the actual cost of wages plus a percentage to cover transport to site, small tools, supervision, overheads and profit.

(b) Materials

The actual quantity invoiced as delivered to site at the rate given in the Schedule of Day works which shall include delivery overheads and profits.

(c) Plant

At the rates give in the Schedule of Day works which shall include delivery and removal from site, fuel and lubricants.

The Contractor will generally only be required to undertake those works, for which in the opinion of the Engineer, he has suitable plant, employs suitable labor, and for which he can obtain the necessary materials.

In the event that the Contractor is required to execute day work for which he does not possess suitable plant, or employ suitable labor, he shall be reimbursed such reasonable expenses as he incurs in the provision of such plant or labor, together with the amounts determined above.

The chargeable time shall be the actual time for which the labor or plant is used on the works, calculated as a multiple of the periods quoted below, and subject to a minimum of that period.

<b>Description</b>	<b>Chargeable Time period</b>
Plant/Equipment	hour
Labor	hour

The rates for plant shall be inclusive of all fuels, greases and other consumable stores, and of spare parts etc. but exclusive of operators, drivers, attendants etc., who will be paid for under the item for labor on the instructions of the Engineer. Idle time shall not be paid for and rates shall include for delivery of plant to the site.

# **SPECIFICATION- TECHNICAL PROVISION**

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## **CONSTRUCTION OF GHOZHEZAI SMALL DAM TSD TANK**

### **SECTION 1 – GENERAL REQUIREMENTS**

#### **PART-1 GENERAL**

##### **1-1.1 The Requirement**

Main components of the project are given below:

- Main Dam Embankment
- Spillway
- Inlet & Outlet Structure
- Irrigation System
- Site Office Oblique Inspection hut
- Drinking Water Supply
- Access Road to Dam

##### **1-1.2 Drawings**

###### **1-1.2.1 Engineer's Drawings**

The Tender Drawings included in the Tender Documents and which will form part of the Drawings to be used for the construction of the Works, show the work to be carried out in accordance with the Contract in sufficient detail for the Contractor to fully plan his activities. The Engineer may issue, the Tender Drawings mentioned as above as construction drawings and any additional construction drawings when required for further details, clarifications or modifications.

The Contractor shall be required to perform the work in accordance with such further drawings and specifications at the applicable rates tendered in the priced Bill of Quantities for such work or work of a similar nature. Although the Drawings may be prepared to scale, work shall be based upon dimensions shown on the Drawings and not on dimensions scaled from the Drawings. The Drawings when read in conjunction with the specifications and instructions that may be issued from time to time by the Engineer, will show sufficient dimensions, specific details and typical details to define the various features of the work but the details necessary for the construction of any part of the work may have to be deduced from several Drawings. Revision of any drawing details considered essential shall be provided by the Engineer prior to carrying out of the specific works.

Two (2) full size prints of the Drawings mentioned above and one (1) transparent copy will be issued by the Engineer to the Contractor in accordance with the construction programme required under the provisions of this specifications Clause 1-1.6.2 - Construction Programme.

On receipt of these Drawings, the Contractor shall check them carefully and advise the Engineer in writing of any discrepancies, errors or omissions and full instructions will be furnished to the Contractor should any discrepancies, errors or omissions be found.

###### **1-1.2.2 Contractor's Drawings**

Based on Engineer's construction drawings Contractor shall prepare working drawings based on actual survey and site conditions showing further details and sections.

The working drawing and shop drawings required to be submitted to the Engineer for approval in accordance with Specification, shall be suitable for microfilming and shall consist

of one transparency of durable plastic, one print and copies of design calculations, specification and parts catalogs in duplicate. All drawings submitted for approval shall be signed, checked and approved by the Contractor prior to submission. The drawings shall be signed by a competent professional Engineer in the relevant discipline responsible for the design and shall be submitted in accordance with provision of this Specification's Clause 1-1.4 - Submittal Procedures.

Each drawing submitted by the Contractor shall be both in ISO paper A1 and A3.

Within thirty (30) days after receiving such designs, design calculations, parts catalogues, specifications and detailed drawings, the Engineer shall signify his approval or request modifications. The Contractor shall modify the designs and drawings as may be required by the Engineer.

The work shall be constructed in accordance with the approved drawings, and a copy of such drawings shall be kept on the Site at all times until the completion of the Contract. All drawings on which changes are made shall have the revisions clearly marked.

Construction, fabrication or manufacture of any portion of the Works shall not commence until the design and drawings have been approved and thereafter no change shall be made to any drawings so approved without the permission of the Engineer. Permission to make such changes shall be requested by sending one (1) transparency and one (1) print of each revised drawing for approval, explaining the reason for such a change.

At least thirty (30) days prior to starting construction of any concrete lift or other placement, the Contractor shall submit lift or other placement drawings to the Engineer for approval. Lift or other placement drawings shall be to such scale as to show clearly all recesses openings and embedded work.

Drawings showing the proposed method of construction and other drawings additional to those referred to herein above and required by the Technical Specifications shall also be submitted by the Contractor to the Engineer for approval.

Any work done prior to the approval of drawings shall be at the Contractor's own risk. The Engineer shall have the right to request any additional details and to require the Contractor to make any changes in the design which are necessary to conform to the provisions and intent of the design and the Technical Specification without additional cost to the Procuring entity/Employer. The approval of the drawings by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory. Approval by the Engineer of the Contractor's drawings shall not be held to relieve the Contractor of the obligation to meet all the requirements of the Technical Specifications or of the responsibility for the correctness of the Contractor's drawings or of the responsibility for correct fitting of assembled parts in final position or of the responsibility for the adequacy of method of construction.

Any additional drawings, which the Contractor requires, to interpret the Drawings to construct the Works or in compliance with this Sub-Clause shall be prepared by the Contractor, and all costs shall be borne by the Contractor. No separate payment shall be made for working, shop, reinforcement lift drawing submitted by the Contractor.

### **1-1.3 Project Meetings**

#### **1-1.3.1 Preconstruction Conference**

The Contractor shall attend a pre-construction conference scheduled by the Procuring entity/Employer. Work shall not commence prior to the conference.

The Contractor shall address project orientation, personnel contact, safety issues, permits, deficiencies, and the location of the Contractor's office.

#### **1-1.3.2 Project Meetings**

The Contractor shall attend project meetings scheduled by the Procuring entity/Employer and Engineer.

A Monthly Progress Report shall be submitted with the progress schedule, and shall address potential factors of delay, deficiencies, material delivery schedules, submittals, and safety issues.

### **1-1.4 Submittal Procedures**

#### **1-1.4.1 Scope**

The Contractor is required to submit various documents and materials for Engineer's review, approval and information in accordance with this Clause and other Sections of the Technical Specifications. Requirements of this Clause apply to, and are a component part of, each Section of the Technical Specifications.

#### **1-1.4.2 Submittals**

Standard approved transmittal form shall be used to transmit each submittal.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-12, are descriptions of data to be submitted for the Project. The requirements to actually furnish the applicable items will be called out in each Specification.

#### **SD-01 Preconstruction Submittals**

Submittals which are required prior to a notice to proceed on a new contract. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work, submitted prior to contract notice to proceed or next major phase of construction.

#### **SD-02 Shop Drawings**

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work.

#### **SD-03 Product Data**

Data composed of catalog cuts, brochures, circulars, Specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

**SD-04 Samples**

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

**SD-05 Design Data**

Design calculations, mix design analyses, or other data, written in nature, and pertaining to a part of the work.

**SD-06 Test Reports**

Written reports of a manufacturer's findings of his product during field inspections, attesting that the products are installed in accordance with the manufacturer's installation instructions, shop drawings, or other manufacturer's requirements. Written reports by the Contractor or his subcontractors including daily logs reporting on the progress of daily activities or attesting that the work has been installed in accordance with the contract plans and Specifications.

**SD-07 Certificates**

A document, required of the Contractor, or through the Contractor by way of a supplier, installer or manufacturer, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

**SD-08 Manufacturer's Instructions**

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets, if any concerning impedances, hazards, and safety precautions.

**SD-09 Manufacturer's Field Reports**

A written report, which includes the findings of a test, made at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation. Report must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

**SD-10 Operation and Maintenance Data**

Data intended to be incorporated in an operations and maintenance manual.

**SD-11 Execution Records**

Records of execution, construction and installation.

**SD-12 Closeout Submittals**

Special requirements necessary to properly close out a construction contract. For example, as-built record drawings, manufacturer's help and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

**1-1.4.3 Preparation****(a) Marking**

Prepare, review and stamp with Contractor's approval all specified submittals.

Permanently mark each submittal to identify it by contract number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; Specification or drawing reference; and similar information to distinguish it from other submittals. Submittal identification shall include space to receive the review action by the Engineer.

**(b) Drawing Format**

Drawing submittals shall be prepared on translucent, reproducible sheets, not less than ISO A4 size nor larger than ISO A3 size, except for full size patterns or templates. The Contractor's working, shop and design drawings shall be both in ISO A3 sizes. The Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawing reproducible shall be suitable for microfilming and shall be of a quality to produce clear, distinct lines and letters. The Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

- (a) Job name, which shall be the general title of the contract drawings.
- (b) Date of the drawings and revisions.
- (c) Name of Contractor.
- (d) Name of Subcontractor.
- (e) Name of the item, material, or equipment detailed thereon.
- f) Submittal number (e.g., first submittal to last submittal) in a uniform location adjacent to the title block.
- (g) Technical Specification section to which submittal applies.
- (h) The Project contract number shall appear in the margin, immediately below the title block.

The Drawings shall be numbered in logical sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. The Project Contract Number shall appear in the margin, immediately below the title block, for each drawing.

A blank space, no smaller than 100 millimeter shall be reserved on the right hand side of each sheet for the Engineer disposition stamp.

**(c) Data Format**

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to

the submittal. Marking of each copy of product data submitted shall be identical.

**(d) Samples**

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range not less than 3 units, shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

**1-1.4.4 Submission Requirements**

**(a) Schedules**

Within 30 calendar days of notice to proceed, provide, for approval by the Engineer, the following schedule of submittals:

- (i) A schedule of shop drawings and technical submittals required by the Specifications and drawings. Indicate the Specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.
- (ii) A separate schedule of other submittals required under the contract but not listed in the Specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).
- (iii) Submittals called for by the contract documents will be listed on one of the above schedules. If a submittal is called for but does not pertain to the contract work, the Contractor shall include the submittal in the applicable schedule and annotate it "N/A" with a brief explanation. Approval of the schedules by the Engineer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the schedules or marked "N/A".
- (iv) Re-submit copies of both schedules and annotate monthly by the Contractor with actual submission and approval dates. When all items on a schedule have been fully approved, no further re-submittal of the schedule is required.

**(b) Drawings Submittals**

Submit translucent reproducible copy and 3 black line or blue line opaque prints of each drawing. 1 print, marked with review notations by the Engineer, will be returned to the Contractor. All required installation, fabrication and connection drawings shall be submitted and approved prior to the start of work detailed on these drawings.

**(c) Data Submittals**

Submit three (3) complete sets of indexed and bound product data. One set, marked with review notations by the Engineer, will be returned to the Contractor.

**(d) Samples**

Submit one (1) set of identified samples. A copy of the transmittal form, marked with review notations including selections by the Engineer, will be returned to the Contractor.

Samples that are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual sections of the Specification. These samples will be returned to the Contractor, at his expense, to be clearly labeled, with installation location recorded. Samples shall be in undamaged condition at the time of installation.

Where mockups and similar large samples are required by individual sections of Specification, it is recognized that these are a special type of sample which cannot be readily "transmitted" as specified for submittal of samples. Otherwise, and except as indicated in the individual Section of the Technical Specifications, the requirements for samples shall be complied with and a transmittal form shall be processed for each mockup, to provide a record of the activity.

**1-1.4.5 Engineer's Review****(a) Review Notations**

Engineer will review submittals and provide pertinent notation within 30 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

- (i) Submittals marked "approved" authorize the Contractor to proceed with the work covered.
- (ii) Submittals marked "approved as noted" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Notes shall be incorporated prior to submission of the final submittal.
- (iii) Submittals marked "return for correction" require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.
- (iv) Submittals marked "not approved" or "disapproved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of requiring a submittal shall be accomplished until the submittals are approved or approved as noted.
- (v) Contractor shall make corrections required by the Engineer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the Tender Drawings or the Technical Specifications; notice as required under the Clauses 13 and 20 of General Conditions of Contract shall be given to the Engineer. Approval of the submittals by the Engineer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Engineer requiring rejection and removal of such work at the Contractor's expense.

- (vi) If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved.

**(b) Sample Approval**

Furnish, for the approval of the Engineer, samples required by the Technical Specifications or by the Engineer. Shipping charges shall be paid by the Contractor. Materials or equipment requiring sample approval shall not be delivered to the site or used in the work until approved in writing by the Engineer.

Each sample shall have a label indicating:

- (a) Name of project
- (b) Name of Contractor
- (c) Material or equipment
- (d) Place of origin
- (e) Name of producer and brand
- (f) Specification section to which samples applies
- (g) Samples of furnished material shall have additional markings that will identify them under the finished schedules.

Contractor shall submit to the Engineer two samples of materials where samples are requested. Transmit to the Engineer with each sample a letter, original and two copies, containing the above information.

Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any contract requirements. Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Materials and equipment incorporated in the work shall match the approved samples. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Engineer reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Variations from contract requirements shall be specifically pointed out in transmittal letters. Failure to point out deviations may result in the Engineer requiring rejection and removal of such work at no additional cost to the Procuring entity/Employer.

Samples of various materials or equipment delivered on the site or in place may be taken by the Engineer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor shall replace such materials or equipment to meet



contract requirements.

Approval of the Contractor's samples by the Engineer shall not relieve the Contractor of his responsibilities under the Contract.

### 1-1.4.6 Progress Schedule

#### (a) Bar Chart

- (i) Submit the progress chart, for approval by the Engineer, at the Preconstruction Conference in one reproducible and 4 copies.
- (ii) Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Engineer.
- (iii) Include no less than the following information on the progress chart:
  - Break out by major headings for primary work activity.
  - A line item break out under each major heading sufficient to track the progress of the work.
  - A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.
  - A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.
  - The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.
  - Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)
- (iv) Update the progress schedule in one reproduction and 4 copies every 30 calendar days throughout the contract performance period.

#### (b) Project Network Analysis

Submit the initial progress schedule within 21 calendar days of notice to proceed. Schedule shall be updated and resubmitted monthly beginning 7 calendar days after return of the approved initial schedule. Updating shall entail complete revision of the graphic and data displays incorporating changes in scheduled dates and performance periods. Redlined updates will only be acceptable for use as weekly status reviews.

Contractor shall provide a single point contact from his on-site organization as his Schedule Specialist. Schedule Specialist shall have the responsibility of updating and coordinating the schedule with actual job conditions. Schedule Specialist shall participate in weekly status meetings and present current information on the status of purchase orders, shop drawings, off-site fabrication, materials deliveries, Subcontractor activities and any problem, which may impact the contract performance period.

Include the following in the project network analysis:

- (i) Graphic display shall be a standard network or arrow diagram capable of illustrating the required data. Drafting shall be computer generated on standard on 279 by 432 millimeter minimum sheets with separate overview and detail breakouts. Provide a project network analysis that is legible with a clear, consistent method for continuations and detail referencing. Clearly delineate the critical path on the display. Clearly indicate the contract milestone date on the project network analysis graphic display.
- (ii) Data shall be presented as a separate printout on paper or, where feasible, may be printed on the same sheet as the graphic display. Data shall be organized in a logical coherent display capable of periodic updating.
- (iii) Data shall include verbal activity descriptions with a numerical ordering system cross referenced to the graphic display. Additionally, costs (broken down into separate materials and labor costs), duration, early start date, early finish date, late start date, late finish date, and float shall be detailed for each activity. A running total of the percent completion based on

- completed activity costs versus total contract cost shall be indicated. A system for indicating scheduled versus actual activity dates and durations shall be provided.
- (iv) Schedule shall be of sufficient detail to facilitate the Contractor's control of the job and to allow the Engineer to readily follow progress for portions of the work.

#### **1-1.4.7 Status Report on Materials Orders**

Within 30 calendar days after notice to proceed, submit, for approval by the Engineer, an initial material status report on all material orders. This report will be updated and re-submitted every 30 calendar days as the status on material orders changes.

Report shall list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

- (a) Material name, supplier, and invoice number.
- (b) Bar chart line item or CPM activity number affected by the order.
- (c) Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.
- (d) Current delivery date agreed on by supplier.
- (e) When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.
- (f) When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order or subcontract with other suppliers.

### **1-1.5 Road Access to the Site**

#### **1-1.5.1 Road Access**

The site is accessible from Bannu city through a mettaled road.

#### **1-1.5.2 Practicability of Use**

The Contractor shall ascertain for himself the practicability of using the existing roads for access.

#### **1-1.5.3 Protection and Strengthening of Existing Facilities**

The highways, roads and bridges have widely varying load limits, and the Contractor shall be responsible for determining the load limits existing at and during Contract period and ensuring that his Constructional Plant does not exceed such limits. Before moving any heavy construction traffic onto highways, roads and bridges, the Contractor shall make suitable arrangements with the appropriate Government authorities and obtain their approval for the passage of such traffic. Where the authorities require and specify any special protection or strengthening of highways, roads or bridges, the Contractor shall submit to the Engineer his proposals for such work after their approval by the authority concerned and shall carry out this work to the satisfaction of the Engineer. Separate payment will not be made for any special protection or strengthening required by Government authorities and carried out at the direction of the Engineer. All costs payment shall be deemed to be included in the rates and lump sum prices in the priced Bill of Quantities.

#### **1-1.5.4 Use of Bituminous Sealed Roads**

The Contractor shall not travel tracked vehicles or plant on any bituminous sealed road surface. Rubber tyred vehicles conforming to applicable load restrictions will be permitted to use bituminous sealed roads.

#### **1-1.5.5 Additional Roads**

All additional roads required by the Contractor as access and haul roads on the Site shall be provided by the Contractor in accordance with Clause 1-1.15 of this Specification.

### **1-1.6 Project Schedule**

#### **1-1.6.1 Commencement, Execution and Completion of Works**

The Contractor shall commence work under the Contract in accordance with Sub-Clause 41.1 of the Part-I General Conditions.

Pursuant to Sub-Clause 43.1 of the Part-I General Conditions of Contract, the Contractor shall execute for mandatory completion of the different sections of the Works listed in the Appendix as Implementation Schedule within the number of days specified herein under taken from the day of issue of the Engineer's written order to commence the Works.

#### **1-1.6.2 Contractor's Construction Programme**

In accordance with Sub-Clause 14.2 of the Part-I General Conditions, the Contractor shall submit a revision of the construction programme attached to the Tender for approval. The submission shall be in accordance with the provisions of Sub-Clause 1-1.6 of this section. The programme shall be prepared according to Sub-Clause 1-1.6.3 of this section.

Whenever the Contractor proposes to change the Construction Programme he shall immediately advise the Engineer in writing and if the Engineer considers the change is a major one the Contractor shall submit a revised programme for approval. If such a change in the construction programme affects the Engineer's design and drawings programme, the Procuring entity/Employer will not be responsible for the consequences of the late issue of any drawings which are attributable to that change.

If the Contractor falls behind the approved construction programme he shall, within fourteen (14) days of the date of such default, submit a revision of the Construction Programme showing the proposed measure to complete the Permanent Works on time, for approval.

When requested by the Engineer, the Contractor shall promptly furnish a detailed sub-programme of the construction for particular sections of the Permanent Works.

#### **1-1.6.3 Requirements of Construction Programme**

##### **(a) General Requirements**

In accordance with Sub-Clause 14.1 of the Part-I General Conditions, the Contractor shall designate an authorized representative who shall be responsible for the preparation of all required Construction Programme reports. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors, and Contractor's Designers, and suppliers working on the project shall also contribute in developing and maintaining an accurate Construction Programme. The approved Construction Programme shall be used to measure the progress of the work, to aid in evaluating time extensions.

##### **(b) Computer Software**

The computer software system utilized by the Contractor to produce the Construction Programme shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the Programme. Manual methods used to produce any required information shall require approval by the Engineer.

##### **(c) Use of the Critical Path Method**

The Critical Path Method (CPM) of network calculation shall be used to generate the Construction Programme. The Contractor shall provide the Construction Programme in the Precedence Diagram Method (PDM) format on Primavera/MS Project software.

##### **(d) Level of Detail Required**

The Construction Programme shall include an appropriate level of detail. Failure to develop or update the Construction Programme or provide data to the Engineer at the appropriate level of detail, as specified by the Engineer, shall result in the disapproval of the Programme. The Engineer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the

Construction Programme:

**(i) Design and Permit Activities**

Design and permitting activities, including necessary conferences and follow-up actions and design package submission dates, shall be integrated into the Programme.

**(ii) Procurement Activities**

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the Construction Programme. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

**(iii) Critical Activities**

The following activities shall be listed as separate line activities on the Contractor's Construction Programme:

- (a) Submission and approval of mechanical/electrical layout drawings.
- (b) Submission and approval of O & M manuals.
- (c) Submission and approval of as-built drawings.
- (d) Performance Verification testing.
- (e) Other systems testing, if required.
- (f) Prefinal inspection.
- (g) Correction of punch list from prefinal inspection.
- (h) Final inspection.

**(iv) Engineer and Procuring entity/Employer's Activities**

Engineer, Procuring entity/Employer or other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, design reviews, environmental permit approvals by State regulators and inspections.

**(v) Responsibility**

All activities shall be identified in the Construction Programme by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm or contractor work force, performing a given task. Activities shall not belong to more than one responsible party.

**(vi) Work Areas**

All activities shall be identified in the Construction Programme by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

**1-1.6.4 Construction Programme Submissions**

The Contractor shall provide the submissions as described below. All necessary data disks, reports, and network diagrams required for each submission shall be provide with the Programme.

**(a) Preliminary Construction Programme Submission**

The Preliminary Construction Programme, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after the Noticed to Proceed, (NTP) is acknowledged. The approved preliminary Programme shall be used for payment purposes not to exceed 60 calendar days after NTP.

**(b) Initial Construction Programme Submission**

The Initial Construction Programme shall be submitted for approval within 40 calendar days after NTP. The Programme shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

**(c) Periodic Programme Updates**

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor

shall submit periodic Programme updates. These submissions shall enable the Engineer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and Construction Programme data, which in the judgment of the Engineer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

### **1-1.7 Performance Security and Insurance**

#### **1-1.7.1 Performance Security**

(a) Sub-Clause 10.1 of the General Conditions specifies the Contractor providing an irrevocable bank guarantee or a bond for the due performance of the Contract.

#### **1-1.7.2 Insurance**

Clause 21.1 of the General Conditions of Contract requires that the Contractor shall take out certain insurances relating to the Contract.

The Contractor shall provide the following three types of Insurances:

- (i) Insurance of Works and Contractors Equipment
- (ii) Insurance against Accident to Workmen.
- (iii) Third Party Insurance.

The insurances drawn shall be in accordance with the requirements stated under insurance in General Conditions of Contract. The Insurance Policies drawn shall be approved by the Engineer.

### **1-1.8 Materials to be furnished by the Contractor**

The Contractor shall furnish all materials required for the execution of the Works.

Unless specifically stated otherwise, any reference in the Technical Specifications or on the Tender Drawings to trade names or catalogue numbers or to a particular manufactured product does not imply that the article or product so mentioned is the only one that may be supplied or used. Any reference so made is purely given as a standard of the quality, class, type and finish of the items specified to be used. Articles or products of similar type and quality produced by other manufacturers shall be submitted by the Contractor for approval.

All materials that will become part of the Permanent Works shall be new and shall conform to the Technical Specification. Where the requirements for any materials are not stated in the Technical Specifications, the material shall conform with the appropriate and most recent Pakistani and/or American and/or British Standard Specification or such other specifications as may be approved.

When a separate item, which includes the furnishing of any materials, is provided in the priced Bill of Quantities, the cost of furnishing, transporting, storing and handling such materials shall be deemed to be included in the rate or lump sum tendered for that item in the priced Bill of Quantities.

Where no separate item is provided in the priced Bill of Quantities for furnishing any materials required to be furnished by the Contractor the cost of furnishing, transporting, storing and handling such materials shall be deemed to be included in the rate or lump sum tendered in the priced Bill of Quantities for the items for which the materials are required.

The Contractor shall make diligent effort to procure the specified materials, but where, because of priorities or other causes materials required by the Specification are not available, approved substitute materials may be used, which approval will state the amount of price adjustment, if any, to be made. The Engineer's decision as to whether substitution will be permitted and as to what substitute materials may be used will be final, binding and conclusive.

Materials and equipment furnished by the Contractor, which will be incorporated in the Permanent

Works, shall be subject to inspection, examination and test as provided in the Contract. To allow sufficient time to provide for inspection, examination and testing, the Contractor shall submit at the time of issue, copies in duplicate of all orders, including drawings and other pertinent information, covering the materials and equipment to be furnished by the Contractor, or shall submit other evidence in the event of such orders being issued verbally or by letter, to the Engineer. The inspection, examination and testing of materials and equipment or the waiving of inspection, examination and testing thereof shall in no way relieve the Contractor of the responsibility for furnishing materials and equipment meeting the requirements of the Technical Specifications.

The responsibility for so ordering and delivering materials and manufactured articles and samples that they may be tested sufficiently far in advance of the work as not to delay it shall rest upon the Contractor and he shall not be entitled to any time credit for delays occasioned by his neglect to order sufficiently well in advance or to payment of any costs he may incur as the result thereof.

### **1-1.9 Standard Specifications**

#### **1-1.9.1 Standards**

Except as otherwise specified in the Technical Specifications, all materials and workmanship shall comply in all respects with the requirements of the appropriate specifications and codes issued by Pakistani and/or the British Standards Institution and/or American or such equivalent standards of other such countries as may be approved and current at the date of Invitation for Tenders as may be applicable to any part of the Permanent Works. If, after the date of Invitation for Tenders, there is an amendment to a standard specification relevant to the Contract, the Engineer will direct whether the amendment is to apply.

#### **1-1.9.2 Copies of Standards, Codes and References**

The Contractor shall have available in his site office at all times at least one (1) copy of every standards, codes and references referred to in this Specification.

Separate payment will not be made for compliance with this Clause and all such costs shall be deemed to be included in the rates and lump sums tendered in the priced Bill of Quantities for the items for which the standards and codes are applicable.

#### **1-1.10 Setting-Out Works**

The Contractor shall be solely responsible for the correct setting out of the Works and shall employ experienced qualified surveyors acceptable to the Engineer for this purpose.

The Engineer will establish free of charge to the Contractor necessary reference marks to define datum lines and the reduce levels of suitably located reference bench-marks to enable the Contractor to set out the Permanent Works. Any reference marks damaged as the result of action by the Contractor will be replaced by the Engineer at the expense for the Contractor.

The Contractor shall furnish all materials, labor and equipment including stakes, templates, patterns, platforms and special labor that may be required in setting out any part of the Works.

Separate payment will not be made for complying with the provisions of this Clause and all costs shall be deemed to be included in the various rates and lump sums tendered in the priced Bill of Quantities.

The Engineer may make checks as the Work progresses to verify lines or lines and grades established by the Contractor and to determine the conformance of the work as it progresses with the requirement of the Technical Specifications and the Drawings. Such checking by the Engineer shall not relieve the Contractor of his responsibility to perform all work in accordance with the Drawings and the Technical Specifications and the lines and grades given therein.

#### **1-1.11 Safety Precautions**

##### **1-1.11.1 General**

The Contractor shall comply with any Safety instruction given by the Engineer. In the performance of the Works, the Contractor shall exercise every reasonable precaution to protect persons or property from injury. The Contractor shall erect and maintain all necessary temporary fencing, barricades, barriers, signs and lights and provide fire alarm, fire extinguishing and fire-fighting services at strategic points on the Site. The Contractor shall adopt and enforce such rules and regulations as may be necessary, desirable or proper to safeguard the public and all persons engaged in the work and its supervision.

#### **1-1.11.2 Safety Officer**

The Contractor shall constantly assign, during the progress of the Works, an employee qualified in safety, and familiar with the type of work being performed, whose assignment shall include initiation of measures for the protection of health and the prevention of accidents and who shall see, by personal inspection, that all safety rules and regulations are enforced. The Contractor shall hold regularly scheduled safety meetings at least once each month with his Engineers, supervisors and foremen. When directed additional meetings will be held. The Contractor shall keep the Engineer advised as to when these meetings are to be held and shall provide the Engineer with a copy of the proposed agenda.

#### **1-1.11.3 Safety Measures**

With limits the generality of Sub-Clause 19.1 of General Conditions, the Safety measures taken by Contractor shall include but shall not be limited to the following:

- (a) Temporary Fencing – The Contractor shall erect, maintain and remove suitable and approved temporary fencing to enclose such areas of the Permanent Works and areas of land occupied by the Contractor within the Site as may be necessary to implement his obligations under the Contract, to the satisfaction of the Engineer. Where any temporary fence has to be erected alongside a public road, footpath, etc., it shall be of the type required by and shall be erected to the satisfaction of the Government authority concerned.
- (b) Lighting –The Contractor shall provide sufficient lighting in all places where work is in progress:
  - (i) Safe working conditions are provided both for the Contractor’s personnel, sub-contractor’s personnel and for personnel of the Engineer;
  - (ii) The Works can be constructed in complete compliance with the Contract; and
  - (iii) A complete inspection of all Works in progress can be made by the Engineer.
- (c) Unless otherwise directed, the minimum service luminance on ground or working surfaces to be provided for the various operations or work areas shall be as tabulated below:

<b>Operation or Area</b>	<b>Design Value (Lux)</b>	<b>Minimum Measured Value (Lux)</b>
Earthworks and Excavation	50	20
Bridges	20	10
Access and haul where Cross traffic or other hazardous conditions exist	20	10
Concrete placing	100	50
Maintenance shops and auxiliary buildings	300	200

- (d) The Contractor shall supply a suitable instrument to the Engineer for measuring the intensity of illumination. The instrument shall comply with BS 667.
- (e) Illumination for areas or operations not listed in the above table shall conform to the requirements of the Lighting Guide, Building and Civil Engineering, Site Illuminating Engineering Society, London.



- (f) All mobile equipment or plant used during night operations, as and when approved by the Engineer, shall be equipped with sufficient lights and reflectors to ensure safe working conditions.
- (g) Not less than fourteen (14) days before the start of night operations, the Contractor shall submit his proposals for lighting in the areas in which he proposes to work at night to the Engineer. The Contractor shall modify the proposals if required by the Engineer, and shall not begin operations at night until the proposals for lighting (in an amended form if required) have been approved.
- (h) Approval of the Contractor's proposals for lighting shall not relieve the Contractor of any of his liabilities or obligations under the Contract.
- (i) Work in the vicinity of electrical equipment – in the interest of safety and security, the Contractor shall complete the erection of any safety fencing around electrical and mechanical apparatus by the time that the said apparatus is connected to any electricity supply.
- (j) Explosives – in the use, handling and storage of explosives, the Contractor shall comply with the guidelines given in Section 5, Excavation and Miscellaneous Earthworks of this Specification and with all statutory regulations of Pakistan. The Contractor's attention is drawn to the fact that, depending on the nature of work in progress, the Engineer may require the Contractor to discontinue the handling or use of explosives during the approach and progress of severe thunderstorms in which case all persons shall be removed from danger areas to a place of safety during such periods.
- (k) Safety Instructions – the Contractor shall at his own cost supply and issue to his employees and those of his subcontractors and the staff of the Engineer printed booklets, of pocket-size, on the scale of one per person, in English and in other languages used by his employees at Site, instructions based on good practice. Within sixty (60) days of the Engineer's written order to commence the Works at Site, proof copies of the booklet shall be submitted for approval before printing and amendments shall be made to the booklet to his entire satisfaction. The Contractor shall issue the booklet immediately after printing as required by this Clause and ensure that all employees are fully conversant with the instructions. Safety instructions shall deal with all safety including:
- (i) Protective clothing, headgear and footwear;
  - (ii) Use of lifting equipment;
  - (iii) Use of drilling equipment;
  - (iv) Contract with and use of electrical equipment;
  - (v) Use and storage of explosives;
  - (vi) Compressed air;
  - (vii) Welding;
  - (viii) Routine for accidents or fires; and
  - (ix) Watchmen, warning notices and barriers.

The Contractor shall allow for 20 booklets for the use of the Engineer.

- (l) The Contractor shall provide for the Engineer and Engineer's supervisory staff the protective clothing, headgear and footwear necessary for the proper discharge of their duties on Site.
- (m) Accident Reports – the Contractor shall promptly report to the Engineer in the form to be prescribed, all accidents involving death or serious injury to staff or workmen, and furnish monthly reports of all accidents to staff or workmen involving loss of time, giving such information as may be prescribed by the Engineer.
- (n) (i) The Contractor shall provide all necessary signs for the works. These shall include, but not be limited to:
- use of sirens before blasting and a all-clear indication
  - standard road signs;
  - warning signs;
  - danger signs;
  - control signs;

- safety signs; and
  - direction signs.
- (ii) Wording on all signs shall be in English and Urdu and other approved languages. The size, colour, lettering and location of all signs will be subject to approval and attention shall be paid to international signs.
- (iii) The Contractor shall maintain all signs placed by him as well as those placed by the Procuring entity/Employer.
- (iv) If the Engineer considers that the system of signs provided by the Contractor is inadequate to ensure safety, or unsatisfactory in other respects, the Contractor shall add to, amend, or otherwise change the system to the satisfaction of the Engineer.
- (v) The Contractor shall at his own cost make suitable replacement as directed by the Engineer in case of loss or damage to any signs provided by the Contractor under this Sub-Clause.
- (vi) The Contractor shall at his own cost adopt such measures as the Engineer may consider reasonable and necessary to minimize nuisance from dust, noise or other disturbance created while or in carrying out the Works.

Separate payment will not be made for complying with the provisions of this Clause and all costs shall be deemed to be included in the various rates and lump sum prices in the priced Bill of Quantities.

#### **1-1.12 Hours and Days of Working**

As per Sub-Clause 45.1 of the General Conditions of Contract the Contractor is not permitted to work during the night or on locally recognized days of rest. However, in special cases, he may be allowed to work during the night or on locally recognized days of rest with prior permission of the Engineer.

Before commencement of work on the Contract, the Contractor shall notify the Engineer, in writing, of the hours and of the number of shifts that he proposes to work and shall give at least 48 hours notice to the Engineer of any changes to such hours of working and / or number of shifts that may be necessary during the currency of the Contract.

#### **1-1.13 Resources Reports**

During the course of construction, the Contractor shall submit on the first day of each week a detailed list by trade classification of manpower employed during the report period and a list of all major items of Constructional Plant on Site to the Engineer.

#### **1-1.14 Temporary Works**

The Procuring entity/Employer will allocate to the Contractor free of cost an area of land at the Site within which the Contractor shall accommodate his work force and set up all services and facilities required for the construction of the Work on Site.

The Contractor's proposals for the details of erection and construction of all Temporary Works shall be in accordance with the proposals submitted with the Tender and approved in the Letter of Acceptance or with such modifications as approved from time to time.

Temporary Works shall include but not be limited to the work covered in Sub-Clauses 1-1.16 to 1-1.27, both inclusive, of this Specification, Contractor's offices and accommodation, building, temporary fences, sanitary facilities, fixed construction facilities including but not limited to workshops, compressed air stations, electric power, water supply, telecommunications and construction and maintenance of access roads required for the execution of the Works and clean-up of the Site on completion.

The Contractor shall submit for approval drawings and full particulars of all Temporary Works, which he intends to construct at least thirty (30) days before he desires to commence constructing such works. Approval of any such proposals from the Contractor shall not relieve the Contractor of any of his responsibility for the sufficiency of the Temporary Works for their intended purpose. The

Contractor shall also obtain any necessary approval from local statutory or other Government authorities before commencing construction. Such work shall not be started without prior approval.

Construction facilities on which interim payments have been made shall be maintained in good order and shall not be demolished, removed from the Site or otherwise disposed of without prior approval.

No house, office, store, workshop or other habitable building will be permitted underneath or within 3 m of the nearest point in plan of the uninsulated overhead conductor of low or medium voltage of an electricity supply main.

On completion of the Works, all Temporary Works whether existing or constructed by the Contractor, unless otherwise specified or directed shall be removed from the Site. The Contractor shall make safe all areas affected by Temporary Works and reinstate natural drainage. The Contractor shall finish, reinstate, clean up and relinquish parts of the site at the end of the Maintenance Period or such earlier times as directed. Buildings and facilities removed from the Site will remain the Contractor's property.

Separate payment will not be made for Temporary Works and complying with the provisions of this Sub-Clause and Sub-Clauses 1-1.16 to 1-1.27 unless included in Bill of Quantities as such.

### **1-1.15 Temporary Access and Haul Roads**

#### **1-1.15.1 General**

The Contractor shall design, construct and maintain all temporary access and haul roads (including associated drainage and stream crossing facilities) to the various working sites and designated borrow and disposal areas and quarry sites as required for the Works.

The temporary access and haul roads may be constructed at times to suit the Contractor's construction program except where the requirements of Sub-Clause 1-1.6 of this Specification apply.

The Contractor shall submit for approval drawings, design and full particulars of all temporary access roads, which he intends to construct at least thirty (30) days before he desires to commence constructing such temporary access roads. Approval of any such proposals by the Engineer shall not relieve the Contractor of any of his responsibility under this Contract.

#### **1-1.15.2 Heavy Construction Traffic**

The Contractor's heavy construction traffic or tracked equipment shall not traverse any public roads or bridges, unless the Contractor has made arrangements with the Authorities concerned and the approval of the Engineer to such arrangements has been obtained.

#### **1-1.15.3 Maintenance of Roads**

The Contractor shall be wholly responsible for the maintenance of all temporary access and haul roads constructed by him or as specified in this Contract.

In maintaining these roads the Contractor shall:

- (a) Keep clear and in good working order at all times all road structures, bridges, culverts, drains and other waterways;
- (b) Patch potholes with approved materials, keep the road surface in good repair and perform any grading and necessary resurfacing;
- (c) Maintain all fender posts, guide posts, guard posts, fencing, signs, signposts and other roadside structures;
- (d) Take reasonable and necessary measures to minimize nuisance from dust created while or in carrying out the Works.

#### **1-1.15.4 Use of Roads by Others**

During the period of the Contract, the Procuring entity/Employer will be engaged on other works in the vicinity of the Works covered by the Technical Specifications, and the Contractor shall allow the Engineer or persons authorized by the Engineer free use of all temporary access and haul roads.

The payment will only be made if so permitted through item of work in the Bill of Quantities for full compliance with requirements of this Sub-Clause.

#### **1-1.16 Electric Power**

The Contractor shall make his own arrangements for the supply and distribution of electricity to provide for power and light for the Contractor's camp accommodation and camp amenities, workshops, stores, offices, including the Project Site Office, laboratories and all other facilities necessary for the execution of the Works.

The power supply shall be three-phase, four-wire, 50 Hz, 415 V (ph-ph) for power and 240 V (ph-N) for lighting and small power and shall comply with the regulations of local power supply authorities. Facilities shall be provided to permit the isolation of individual supply points while maintaining supply to the remainder of the system. Unless otherwise provided, the Contractor shall install a meter at the Project Site Office.

Not less than sixty (60) days prior to the installation for supply and distribution of electricity as required under this Sub-Clause, the Contractor shall submit in full detail his proposals and drawings for approval.

Unless otherwise directed, on the completion of the Works, the Contractor shall remove from the Site the installation for electricity supply provided by him and the electrical distribution systems in and amongst the Contractor camps, offices, stores, workshops and other areas.

Separate payment will not be made for complying with the requirements of this Clause.

#### **1-1.17 Telecommunications**

The Contractor shall make his own arrangements for the required telecommunication services.

The Contractor shall provide and operate an independent automatic external telephone connection with exchange access to each of the rooms in the Project Site Office along with four (4) numbers of mobile telephones. .

In addition to the above service, the Contractor shall provide and operate a communications system for the purpose of intercommunication within the Site area but without exchange access. Such intercommunication shall consist of eight (8) units of 2-channel walkie-talkie and will cover the following:

Communication between the Contractor and the Engineer at Site and Communications between all offices and working points within the scope of the Contract.

The walkie-talkies shall be of a make and model approved by the Engineer and shall become the property of the Procuring entity/Employer at the end of the Contract. The Contractor shall obtain the required license to operate the walkie-talkies and shall keep them in regular and proper service.

The payment will be made for complying with the requirements of this Sub-Clause up to the Lump Sum Price quoted in the Bill of Quantities with no any additional payment.

#### **1-1.18 Water Supply**

The Contractor shall make his own arrangements for the supply of adequate safe drinking water. The Contractor shall comply with all rules and regulations that may be made by the authorities having jurisdiction, and by the Engineer, regarding the taking of water from the Sours.

If any need should arise that the Contractor requires to obtain water from other sources, the water should be tested for impurities contents and approved by the Engineer. Any additional cost incurred will not be paid but will be deemed to be included in the various rates of the priced Bill of Quantities.

The Contractor shall be responsible for the supply and reticulation of all water for his own use and to the Engineer's residential camp, Project Site Office and Field Offices. Water supplied for domestic use shall be potable.

The Contractor's methods of storage of water for construction purposes shall be in accordance with the proposals approved by the Engineer.

Separate payment will not be made for the provision for water supply.

#### **1-1.19 Sewerage**

The Contractor shall provide and install an approved treatment process for disposal of sewage from all offices, camps and other buildings constructed by the completion of this Contract.

The Contractor shall construct, operate and maintain at the site temporary toilet facilities complete with adequate water borne water closets, urinals and hand-basins, septic tanks, absorption trenches or other sewerage disposal installations, for all site personnel.

The temporary toilet facilities shall meet the requirements of the Government health authority. The location of these facilities and their construction shall be as approved.

Sewage from temporary facilities shall be disposed of in a hygienic manner as approved.

Separate payment will not be made for complying with the requirements of this Clause.

#### **1-1.20 Garbage Disposal**

The Contractor shall undertake the collection of and disposal of all garbage from within the area of both the Permanent and Temporary Works including from the Engineer's residential camp Project Site Office. Garbage collections shall be made at least twice each week and shall continue until completion of the Works.

Garbage shall be disposed of in a properly constructed incinerator followed by burial of the residue in an approved location. The Contractor shall submit the proposed design and layout of garbage disposal facilities for approval.

The payment will be made for complying with the provision of this Sub-Clause, up to the Lump Sum Price quoted in the Bill of Quantities with no any additional payment.

#### **1-1.21 Fire Prevention**

The Contractor shall provide and maintain adequate fire-fighting equipment and take adequate fire precaution measures for the safety of all personnel, temporary and permanent works, and shall take action to prevent damage to or destruction by fire of trees, shrubs or grasses.

Separate payment will not be made for the provision of fire prevention measures.

#### **1-1.22 First Aid and Medical Facilities**

##### **1-1.22.1 General**

The Contractor shall in all respects be fully responsible for ensuring necessary first-aid services to his employees and employees of his subcontractors, including transport for injured personnel to hospital or other appropriate accommodation as and when required.

##### **1.1.22.2 Staff**

To enable the fulfillment of his obligations under this Clause, the Contractor shall engage qualified resident first-aid staff, provide and maintain an Ambulance to move serious patients or victims of an accident to nearby Hospital.

Separate payment will not be made for first-aid and medical facilities provided by the Contractor for his employees and the employees of his subcontractors. The facility shall be also available for the use of Engineer's staff.

### **1-1.23 Living Facilities, Camp Amenities and Recreation Facilities**

#### **1-1.23.1 Location of Construction Township**

The Procuring entity/Employer will allocate free of cost to the Contractor an area of land to be used for the construction of quarters for his own staff and camps for workmen and for other camp amenities for his employees and the employees of the Procuring entity/Employer.

#### **1-1.23.2 Contractor's Staff Quarters and Camps**

The Contractor shall ensure that his allocated areas are at all times kept in a clean and sanitary condition, and shall provide and maintain sanitary conveniences for the use of persons employed on the Works to the extent and in the manner and at such places as shall be approved by the Engineer and by any local or other Government authority concerned, and all employees of the Contractor and his subcontractors shall be obliged to use these conveniences. Any employee found violating this requirement shall be liable to immediate termination of employment and to the refusal of further employment on the Works.

#### **1-1.23.3 Camp Amenities**

- (a) The Contractor may be permitted to lease areas within his labor camp or quarters area for his staff, or space in buildings constructed by him in these areas, for conducting such business or services as may be necessary for the convenience of his labor or staff. The Contractor may recoup from leases such rent as necessary to cover the costs of administering the provision of these businesses or services. Patronage of such businesses or employment of such services by the Contractor's employees shall be optional.
- (b) All concessions or leases shall require a submission to the Engineer and the approval of the Procuring entity/Employer. No concessions or leases shall be granted for the operation of games of chance or gambling in any form. They shall contain provisions making them subject to termination upon both completion of the Works and in the case of the business or service, being conducted in such a manner as to infringe the terms of this Sub-Clause.
- (c) The charges for all goods and services at camp shops, canteens and the like shall be fair and reasonable and not in excess of the charges for similar goods and services in the area.

#### **1-1.23.4 Recreation Facilities**

- (a) The Contractor shall provide construct and maintain in an approved area, recreation facilities for sports such as soccer, volley ball and tennis etc. These facilities shall be available for the use of the Contractor and the Engineer's staff, and respective dependents.
- (b) The Contractor may also at his expense, construct any additional service facilities required in the recreation area and shall ensure that the standard is at least equal to other township buildings.
- (c) The Contractor shall ensure the recreation area and service facilities are at all times kept in a clean and tidy condition.
- (d) Separate payment will not be made for complying with requirements of above mentioned Sub-Clause.

#### **1-1.23.5 Security Fencing**

The Contractor shall erect and maintain and keep in good repair this security fence and shall make good any damage, at his own costs, before vacating the site on the completion of the Contract.

Separate payment will not be made for complying with requirements of abovementioned Sub-Clause

#### **1-1.23.6 Removal of Buildings and Facilities**

The Contractor, upon completion of the works, shall dismantle and remove all buildings complete including the facilities as stated in this Sub-Clause and temporary structures erected by him as part of his construction camp, and fill in all excavated areas as directed, remove all refuse, debris and other objectionable materials and leave the camp area in a clean and rightly condition to the satisfaction of the Engineer.

Separate payment will not be made for complying with the requirements of this Sub-Clause.

### **1-1.24 Contractor's Offices, Stores and Workshops**

#### **1-1.24.1 General**

- (a) The Contractor shall provide and maintain such offices, stores, workshops and adequately fenced store and delivery compounds as are necessary for the execution of the Works, including all necessary services for water supply, drainage, lighting, roads, paths, parking places, sewerage and garbage disposal.
- (b) On the completion of the Works, all buildings and facilities provided by the Contractor in accordance with the provisions of this Clause shall remain the property of the Contractor and shall be removed from the Site.

Separate payment will not be made for complying with the requirements of this Sub-Clause.

### **1-1.25 Flood Prevention**

The Contractor shall plan his work in such a manner to ensure no flooding or pounding of water outside the construction area will occur.

Separate payment will not be made for the provision of flood prevention measures and the cost of this work shall be deemed to be included in the various rates and lump sum prices in the priced Bill of Quantities.

### **1-1.26 Security**

#### **1-1.26.1 General**

- (a) The Procuring entity/Employer will specify overall security requirements for the project and the Contractor shall conform to such requirements and be responsible for such action of his personnel in respect of such requirements.
- (b) The project site may be located within a Security Controlled Area and the Contractor shall conform with all requirements established by the Police/Defense Department for this area.
- (c) The entry of personnel, food stuff, clothing and other items into the Security Controlled Area will be regulated by the Police Department or as directed by the Engineer.
- (d) The Contractor shall obtain Police Permits to enter the Security Controlled Area for all personnel employed on the project including personnel of his subcontractors and all other persons he requires to visit the Site. Application for permits shall be lodged with the Police Department not less than fourteen (14) days prior to the date of proposed entry to the area. Applications shall include all personnel information as required by the Police Department.

#### **1-1.26.2 Identification**

- (a) All Contractor's employees, representatives, and subcontractor's employees shall wear identification badges provided by the Contractor. Badges shall identify the Contractor, show an employee number, and shall be worn at all times while at the Site.
- (b) All vehicles used by the Contractor shall be clearly marked with the Contractor's name, and name of project.

#### **1-1.26.3 Site Security**

The Contractor shall be responsible for the security of the works for the duration of the Contract and shall provide and maintain continuously an adequate security force to fulfill these obligations. The duties of the Contractor's security force shall include, but not be limited to, maintenance of order on the Site, provision of all lighting, fencing, guards, flagmen, and all other measures necessary for the protection of the Works within the

township and elsewhere on the Site, all material delivered to the Site, the public, and all persons employed in connection with the Works, continuously throughout working and non-working periods, including nights, days of rest and holidays, for the duration of the Contract.

**1-1.26.4 Camp Security**

Each entrance in the security fence surrounding camp area shall be continuously manned by the Contractor's security personnel who shall control the movement of personnel and goods into and out of the enclosed area and shall prohibit persons leaving the area between night hours except those authorized personnel employed during the night shift on the construction work.

Separate payment will not be made for complying with the requirements of this Sub-Clause.



### 1-1.27 Engineer's Project Site Offices, Supervision Staff Offices and Rest Houses

#### 1-1.27.1 General

The contractor shall design, construct, maintain and insure until completion of the Works the buildings of single storey construction of temporary nature which shall consist of the facilities complete with fixtures and equipment for sole use by the Engineer/ Engineer's staff as follows.

Project Manager	1 Nos
Resident Engineers	1 Nos.
Assistant Resident Engineers	2 Nos.
Supervisors	5 Nos.
Surveyors	1 Nos.
Laboratory Technician	1 Nos.

The space requirements are as follows.

- (i) An office measuring not less than eight hundred (89 square meters), furnished with 3 desks with chairs, three guest chairs and lockable filing cabinets.
- (ii) Six (6) furnished Bed Room with toilet, mess facilities, potable water supply, sanitation, power supply, electric fans and lights. Minimum bedroom size should be 14' x 16' for CRE, RE and AREs and 16'x18' for supervisors and other staff. In addition a guest room measuring not less than 14' x 16' with attached bathroom should also
- (iii) Testing Laboratory

#### 1-1.27.2 Construction

Building materials and surface finishes used shall be appropriate for this class of work.

The roofs and external walls shall have effective thermal insulation and all ceiling and internal partitions shall be effectively soundproofed. The floors shall be fitted with a heavy duty vinyl covering.

The buildings will be located on site as approved by the Engineer after consideration of the proposal by the Contractor and the Contractor shall construct drains, temporary roads, parking areas and paths as directed. Earthworks and drainage for the buildings, roads and parking areas shall be carried out to an approved standard. Car parks shall be constructed at the Project Site Office with space for twelve cars; five of these spaces shall be covered. The area surrounding the Project Site Office, laboratory shall be surrounded with chain link fencing not less than 1.8 meters high and lockable gates along with guards shall be provided at entry / exit points.

The Contractor shall submit the specifications and full construction drawings for the Project Site Office, laboratory and residential houses to the Engineer. The construction of the Project Site Office, laboratory and residential houses shall be in accordance with the layout as approved by the Engineer. The Contractor shall not commence any construction or fabrication work on the buildings or services until approval has been given by the Engineer.

The design, construction and supply of the Project Site Office, laboratory and residential houses shall include all necessary electrical installations, including switchboards and meters in accordance with the provisions of the related local unless and incase they are silent, the Regulations for Electrical Equipment of Buildings as issued by the Institution of Electrical Engineer's G.B. The artificial lighting provided in the building shall be with the provisions of IES Code for Interim Lighting (Illuminating Engineering Society London).

#### 1-1.27.3 Services

- (a) The Project Site Office, laboratory and residential houses shall be connected to the Contractor's distribution system for power and light.
- (b) Communication services shall be installed in each of the room provided in the Project Site Office as required by Sub-Clause 1-1.18 of this Specification.
- (c) Washroom with approved sanitary fittings shall be provided at the Project site office.
- (d) The Contractor shall install and maintain an approved sewerage installation for the Project Site Office and residential houses.
- (e) The Contractor shall provide and maintain a suitable water supply to all plumbing connections in the Project Site Office and residential houses. The water supply for sinks and water cooler shall be potable water. The installation shall include such supply and storage tanks as are necessary to maintain an adequate supply of suitable water and electric water heaters storage type of 150 and 50-liter capacity for the Project Site Office.
- (f) The Contractor shall pay for all water, electricity and telephone charges consumed in the Project Site Office, laboratory and residential houses. The cost shall be included in the maintenance of the Project Office, laboratory and residential houses.

The contractor shall include the cost of maintenance of the project office, laboratory & residential houses.

#### **1-1.27.4 Engineer's Testing Laboratory**

- (a) The Contractor shall provide, install and maintain on Site for the duration of the contract a laboratory in a temporary building for the exclusive use of the Engineer for testing soils, aggregate, concrete and bituminous materials. The laboratory shall be fully equipped with all utilities, furniture, apparatus and fittings appropriate to such use as per the instructions provided by the Engineer.
- (b) The Laboratory shall be located adjacent to the Engineer's Office, or elsewhere if required by the Engineer, and shall consist of a hall and two offices with storage, lavatory and washing facilities. The total area of the laboratory building shall be 50 sq.m. The hall shall be divided into a soil and aggregates section, and a concrete section.
- (c) Outside the laboratory water tanks shall be constructed for curing concrete samples, of a size and location approved by the Engineer.
- (d) The laboratory shall be provided with electricity and telephone and shall be fully air-conditioned. It shall have a regular and dependable supply of water and electricity available throughout 24 hours of each day.
- (e) All rooms shall be provided with exhaust fans, located particularly over fume cupboards and the like.
- (f) The water supply shall be maintained by an elevated or pressure tank of adequate capacity.
- (g) The Contractor shall provide qualified materials technicians and qualified laboratory helpers as deemed necessary by the Engineer to assist in operating the laboratory. All costs necessary for the provision and upkeep of these personnel shall be the responsibility of the Contractor and shall be considered included in the payment herein specified for providing and maintaining the Engineer's Laboratory.
- (h) The equipment & furnishings and building of Engineer's laboratory shall become the property of the Procuring entity/Employer on the date of issue of the Taking-over certificates, when the buildings shall be re-instated and repaired as necessary by the Contractor to its original condition.
- (i) It shall be the responsibility of the Contractor to take samples as required by the Engineer and to provide all necessary transport, labor, tools, containers, wrappings and so forth for uplifting and dispatching samples to the Engineer's Laboratory.

- (j) The Contractor shall maintain, and shall repair and replace the laboratory equipment's in the event of loss or damage of these equipment's during the duration of the Contract. This work is part of maintenance and the cost shall be included in the price of maintenance of the project office laboratory and no additional payment shall be made by the Procuring entity/Employer.

**1-1.27.5 Maintenance and Cleaning**

- (a) The Contractor shall maintain the Project Site Office, Residential Houses with all the fittings, equipment's, and associated facilities provided in accordance with the provisions of this Clause and its Appendices in good order and condition including any replacement due to loss or damage until completion of the Works. Maintenance shall include the repair and making good of all faults and defects that become apparent in the buildings surface drainage, roads and paths including cleaning, electrical, plumbing, water supply and sewerage services appurtenant to the buildings and all items in the buildings provided in accordance with the provisions of this Sub-Clause and its Appendices.
- (b) Maintenance shall also include the provision of expendable items such as electric light tubes and bulbs or repainting including repainting required by manifestly poor workmanship or materials in the initial supply.
- (c) The Contractor shall carry out regular daily cleaning of the Project Site Office, laboratory and arrange disposal of waste from residential houses. The cost shall be included in the maintenance of the Project Site Office, laboratory and residential houses and no additional payment shall be made by the Procuring entity/Employer.

Separate payment will not be made for complying with the requirements of this Sub-Clause.

**1-1.27.6 Insurances**

The Contractor shall insure the Project Site Office, laboratory, residential houses and all associated facilities in accordance with the provisions of Clause 23.1 of the Part-I General Conditions.

No additional payment shall be made by the Procuring entity/Employer in this regard.

**1-1.28 Existing Public Utilities and Other Services**

**1-1.28.1 Location, Protection and Repair of Damage**

The Contractor shall be responsible for locating the position of all services, including mains, overhead and underground cables, pipes, canals, sewers and drains, and where necessary shall adopt such methods of excavation as may be required by the appropriate Authorities or Owners to ensure that no damage is caused to them.

All services which are encountered in the course of the Works even though they may not be in the line of excavation but near to it shall be adequately supported, slung up, strutted or otherwise protected from injury to the satisfaction of the persons or Authority in whom they may be vested.

The Contractor shall make good, at his own expense, any damage done to existing services to the complete satisfaction of and in accordance with the instruction of the appropriate Authority or Owner concerned, and shall keep the Procuring entity/Employer indemnified at all times from all claims, costs and expenses which may be brought against or incurred by the Procuring entity/Employer for or on account of any damage (whether permanent, temporary or recurring) to the said services.

In the event of the Owner or responsible Authority electing to repair such damage the Contractor shall pay the cost of his or their so doing the work. Should the Contractor fail to pay the cost of the said work within a reasonable period of the account being presented the Procuring entity/Employer reserves the right to settle the account and deduct the sum paid by

him from moneys due or which may become due to the Contractor. This shall in no case relieve the responsibilities of the Contractor under this Clause.

Separate payment will not be made for complying with the requirements of this Clause and all costs shall be deemed to be included in the various rates and lump sums tendered in the priced Bill of Quantities.

### **1-1.28.2 Diversion / Relocation of Public Utilities and Services**

The diversion / relocation of any public utilities or services within or outside the Works area to permit the construction of the Works or to suit the Contractor's method or sequence of work shall be the responsibility of the Contractor. Where a service is required to be interrupted or relocated the Contractor shall notify and arrange with the appropriate Authority or Owner for all permanent and temporary diversions so required. The Contractor shall keep the Engineer fully informed of his negotiations and no final arrangements shall be made without the approval of the Engineer.

In planning his work for the diversion / relocation of Public utilities or services the Contractor shall make proper allowance for the time necessary to obtain the Engineer's approval for the work and for the appropriate Authorities or Owners to authorize the work, obtain the necessary materials and carry out the work. The Contractor shall not be entitled to any extension of time because of his making insufficient allowances for the time taken to obtain approvals and complete the work.

Due allowance shall be made by the Contractor for the effect on the phasing of the Works of alterations to existing public and private mains and services necessitated by the Works. The Contractor must ensure that such existing mains and services are not interrupted without the written consent of the appropriate Authority or the Owner of the services concerned.

The Contractor shall ensure that his programme for the whole of the Works executed under the Contract is compatible with the requirements of the Service Authorities and the specifications and the Conditions of Contract. During the execution of the Works, he shall coordinate all services diversion operations with the remainder of the Works in close liaison with the Service Authorities and shall make such adjustments to his programme as are from time to time necessary to accommodate the actual progress achieved with the temporary and permanent diversions undertaken.

Separate payment will not be made for complying with the requirements of this Sub-Clause and all costs shall be deemed to be included in the various rates and lump sums tendered in the priced Bill of Quantities.

### **1-1.28.3 Relocation of Privately Owned Services**

If any privately Owned Services for water, electricity, drainage sewerage or telephones, passing through the site will be affected by the Works, the Contractor shall provide an approved equivalent alternative service in full working order to the satisfaction of the owner of the service and the Engineer, before the cutting of the existing service.

Separate payment will not be made for complying with the requirements of this Sub-Clause and all costs shall be deemed to be included in the various rates and lump sums tendered in the priced Bill of Quantities.

#### **1-1.29 Traffic Safety and Control (Traffic Safety Measures)**

The Contractor shall provide, erect and maintain such traffic signs, lamps barriers and traffic control signals and such other measures as may be necessitated by the construction of the Works in accordance with this Specification and in the local traffic safety rules. Where the circumstances of any particular case are not covered by the recommendations the Contractor shall submit proposals for dealing with such situations to the Engineer for approval. Compliance with this Clause shall not relieve the Contractor of any of his other obligations and liabilities under the Contract and under the relevant provision of the Road Traffic Ordinance.

The Contractor shall, after consultation with any statutory or other authority concerned, submit to the Engineer for his approval a programme based on such consultation showing the scheme of traffic management he proposed for carrying out the Works before commencing any work which affects the use of public highway or road and then furnish such further details and information as necessitated by the Works or as the Engineer may require.

The Contractor shall not commence any work which affects the public road until all traffic safety measures necessitated by the work are fully operational.

The traffic signs, lamps, barriers and traffic control signals shall be in accordance with the requirements of the Traffic Signs (Size, Colour and Type) Rules current at the date of the execution of the work and the local traffic safety rules.

Traffic signs and road danger lamps shall comply with the provisions of Section 12, Road Work, except that the flashing rate for flashing lamps shall be within the range 120-150 flashes per minute.

The minimum luminous intensity of the lamps shall be 0.5 candela for steady lamps, 1.0 candela for ripple lamps at their peak, and 1.5 candela for flashing lamps at their peak.

The Contractor shall keep clean and legible at all times signs, lamps, barriers and traffic control signals and he shall position, re-position, cover or remove them as necessitated by the progress of Works.

Separate payment will not be made for complying with the requirements of this Clause and all costs shall be deemed to be included in the various rates and lump sums tendered in the priced Bill of Quantities.

#### **1-1.31 Survey Equipment for the Engineer**

The Contractor shall provide and maintain during the period of the Contract for the exclusive use of the Engineer for any purpose in connection with the Contract surveying equipment in accordance with the following:

1 No.-	Total Station with tripod
1 No.-	Precise Levels (Automatic type), with tripod, magnification 34X
2 No.-	Leveling Staff with graduations in metric units
2 No.-	Steel measuring tapes 100 m long
2 No.-	Steel measuring tapes 20m long
3 No.-	Hand tapes 3 m (lockable in pocket)
2 No.-	Measuring rods(4m)
2 No.-	Ranging rods
2 No.-	Club hammer 2 Kg
1 No.-	Sledge hammer 4 Kg
2 No.-	Survey Umbrellas
1 No.-	Aluminum Straight Edges,3.0m long
1 No.-	Aluminum Straight Edges,5.0m long
1 No.-	Spirit Levels, 30 cm long.

The contractor shall make available one (1) qualified surveyor and required numbers of helpers as and when required by the Engineer Representative.

The equipment shall be maintained by the Contractor and kept in good working order and correct adjustment during the period of the Contract.

All equipment shall be suitable for working in metric units.

The Contractor shall make suitable replacement as directed by the Engineer in case of any loss or damage to the equipment provide by Contractor under this Clause. No extra payment shall be made for such replacements that shall be deemed to be covered under maintenance of Survey Equipments.

Upon completion of the Contract or at such time as it is no longer required by the Engineer for the Works the surveying equipment provided under this Clause shall remain the property of the Procuring entity/Employer.

**1-1.32 Assistance to Engineer****1-1.32.1 Provision of Labor**

The Contractor shall provide at all times during the period of the Contract, for the exclusive use of the Engineer, such labor, either continuously or from time to time, as may be required by the Engineer in carrying out his duties in connection with the Contract, namely:

- (i) In checking the setting out of the Works;
- (ii) In measuring the Works;
- (iii) In carrying out tests;
- (iv) Embankment cum concrete Laboratory Assistance
- (v) As messengers in connection with the Works; and
- (vi) As watchmen over the Project Site Office and equipment.

Separate payment will be made for fulfilling the requirements of this Sub-Clause. The costs shall be covered in the various rates tendered in the priced Bill of Quantities.

**1-1.33 Contractor's Duty Staff**

At least one responsible senior representative of the Contractor shall be immediately available at all times and he shall be on the Site during normal working hours. The representative shall be reasonably proficient in English as required in relevant Clauses of the Special Conditions of Contract. To such representative shall be delegated full authority to confer with the Engineer's Representative or his deputy and to take all steps and to issue all those instructions which may be required in an emergency to ensure the safety of all personnel of the Works and of all the Procuring entity/Employer's and other property on the Site and in the immediate vicinity thereof.

The Engineer may from time to time at his discretion after taking into consideration all the prevailing conditions allow some relaxation of this Clause but such relaxation shall be made only with the Engineer's written permission and subject to any special conditions which the Engineer may then require.

Separate payment will not be made for complying with the requirements of this Clause.

**1-1.34 Photographic Records****1-1.34.1 Color Photographs & Slides**

The Contractor shall procure a digital camera approved by the Engineers take colour progress photographs and slides under the direction of the Engineer of the works before during and after construction viewed from the same position. The number of photographs taken each month for the Engineer's selection shall not be less than 36.

The Contractor shall provide the Engineer, within seven (7) days of the following month proof copies of the photographs taken which shall be 120 mm by 90 mm in size, together with the color negatives.

The date the photograph was taken, the description and the negative number shall be recorded on the reverse side of each print.

After selection by the Engineer, one copy of each of the photographs selected shall be supplied to the Engineer together with their negatives in an approved album provided by the Contractor.

In addition, during the construction of the Works, the Contractor shall provide the Engineer with colour photographs for record purposes taken under the direction of the Engineer. These record photographs shall be supplied as two (2) prints, each not less than 290 mm by 200 mm in size together with the colour negative. The reverse of each print shall be inscribed with the signatures of the Contractor and Engineer, or their authorized representatives for the purposes of attestation and will be retained by the Procuring entity/Employer. Additional prints similarly attested may be retained by the Contractor. The date, caption, description and negative number shall also be recorded on the reverse side of each print. Negatives and prints shall not be retouched. The copyright of all photographs shall belong to the Procuring entity/Employer.

#### **1-1.34.2 Video Film**

- (a) The Contractor shall produce an edited and narrated video film in colour of not less than 90 minutes duration, showing all the major phases in the construction of the Project. The film shall be edited by a specialist experienced in the production of documentary video films. On completion of the project, two sets of the so completed video films shall be provided to the Procuring entity/Employer and one to the Engineer. Also video compact disc shall be provided to the Procuring entity/Employer.
- (b) The Contractor shall within Thirty (30) days of the Engineer's written order to commence work, submit for approval the name of the specialist proposed to carry out the work and details of his previous experience.
- (c) The copyright of the video-film shall belong to the Procuring entity/Employer.

#### **1-1.35 Amenities to be Preserved**

The Contractor shall cause the least possible interference with existing amenities whether natural or man-made. No trees shall be felled except on the instructions of the Engineer, and clearance of the Site shall be kept to the minimum necessary in the Work and Temporary Works.

#### **1-1.36 Impounding of Reservoir**

Impounding shall not commence until the Engineer has issued a written permission. The manner in which the reservoir is filled in so far as it is within the control of the Contractor, shall comply strictly with the terms and conditions laid down by the Engineer together with the permission for impounding.

Separate payment for Reservoir Impounding will not be made for complying with the requirements of this Clause and all coats shall be deemed to be included in the various rates and lump sums tendered in the priced Bill of Quantities.



**PART 2      PRODUCTS**  
**Not Used**

**PART 3      EXECUTION**  
**Not Used**

**PART 4      MEASUREMENT AND PAYMENT**

**1-4.1 Performance Security**

**1-4.1.1 Payment**

The cost of providing the Performance Security will be borne by the Contractor.

**1-4.3 Mobilization and Demobilization**

**1-4.3.1 Measurement**

The breakup of Lump sum price as proposed by the contractor and approved by the Engineer shall be the basis for payment

**1-4.3.2 Payment**

Payment for mobilization and demobilization shall be made on the basis of approved break-up of the lump sum price tendered thereof in the priced Bill of Quantities, which provide for all the cost of complying with the requirements of the General and Special Conditions of Contract. The Procuring entity/Employer shall not pay any additional amount for contractor's compliance with the related requirements of General Conditions of Contract.

**1-4.4.1 Measurement**

- a) The accommodation, office services and maintenance shall be made in arrears on monthly basis shall be the basis of payment for each month

**1-4.4.3 Unit of Measure**

Unit of measure for: a) Man-Month

## **SECTION 2 - QUALITY CONTROL**

### **PART 1 GENERAL**

#### **2-1.1 Scope**

The Contractor shall institute a Quality Assurance System to demonstrate compliance with the requirement of the Contract. The requirements of this Section of the Specifications apply to, and are a component part of, each section of the Specifications.

#### **2-1.2 References**

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM INTERNATIONAL (ASTM)**

ASTM D 3740 (2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (2002) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

#### **U.S. ARMY CORPS OF ENGINEERS (USACE)**

ER 1110-1-12 (1993) Quality Management

#### **2-1.3 Submittals**

The followings shall be submitted for Engineer's review and approval in accordance with Clause 1-1.4 - Submittal Procedures and in sufficient detail to show full compliance with the Specification:

#### **SD-01 Preconstruction Submittals**

Contractor's Quality Assurance Plan

#### **SD-06 Test Reports**

Contractor shall submit the following items in accordance with the Sub-Clause 2-1.6 – Records, of this section:

#### **Quality Control Data**

Quality Control Coordinating Actions

Quality Control Training

Inspection Records

Letters of Authority or Delegation

Field Tests

Factory Tests

#### **SD-07 Certificates**

a. Contractor shall submit a detailed written statement describing procedures that will be implemented to achieve quality on the project according to the Sub-Clause 2-1.5.1- Quality Assurance (QA) Plan of this Section.

- b. Contractor shall submit the following in accordance with the Sub-Clause 2-1.7.1- Qualifications of this Section:
- (i) Contractor's Quality Representative Qualifications
  - (ii) Special Certifications

#### **2-1.4 General Requirements**

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Conditions of Contract Sub-Clause 4.9 - Quality Assurance. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction, design and construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The Contractor's site project superintendent (Engineer) will be held responsible for the quality of work on the job and is subject to removal by the Engineer for non-compliance with the quality requirements specified in the Contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Engineer, and shall be responsible for all construction and construction related activities at the site.

#### **2-1.5 Quality Control Plan**

The Contractor shall furnish for review by the Engineer, not later than 60 days after receipt of notice to proceed, the Contractor's Quality Assurance (QA) Plan and a Design Quality control (DQC) Plan proposed to implement the requirements of the Part-I General Conditions of Contract Sub-Clause 36.1.

The QA plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Procuring entity/Employer will consider an interim plan for the first 90 days of operation. Design and construction will be permitted to begin only after acceptance of the QA Plan and DQC Plan or acceptance of interim plans applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a QA Plan and or DQC plan other interim plan containing the additional features of work to be started.

##### **2-1.5.1 Quality Assurance (QA) Plan**

The QA plan shall address the following:

- (a) Description of the authority, responsibilities and coordinating procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.
- (b) Plan shall list personnel designated by the Contractor to accomplish the work required by the contract.
- (c) QA plan shall also contain an appendix with a copy of each form, report format, or similar record to be used in the QA program.
- (d) Contractor's organization that handles construction contract activities.
- (e) Contractor's operational plan for accomplishing and reviewing work controls, fabrication controls, certifications, and documentation of quality control operations, inspections, and test records, including those for subcontractors. These provisions shall include the methods to be used during the procurement cycle (order to delivery)

for those materials or equipment that require source inspections, shop fabrications, or similar operations located separately from the work site.

- (f) Description of on-site personnel training.
- (g) Certification(s) of personnel, procedures, processes, and equipment.
- (h) Nondestructive testing requirements.
- (i) Identification of independent certifying and testing laboratories.

### **2-1.5.2 Design Quality Control (DQC) Plan**

The following requirements apply to the Design Quality Control (DQC) plan for the works, which are to be designed by the Contractor.

- (a) The Contractor shall maintain a Design Quality Control (DQC) Plan as an effective quality control program which will assure that all services required by this Contract are performed and provided in a manner that meets professional engineering quality standards. The Contractor shall correct errors and deficiencies in the design documents prior to submitting them to the Engineer for review and approval.
- (b) The Contractor shall include the design schedule in the master project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific contract period. This should be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. The schedule shall include review and correction periods associated with each item. This should be a forward planning as well as a project monitoring tool. If the schedule is changed, the Contractor shall submit a revised schedule reflecting the change within 7 calendar days. The Contractor shall include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. These completed checklists shall be submitted at each design phase as part of the project documentation.
- (c) The DQC Plan shall be implemented by a Design Quality Control Manager who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated. This individual shall be a person who has verifiable engineering design experience and is a registered professional engineer. The Contractor shall notify the Engineer, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

The Engineer will notify the Contractor in writing of the acceptance of the DQC Plan. After acceptance, any changes proposed by the Contractor are subject to the acceptance of the Engineer.

### **2-1.6 Records**

Records shall include all quality control data; factory tests or manufacturer's certifications, quality control coordinating actions; records of quality control training/certifications as well as routine hydrostatic, electrical continuity, grounding, welding, line cleaning, field tests and similar tests. Quality records shall be available for examination by the Engineer.

Legible copies of the test and inspection records shall be furnished to the Engineer. Records shall cover work placement traceable to the contract schedule, Specifications and drawings, and shall be verified by the Contractor.

Contractor shall submit for approval, the narrative description of an inspection system which provides for compliance with the quality requirements and technical criteria of the Contract within 30 calendar days after notice to proceed.

Contractor shall submit a monthly performance report that summarizes the quality operations. This report shall identify inspections made, tests performed, nonconformances, corrective actions taken, status of plans/procedures being developed, and status of open items/problems in work.

Contractor shall submit Letters of Authority or Delegation outlining the authority and responsibilities of quality control personnel along with a copy of the letter of delegation to the Engineer that defines delegated duties and responsibilities.

In-process inspection records and control away from the job site may be used as evidence of quality of materials/work and may reduce further inspection or testing after delivery to the job site.

## **2-1.7 Quality Assurance**

### **2-1.7.1 Qualifications**

Contractor's Quality Representative qualifications shall be submitted to the Engineer for approval.

When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the Specifications, the Contractor shall obtain necessary approvals or special certifications prior to starting the work.

### **2-1.7.2 Quality Control Requirements**

Contractor shall provide a quality control program encompassing: selection of construction materials and sources; suppliers; subcontractors; on-site and off-site fabrication of Contractor-furnished assemblies; on-site and off-site assembly; erection; work procedures; workmanship; inspection; and testing.

Contractor's program shall provide document systems ensuring that quality provisions of contract schedule, Specifications, and drawings have been performed.

#### **(a) Management and Organization**

Contractor shall designate an individual as Quality Programme Manager within the on-site organization whose sole responsibility shall be the day-to-day on-site management and direction of the Quality Program.

The Quality Program Manager shall report to the Contractor's management and shall have the necessary authority to discharge contractual responsibilities.

#### **(b) CQC Personnel**

The Contractor shall also provide specialized personnel to assist the Quality Programme Manager for the following areas: civil, structural, electrical, mechanical, environmental, materials technician, engineering geology, submittals clerk. These individuals may be employees of the Contractor or Subcontractor; be responsible to the Quality Programme Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan.

#### **Experience Matrix**

<b>Area</b>	<b>Qualifications</b>
• Civil	Graduate Civil Engineer with 5 years' experience in the type of work being performed on this project or technician with 10 yrs related experience
• Structural	Graduate Structural Engineer with 5 yrs experience or person with 5 yrs related experience

- Mechanical Graduate Mechanical Engineer with 2 yrs experience or person with 5 yrs related experience
- Electrical Graduate Electrical Engineer with 2 yrs related experience or person with 5 yrs related experience
- Engineering Geologist Graduate Engineering Geologist with 2 yrs experience or person with 5 yrs related experience
- Environmental Graduate Environmental Engineer with 3 yrs experience
- Concrete, Pavements and Soils Materials Technician with 10 yrs experience for the appropriate area
- Design Quality Control Manager Registered Professional Engineer
- Submittals Submittal Clerk with 1 yr experience

**(c) Identification and Data Retrieval**

Contractor shall have an identification and data retrieval system.

Referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System shall identify records, drawings, submittals, and equipment.

**(d) Procurement**

Contractor shall be responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality requirements.

**(e) Receiving Inspection System**

Contractor shall maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records shall accompany each procurement delivery to the construction site. Records of site receiving inspections shall be maintained by the Contractor.

Records shall show defects, discrepancies, dispositions, and waivers.

**(f) Nonconforming Articles and Material Control**

The Contractor shall control non-conformances discovered by the Contractor, subcontractors, suppliers or Engineer quality representatives to prevent their use and to correct deficient operations.

- (i) Contractor shall prepare a "non-conformance" report for each instance comprising:
  - (1) A unique and traceable number.
  - (2) Identification of the non-conforming article or material.
  - (3) A description of the non-conformance and the applicable requirement.
  - (4) Cause or reason for the non-conformance.
  - (5) Remedial actions taken or recommended.
  - (6) Disposition of the nonconforming article or material.
- (ii) The Contractor shall identify and mark each nonconforming article for removal from the work area.
- (iii) The Contractor shall monitor and correct deficient operations.

**(g) Fabrication Process and Work Control**

Contractor's procedures and controls shall ensure compliance with requirements in contract Specifications and drawings.

Contractor shall establish in-process inspections, to ensure compliance with quality requirements.

Special processes may include, but are not limited to, plating, anodizing, nondestructive testing, welding, and soldering.

**(h) Quality Control Records**

Quality control records shall be maintained at a central on-site location. Maintenance of quality control records shall not relieve the Contractor from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification.

Contractor shall ensure each record is identified and traceable to specific requirements in the Specifications and drawings.

**(i) Drawings and Change Control**

Drawing-control system shall be maintained to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Changes involving interface with other work areas, or affecting materials controlled by others shall be controlled by the Contractor. This system shall be integrated with the document requirements of the contract.

Drawing changes shall be clearly annotated. Implemented changes shall be clearly identified and associated drawings shall be revised accordingly. Drawings that have been approved, or approved as noted, by the Engineer shall be used for fabrication and inspection.

**2-1.7.3 Quality Inspections**

**(a) Engineer's Inspections**

Work performed under this Contract will be subject to inspection by the Engineer.

When the Engineer determines that inspected work needs to be corrected, the Engineer will be allowed 24 hours to complete reinspection of the corrected work.

Engineer shall also be notified in writing before backfilling or encasing any utility so that work may be inspected. Failure to notify the Engineer before backfill or encasement occurs shall require the work be uncovered at no additional cost to the Procuring entity/Employer.

Contractor's program is subject to continuous evaluation, review, and verification by the Engineer. Contractor will be notified in writing of any noncompliance and will be given 15 calendar days to correct identified deficiencies.

**(b) Contractor's Quality Inspections**

Contractor shall implement an inspection system. Documentation shall indicate quality control through records of inspections, tests, and procedures.

Contractor's quality assurance system shall include the following:

- (i) Single Contractor's representative responsible for on-site communication and operation of the inspection program.
- (ii) Purchasing control system documenting project procurement to drawings, Specifications, and approved submittals.
- (iii) Receiving inspection system documenting inspections for each procurement.
- (iv) Documentation for handling and disposing of nonconforming components and materials.
- (v) Inspection records for each specific section of the Specification and drawings.
- (vi) Identification of test(s) to be performed, test procedures, records, and independent organizations used.
- (vii) Documenting and maintaining certification or re-certification of procedures.

(viii) Calibration of gages, tools, measuring instruments, and independent laboratories used.

Contractor shall establish a system of scheduled or random audits to ensure task completion.

#### **2-1.7.4 Field Services**

##### **(a) Responsibility for Inspection and Testing**

Contractor shall be responsible for all inspections and tests, and the accompanying documentation for each inspection and test. Contractor shall establish his own laboratory at site or may utilize independent inspection and testing laboratories or services as approved by the Engineer. Contractor shall also be responsible for tests of construction materials utilizing the services of an approved independent testing laboratory.

##### **(b) Inspection and Test Records**

Contractor shall provide on-site records of each inspection and test performed throughout the life of the contract. Records shall include, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Inspection records, test procedures, test results, and associated forms be verified by and provided to the Engineer. Final test data shall have a cover letter/sheet clearly marked with the system name, date, and the words "Final Test Data".

#### **2-1.8 Handling and Storage**

Contractor shall provide controls, procedures and documentation with each shipment that meet requirements of each section of the Specifications.

The Contractor shall include documentation with each shipment. The data shall consist of documentation required by the Contract along with Specifications required to identify, store, preserve, operate, and maintain the items shipped.

#### **2-1.9 Sequencing and Scheduling**

Contractor shall notify the Engineer at least 24 hours prior to scheduled inspections and tests.

Contractor shall provide 24 hour notice to the Engineer of the date when any contract work will begin at the site.

When Contractor suspends work for 7 calendar days or longer prior to completion, the Engineer shall be notified. Work shall not resume without notification of the Engineer.

Engineer shall be notified at least 24 hours in advance of backfilling or encasing any underground utility.

#### **2-1.10 Tests**

##### **2-1.10.1 Testing Procedure**

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Engineer duplicate samples of test specimens for possible testing by the Procuring entity/Employer. Testing includes operation and/or acceptance tests when specified. The tests shall be conducted at the project site laboratory or any other laboratory approved by the Engineer. The Contractor shall perform the following activities and record and provide the following data:

- (a) Verify that testing procedures comply with contract requirements.
- (b) Verify that facilities and testing equipment are available and comply with testing standards.
- (c) Check test instrument calibration data against certified standards.



- (d) Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- (e) Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Engineer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Engineer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this Contract.

#### **2-1.10.2 Testing Laboratories**

##### (a) Capability Check

The Procuring entity/Employer reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract Specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

##### **(b) Onsite Laboratory**

The Procuring entity/Employer reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Procuring entity/Employer.

#### **2-1.10.3 Furnishing or Transportation of Samples for Testing**

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Procuring entity/Employer shall be delivered to the laboratory approved by the Engineer located in Pakistan.

### **2-1.11 Completion Inspection**

#### **2-1.11.1 Pre-Final Inspection**

The Engineer will perform the pre-final inspection to verify that the project works are complete and ready to be occupied. A Pre-Final Punch List may be developed as a result of this inspection. The Contractor's Quality Program Manager shall ensure that all items on this list have been corrected before notifying the Engineer, so that a Final inspection with the Procuring entity/Employer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time stated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

#### **2-1.11.2 Final Acceptance Inspection**

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Engineer's Representative shall be in attendance at the final acceptance inspection. Additional Procuring entity/Employer personnel including, may also be in attendance. The final acceptance inspection will be formally scheduled by the Engineer based upon results of the Pre-Final inspection. Notice shall be given to the Engineer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection.

### **2-1.12 Documentation**

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- (a) Contractor/subcontractor and their area of responsibility.
- (b) Operating plant/equipment with hours worked, idle, or down for repair.
- (c) Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- (d) Test and/or control activities performed with results and references to Specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.
- (e) Quantity of materials received at the site with statement as to acceptability, storage, and reference to Specifications/drawings requirements.
- (f) Submittals and deliverables reviewed, with contract reference, by whom, and action taken.
- (g) Offsite surveillance activities, including actions taken.
- (h) Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- (i) Instructions given/received and conflicts in plans and/or Specifications.
- (j) Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Engineer daily within 48 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the Quality Program Manager. The report from the Quality Program Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

### **2-1.13 Notification of Noncompliance**

The Engineer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTIONS**

Not Used

## **PART 4 MEASUREMENT AND PAYMENT**

### **2-4.1 Payment**

No separate payment will be made for compliance of requirements of this Section. All costs associated with Quality Control are deemed to be covered in the rates tendered for the Bill of Quantities and as such indirectly included in the Contract Price.

## SECTION 3 – ENVIRONMENTAL PROTECTION

### PART 1 GENERAL

#### 3-1.1 References

The documents listed below form a part of this specification to the extent refined:

- World Bank (OD/OP 04)
- Pakistan Land Acquisition Act.
- The Environmental Protection Agency, Government of Pakistan.

#### 3-1.2 Definitions

#### 3-1.3 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

#### 3-1.4 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

#### 3-1.5 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of materials brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

#### 3-1.6 General Requirements

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental laws and regulations of Government. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

#### 3-1.7 Subcontractors

The Contractor shall ensure compliance with this section by subcontractors.

#### 3-1.8 Submittals

The following shall be submitted in accordance with Sub-Clause 1-1.4 Submittals Procedures:

#### SD-01 Preconstruction Submittals:

Environmental Protection Plan

#### 3-1.9 Environmental Protection Plan

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Engineer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall

be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task. Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Engineer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained on site by the Contractor.

### **3-1.9.1 Compliance**

No requirement in this Section shall be construed as relieving the Contractor of any applicable Environmental protection laws and regulations of the Government. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

### **3-1.9.2 Contents**

The Environmental Protection Plan shall include, but shall not be limited to, the following:

- a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
- b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.
- c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
- d. Description of the Contractor's environmental protection personnel training program.
- e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, laws and regulations of the Government.
- f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.
- g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.
- h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or non-use. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.
- i. Drawing showing the location of borrow areas.
- j. The Spill Control Plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated under laws and regulations of the Government. The Spill Control Plan shall include as a minimum:
  1. The name of the individual who will report any spills or releases of hazardous substances and who will follow up with complete documentation. This individual shall immediately notify the Engineer and the local fire department in addition to the legally required reporting channels if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.
  3. Training requirements for Contractor's personnel and methods of accomplishing the training.
  4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
  5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.
  6. The methods and procedures to be used for expeditious contaminant cleanup.
- k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July, and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic meters or tons along with the percent that was diverted.
- l. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to participate in Government sponsored recycling programs to reduce the volume of solid waste at the source.
- m. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.
- n. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Government laws and regulations for storage and handling of these materials. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.
- o. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfections water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.
- p. A historical, archaeological, cultural resources biological resources and wet lands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be on site or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Engineer.

- q. A pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for the Government regulations on pest management record keeping and reporting requirements.

### **3-1.9.3 Appendix**

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached, as an appendix, to the Environmental Protection Plan.

### **3-1.10 Protection Features**

Prior to start of any onsite construction activities, the Contractor and the Engineer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and the Engineer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the Contract.

### **3-1.12 Environmental Assessment of Contract Deviations**

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Engineer and may require an extended review, processing, and approval time. The Engineer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Engineer determines that the proposed alternate method will have an adverse environmental impact.

### **3-1.13 Notification**

The Engineer will notify the Contractor in writing of any observed noncompliance with the Government environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Engineer of the proposed corrective action and take such action when approved by the Engineer. The Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Engineer may take under the Contract.

## **PART 2 PRODUCTS**

**(NOT USED)**

## **PART 3 EXECUTION**

### **3-3.1 Environmental Permits and Commitments**

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by the Government environmental laws and regulations.

### **3-3.2 Land Resources**

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following Sub-Clauses. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

#### **3-3.2.1 Work Area Limits**

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

#### **3-3.2.2 Landscape**

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

#### **3-3.2.3 Erosion and Sediment Controls**

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Government laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices which may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Any temporary measures shall be removed after the area has been stabilized.

#### **3-3.2.4 Contractor Facilities and Work Areas**

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Engineer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

### **3-3.2 Water Resources**

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by concerned Government Agencies.

**3-3.3.1 Cofferdams, Diversions, and Dewatering Operations**

Construction operations for dewatering and removal of cofferdams shall be controlled at all times to maintain compliance with existing Government Water Quality standards and designated uses of the surface water body.

**3-3.3.2 Stream Crossings**

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Government.

**3-3.4 Air Resources**

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all air emission and performance laws and standards of the Government. The Contractor shall provide temporary ventilation system for working inside the grouting and inspection gallery until the permanent ventilation system, as specified, is installed and commissioned.

**3-3.4.1 Particulates**

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the air pollution standards of the Government to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, bag house, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all the Government Visibility Regulations.

**3-3.4.2 Odors**

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with Government regulations and/or ordinances.

**3-3.4.3 Sound Intrusions**

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the Government, rules.

**3-3.4.4 Burning**

Burning will not be allowed on the project site unless specified in other sections of the specifications or authorized in writing by the Engineer. The specific time, location, and manner of burning shall be subject to approval. Fires shall be confined to a closed vessel, guarded at all times, and shall be under constant surveillance until contents have burned out or have been extinguished. Burning shall completely reduce the materials to ashes.

**3-3.5 Chemical Materials Management and Waste Disposal**

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.



**3-3.5.1 Solid Wastes**

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste.

**3-3.5.2 Chemicals and Chemical Wastes**

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 150 mm of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with the Government laws and regulations.

**3-3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials**

Hazardous wastes are as defined by applicable regulations of the Government. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with the Government laws and regulations. The Contractor shall dispose of hazardous waste in compliance with the Government laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Engineer Cleanup and cleanup costs due to spills shall be the Contractor's responsibility.

**3-3.5.4 Fuel and Lubricants**

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Government laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with the Government laws and regulations.

**3-3.5.5 Waste Water**

Disposal of waste water shall be as specified below.

- a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water in accordance with all the Government laws and regulations or by collecting and placing it in a retention pond, where suspended material can be settled out and/or the water can evaporate to separate pollutants from the water. The site for the retention pond shall be coordinated and approved by the Engineer. The residue left in the pond prior to completion of the project shall be removed, tested, and disposed of from project site in accordance with the Government laws and regulations. The area shall be backfilled to the original grade, top-soiled and seeded/sodded.
- b. For discharge of groundwater, the Contractor shall obtain a Government permit specific for pumping and discharging ground water prior to surface discharging. Land application shall be in accordance with all Government laws and regulations for pumping and land applying ground water.

**3-3.6 Recycling and Waste Minimization**

The Contractor shall participate in the Government sponsored Recycling Programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

**3-3.7 Non-Hazardous Solid Waste Diversion Report**

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall submit a report to the Engineer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. The following shall be included in the report:

- a. Construction and Demolition (C&D) Debris Disposed in cubic meters.
- b. Construction and Demolition (C&D) Debris Recycled in cubic meters.
- c. Total C&D Debris Generated in cubic meters.

**3-3.8 Historical, Archaeological, and Cultural Resources**

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, paving's, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Engineer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

**3-3.9 Biological Resources**

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Government laws and regulations.

**3-3.10 Integrated Pest Management**

In order to minimize impacts to existing fauna and flora, the Contractor, through the Engineer, shall coordinate with the concerned government agency to give opportunity to their representative to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide.

**3-3.10.1 Pesticide Delivery and Storage**

Pesticides shall be delivered to the site in the original, unopened containers bearing legible labels and the manufacturer's registered uses. Pesticides shall be stored according to manufacturer's instructions and stored under lock and key when unattended.

**3-3.10.2 Qualifications**

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the Governorate where the work is to be performed.

**3-3.10.3 Pesticide Handling Requirements**

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment

specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS) shall be available for all pesticide products.

#### **3-3.10.4 Application**

Pesticides shall be applied by a Government Certified Pesticide Applicator in accordance with the Government restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Engineer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

#### **3-3.11 Previously Used Equipment**

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds.

#### **3-3.12 Maintenance of Pollution Facilities**

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

#### **3-3.13 Military Munitions**

In the event the Contractor discovers or uncovers military ammunitions as defined the Contractor shall immediately stop work in that area and immediately inform the Engineer.

#### **3-3.14 Training of Contractor's Personnel**

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

#### **3-3.15 Post Construction Clean-up**

The Contractor shall clean up all areas used for construction in accordance with Sub-Clause 4.23 of the Conditions of Contract. The Contractor shall, unless otherwise instructed in writing by the Engineer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

### **PART 4 MEASUREMENT AND PAYMENT**

#### **3-4.1 Payment**

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. (The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with the Government laws and regulations).

All costs associated with this section shall be deemed covered in the rates quoted in the Bill of Quantities & included in the Contract Price.

## **SECTION 4 - DIVERSION AND CARE OF WATER**

### **PART I**

#### **4-1.1 Scope**

This Section covers the technical requirements for the planning, design, testing, construction, maintenance and removal of the Temporary Works required for the diversion and care of water during the period of construction of the Permanent Works.

#### **4-1.2 Reference**

##### **U.S. Army Corps of Engineers (USACE)**

EM 1110-2-2300 (1994) Earth and Rock fill Dams-General Design and Construction Considerations.

#### **4-1.3 Definitions**

The following terms shall have the meanings hereby assigned to them:

Cofferdam: A temporary diversion embankment to divert flood water during construction.

#### **4-1.4 Submittals**

The following shall be submitted for Engineer's review and approval in accordance with Sub-Clause 1-1.4 - Submittal Procedures.

##### **SD-01 Preconstruction Submittals**

Proposal on Diversion and Care of water.

##### **SD-02 Shop Drawings**

- Drawings of Diversion Scheme

##### **SD-05 Design Data**

Construction of diversion and appurtenant system for the diversion and care of water.

##### **4-1.4.1 Initial Submission**

The Contractor shall submit his proposed Diversion Scheme for the approval of the Engineer within 30 days of the Engineer's notice to commence work. This submission shall include all information necessary to understand fully the Contractor's Diversion Scheme and its interrelationship with the Contractor's Construction Schedule. The submission shall include the following:

- Descriptions and drawings of the various stages of the Diversion Scheme.
- Outline designs and construction methods of all the features of the Diversion Scheme.
- Descriptions of the methods, including the layout and capacity, of the drainage and dewatering systems proposed for the construction of all parts of the Permanent Works.
- Proposed outline specifications for any elements of the Temporary Works not covered by these Technical Specifications, or for which the Contractor wishes to propose alternative specifications.

- Description of any aspects of the Contractor's Diversion Scheme which may differ from that submitted with his Tender, giving the reasons for such differences.

After reviewing the initial submission, the Engineer may require the Contractor to submit further information or amended proposals until, in the Engineer's opinion, the proposals are satisfactory. The Engineer will then approve the Contractor's Diversion Scheme.

#### **4.1.4.2 Detailed Submissions**

Within 28 days after approval of the Contractor's Diversion Scheme, the Contractor shall submit for the approval of the Engineer detailed designs of all the features forming part of the scheme, together with full technical specifications for any matters covered by Sub-Clause 4-1.4.1 hereof.

#### **4-1.5 Measures Included**

In accordance with the Specifications contained in this Section and or as directed, the Contractor shall:

- Divert and control the flows from the catchment of the Nari River, and
- Care for all surface water and groundwater from any source, as may be required, so that all the construction work can be performed in areas free from water.

The Contractor shall design, furnish, construct, operate, maintain, and remove the necessary facilities as may be required for diversion, for dewatering the construction areas, for caring for all surface water and groundwater from any source, and for general protection of the Works.

The design of all Temporary Works for the diversion and care of water shall be carried out by the Contractor and shall conform to accepted and safe engineering practice. The Contractor shall include with his submissions copies of all design calculations relating thereto.

The Contractor's proposals for diversion and care of water shall not require any change to the location, dimensions, design or details of any part of the Permanent Works, unless approved by the Engineer pursuant to Sub-Clause 4-3.5.

#### **4-1.6 Works used for diversion**

With the approval of the Engineer, the Contractor may use parts of the Permanent Works, such as the sluices, outlets and partly completed spillway section where downstream stilling basin and downstream protection works have been completed to divert river flows.

#### **4-1.7 Data Supplied to Contractor**

The limited hydrological data, for Jalar algadis available which can be supplied to the Contractor on demand. The Procuring entity/Employer does not guarantee the reliability or accuracy of these data and will not be responsible for any deductions, conclusions or interpretations, which may be made by the Contractor from these data.

#### **4-1.8 Contractor's Diversion Scheme**

#### **4-1.8.1 General Requirements**

The Contractor shall plan, design, construct, operate, maintain and remove, when required, all parts of his scheme for controlling and diverting the tributaries and for taking care of surface and ground water throughout the construction period.

The Contractor's Diversion Scheme shall be suitable and sufficient for the intended purpose and shall meet the specific design criteria given hereunder.

#### **4-1.8.2 Criteria**

The Contractor's Diversion Scheme shall be based on the general guidelines on design of diversion works as provided in USACE – EM 1110-2-2300: “Earth and Rock fill Dams – General Design and Construction Considerations”, or any other criteria approved by the Engineer.

Any diversion channel included in the Contractor's Diversion Scheme other than that mentioned in Engineer's Diversion Plan shall be designed by the Contractor. The Contractor shall carry out sufficient surveys as may be needed to establish the required extent of the diversion channel and demonstrate to the satisfaction of the Engineer that the channel will perform as intended.

#### **4-1.8.3 Use of Permanent Works**

The proposed use of any part of the Permanent Works as part of the Contractor's Diversion Scheme shall be such that the Permanent Works are not subjected to any greater loads or any other more adverse conditions, such as erosion, than would occur after that part of the Permanent Works has been put into service during impounding or after completion of the construction.

#### **4-1.9 Contractor's acknowledgement and responsibility**

The Contractor shall be solely and fully responsible for the diversion and care of water throughout the period of construction and for any damage to persons and property, as provided in Clauses 21.1 of the Part-I General Conditions of Contract.

The Contractor shall be responsible for any damage or detriment to the Permanent Works which may result from any overtopping, breach, breakdown or other failure of his measures for the diversion and care of water, and shall make good such damage to the satisfaction of the Engineer, at no additional cost to the Procuring entity/Employer.

### **PART 2 PRODUCTS**

#### **4-2.1 Materials**

The materials used for all diversion features shall conform to the requirements of the appropriate sections of these Specifications.

### **PART 3 EXECUTION**

#### **4-3.1 General**

In addition to the specific requirements of this Section, the construction of all Temporary Works for the diversion and care of water shall conform to the requirements of the appropriate sections of these Specifications.

#### **4-3.2 Closure of Diversion Channels**

No diversion channel shall be closed unless the Engineer is satisfied that its closure can be undertaken without detriment to the safe conveyance of water through and/or past the site of the Permanent Works, and that those parts of the arrangements for the diversion and care of the water remaining after its closure will meet the requirements of this Section of the Specifications. Nor shall it be closed until the Engineer is satisfied that the Contractor has made adequate preparations and secured sufficient resources for the proper and timely execution of any subsequent parts of the Diversion Scheme as the Engineer may consider necessary to allow the safe discharge of river flows.

Closure of a diversion channel shall not be commenced without the written permission of the Engineer.

#### **4-3.3 Incorporation in Permanent Works**

Subject to the approval of the Engineer, any suitable part of the Temporary Works which is located within the limits of Permanent Works may be incorporated therein, provided that its construction standard has been shown to meet the specified requirements, and the construction details are compatible with the design of the Permanent Works.

Subject to the approval of the Engineer, parts of the Permanent Works may be constructed with additional features required to enable them to function as part of the diversion arrangements. Such features may be retained within the Permanent Works, subject to the approval of the Engineer, provided that their construction standard has been shown to meet the specified requirements and the construction details are compatible with the design of the Permanent Works.

#### **4-3.4 Dewatering**

##### **4-3.4.1 General**

Except where otherwise specified, shown on the Drawings or approved by the Engineer, the Contractor shall maintain all foundations and other Permanent Works areas well drained and free of water of any origin, including groundwater, seepage, precipitation, runoff or from construction uses.

Except where otherwise approved by the Engineer, the Contractor shall drain, dewater and keep dry all areas of construction that are below the river or the groundwater elevation, and shall ensure that all excavated surfaces are maintained in a safe and stable condition.

All embankments whether Permanent Works or Temporary Works, shall be placed in the dry, with the exception of such parts of the Contractor's Diversion Scheme as are designed to be placed in water and have received the Engineer's approval for that method of placing.

The work to be performed by the Contractor in connection with dewatering shall include, but not necessarily be limited to, the following:

- The supply, installation, operation, maintenance and subsequent removal of all pumps, pumping stations, pipework and other equipment, including sufficient standby equipment, for the dewatering of the works areas and maintaining those areas free of water as required. Should deep well pumps be deployed, they shall be placed at least 30 m beyond the limits of any completed Permanent Works, except flexible aprons.
- The construction, maintenance and subsequent removal of any temporary sumps, lagoons, chambers, flumes, cofferdams, protective bunds or dykes and the like. All temporary sumps and lagoons shall be placed at least 20 m beyond the limits of any Permanent Works.

- The construction, maintenance and subsequent backfilling of such temporary drains or ditches as are required to efficiently carry all water to sumps or other collection or disposal locations.
- The supply, installation, maintenance, operation and subsequent removal of dewatering wells and/or well points.

Subject to the Engineer's approval, which shall not be unreasonably withheld, the Contractor may deploy any other appropriate part of the Permanent Works as part of his drainage and dewatering arrangements.

#### **4-3.4.2 Groundwater Pressure Relief**

The Contractor shall evaluate all groundwater information and take whatever measures are necessary to ensure the stability of all structures and ground surfaces during construction. The measures needed may depend on the precise sequence of such matters as excavation, construction and the installation of permanent drainage wells and blankets.

The Contractor's dewatering arrangements may require the drilling of drainage wells from the ground surface, together with the installation of piezometers to monitor groundwater levels and the performance of the dewatering arrangements.

If, in the opinion of the Engineer, the foundation is damaged due to any inadequacy or failure of the Contractor's system for groundwater pressure relief, then the Contractor shall take all corrective measures necessary, as directed by the Engineer, at no additional cost to the Procuring entity/Employer.

#### **4-3.4.3 Excavations for Concrete Structures**

At all excavations where concrete is to be placed, the water level within and adjacent to the excavation shall be maintained a minimum of 300 mm below the finished excavation for at least 24 hours after the completion of the structure to an elevation above the natural water-table, or for such additional time as the Engineer may require to preclude injury to the foundation or structure.

#### **4-3.5 Maintenance of Temporary Works**

The Contractor shall maintain all Temporary Works required for the diversion and care of water, shall carry out any repairs promptly and shall ensure that each part of the Temporary Works functions properly throughout the period during which it is required.

#### **4-3.6 Removal of Temporary Works**

Subject to the requirements for the diversion and care of water shall be removed promptly after they have served their intended purpose. The Engineer may, however, permit the removal of certain Temporary Works to be delayed, if he is satisfied that this will cause no detriment to the Permanent Works or to the safe conveyance of water through and/or past the site of the Permanent Works, and that the Contractor has made adequate provision for their subsequent timely removal.

Removal of all Temporary Works for the diversion and care of water shall be carried out in a workmanlike manner and to the approval of the Engineer, leaving a clean appearance to the remaining surfaces, and so as not to interfere with the proper completion or future functioning of the Project. Waste material shall be properly disposed of, to the approval of the Engineer.



The site of any diversion channel shall be backfilled and reinstated to such levels and in such a manner as the Engineer may direct, having regard to the subsequent construction of Permanent Works on or near the site of the diversion channel and the safe conveyance of water through and/or past the Works.

#### **4-3.7 Reinstatement**

Any surfaces which are affected by erosion or deposition due to the flow of water shall be reinstated in such a manner and at such a time as the Engineer may direct, having regard to the construction, safety, stability and proper functioning of the Permanent Works.

### **PART 4 MEASUREMENT AND PAYMENT**

#### **4-4.1 General**

No measurement or payment shall be made for diversion, drainage, dewatering or care of water, except as specified herein and included in the Bill of Quantities.

The lump sum price included in the priced Bill of Quantities shall be deemed to cover all costs of diverting the flows, conveying flows through and/or past the site of the Permanent Works, keeping each part of the Works protected against inundation, well drained and properly dewatered during construction; and of constructing, maintaining, operating and removing all Temporary Works in connection therewith. Any costs resulting from accidental inundation of any working areas, whether due to breakdown, failure or overtopping of the Temporary Works, shall be to the account of the Contractor.

The lump sum price shall be deemed to include all measures for the diversion and care of water including dewatering of foundations, required for the proper completion of the Permanent Works, whether or not they are specifically mentioned in the Contract.

The lump sum price shall be deemed to take account of any effects of the measures for the diversion and care of water on any surfaces, including such effects as erosion and deposition due to the flow of water. The lump sum price shall be deemed to include all costs resulting from the reinstatement of such surfaces.

Progress payments for diversion and care of water shall be made according to such schedule as the Engineer approves as reasonable, having regard to the construction schedule of each feature of the Works.

#### **4-4.2 Diversion and Care of Water**

##### **4-4.2.1 Measurement**

Diversion and care of water will be measured on the basis of breakdown of the Lumpsum Price showing cost of all items for water control works of listed in the Water Control Plan proposed by him and submitted with the Tender.

##### **4-4.3 Incorporation in Permanent Works**

Any parts of the Temporary Works which become incorporated within the Permanent Works shall, at the time of incorporation, be measured for payment to such limits and under such bill items as would have applied to the relevant part of the Permanent Works, as if that part of the Temporary Works had not previously existed.

## SECTION 5 – EXCAVATION AND MISCELLANEOUS EARTHWORK

### PART 1      GENERAL

#### 5-1.2      REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM INTERNATIONAL (ASTM)

ASTM C 117	(1995) Standard Test Method for Materials Finer than 75-micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2001) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33	(2003) Concrete Aggregates.
ASTM C 88	(1999a) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2434	(1968; R 2000) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(2000e1) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3282	(1993; R 1997) Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D 3740	(1994) Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

**AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)**

AASHTO T 2 (2000) Standard Specification for Sampling of Aggregates

AASHTO M 145 (1991; R 1995) Recommended Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

AASHTO T 180 (1997) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 87 (1986; Rev 1993) Standard Method for the Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test

**U.S. ARMY CORPS OF ENGINEERS (USACE)**

EM 385-1-1 (2003) Safety -- Safety and Health Requirements

**U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)**

29 CFR 1926 (2001) Safety and Health Regulations for Construction

**5-1.3 DEFINITIONS****5-1.3.1 Satisfactory Materials**

Satisfactory materials for road fill shall mean AASHTO M 145, (ASTM D 3282) Soil Classification Groups A-1, A-2-4, A-2-5, and A-3.

Satisfactory materials for grading shall be comprised of stones less than 200 mm, except for fill material for pavements and roads which shall be comprised of stones less than 75 mm in any dimension.

**5-1.3.2 Unsatisfactory Materials**

Unsatisfactory soil materials for road fill shall mean AASHTO M 145, Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, peat and other highly organic soil, and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

For other fills, the materials, which do not comply with the requirements for satisfactory materials, are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Engineer shall be notified of any contaminated materials.

**5-1.3.3 Cohesion less and Cohesive Materials**

Cohesion less materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesion less only when the fines are neoplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

**5-1.3.4 Hard/Unyielding Materials**

Weathered rock, dense consolidated deposits, or conglomerate materials, not included in the definition of "rock", with stones greater than 100 mm in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

**5-1.3.5 Rock**

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 0.4 cubic meter in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

#### **5-1.3.6 Unstable Material**

Unstable material is defined as any material that is too wet to properly support the utility pipe, conduit, or appurtenant structure.

#### **5-1.3.7 Select Granular Material**

Select granular material is defined as any material classified as GW, GP, SW, and SP by ASTM D 2487 where indicated. Coefficient of permeability shall be a minimum of 0.01 mm per second when tested in accordance with ASTM D 2434.

#### **5-1.3.8 Initial Backfill Material**

Initial backfill is defined as select granular material or satisfactory materials free from rocks 75 mm or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 75 mm in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

#### **5-1.3.9 Expansive Soils**

Expansive soils are defined as soils that have a plasticity index equal to or greater than 25 percent when tested in accordance with ASTM D 4318.

#### **5-1.3.10 Trees**

The line of demarcation between brush and trees, for the purpose of distinguishing clearing requirements, is that trees, as used, will be considered as that woody growth not falling within the limits of brush as defined below.

#### **5-1.3.11 Brush**

Brush is that growth, which is less than 50 mm in diameter, measured 150 mm from the ground on the uphill side and is less than 2 m in height measured from the ground on the uphill side.

#### **5-1.3.12 Structures to be removed**

The term "structures to be removed" shall include buildings or portions thereof, walls, silos, storm or root cellars, cisterns, wells, windmills, pit silos, water towers, etc. Structures shall be removed or filled to the ground surface.

### **5-1.4 Submittals**

The following shall be submitted for Engineers review and approval in accordance with Clause 1-1.4 - Submittal Procedures:

**SD-01 Preconstruction Submittals**

- **Shoring**
- **Blasting**

Submit 15 days prior to starting work.

**SD-03 Product Data**

- **Utilization of Excavated Materials**
- **Rock Excavation,**
- **Opening of any Excavation or Borrow Pit or Quarry**

Procedure and location for disposal of unused satisfactory material and quarry. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas.

**SD-06 Test Reports**

- **Testing**
- **Borrow Site and Quarry Testing**

Within 24 hours of conclusion of physical tests, copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

**SD-07 Certificates**

- **Testing**

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

**SD-01 Preconstruction Submittals**

Construction Equipment List shall be submitted.

Contractor shall record Existing Conditions prior to starting work in accordance with the Clause 5-1.7 - Existing Conditions of this section.

**SD-06 Test Reports**

Test Reports shall be submitted for Soil Test results within 7 calendar days. Test reports shall be submitted according to Sub-Clause 5-1.5.3 - Quality Control Testing During Construction of this section.

**SD-07 Certificates**

Certificates of Compliance for Proposed Soil Materials shall be submitted according to Sub-Clause 5-1.5.2 - Tests for Proposed Soil Materials of this section.

Certificates of Compliance for Compost shall be submitted indicating grade and compliance with state and local regulations.

**5-1.5 Sampling and Testing****5-1.5.1 Soil Test and Inspection Service**

Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil-testing service approved by the Engineer shall be provided by the Contractor. Testing shall include soil survey for satisfactory soil materials; sampling and testing soil materials proposed for use in the work, and field-testing facilities for quality control during construction period.

Testing agencies shall conform to the requirements of ASTM D 3740.

### 5-1.5.2 Tests for Proposed Soil Materials

Materials shall be approved by the Engineer prior to start of work.

Soil materials proposed for use in the work shall be tested as follows:

**Table 5-1**

Material	Requirement	Test Method	Number of Tests
Satisfactory soil materials	Sampling	AASHTO T 2	Three from each source of materials to determine conformance to Definition of satisfactory soil materials; additional tests whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis is of fine and coarse aggregates	ASTM C 136	
	Amount of material passing 75 micrometer sieve	ASTM C 117	
	Liquid Limit	ASTM D 4318	
	Plastic limit and plasticity index	ASTM D 4318	
	Mechanical analysis	ASTM D 4318	
	Moisture density relations	ASTM D 1557, Method D	As required to determine moisture-density requirement of materials from each source.
	Los Angeles abrasion of coarse aggregates	ASTM C 131	One for each soil material from each source if called for in reference specification
	Magnesium sulfate soundness test	ASTM C 88	

### 5-1.5.3 Quality Control Testing During Construction

Soil materials shall be tested during construction as follows:

**Table 5-2**

Material	Requirement	Test Method	Number of Tests
Soil materials Specified	Sieve analysis is of fine and coarse aggregates	ASTM C 136	One daily for each soil material from each source; additional test whenever there is any apparent change
	Amount of material passing 75 micrometer sieve	ASTM C 117	
Soil materials prior to compaction	Moisture density relations of soil	ASTM D 1557, Method D	One for each subgrade soil material except under backfill for structures; One for each backfill and fill material from each source
Soil Material-in-place after compaction	Density of Soil-in-place	ASTM D 1556 Sand Cone Method or ASTM D 2922, Nuclear Method (when Approved by Engineer)	At least three daily for each subgrade soil material except under backfill for structures, and for each layer and backfill and fill material; additional test whenever there is any

			change in moisture conditions
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#### **5-1.5.4 Test Reports**

No soil material shall be used until test reports have been reviewed and approved by the Engineer.

#### **5-1.5.5 Evaluation of Test Results**

Results of density of soil-in-place tests shall be considered satisfactory if the average of any group of four consecutive density tests which may be selected is in each instance equal to or greater than the specified density, and if not more than one density test in five has a value more than 2 percentage points below the specified density.

#### **5-1.6 Construction Equipment List**

Construction Equipment List of all major equipment to be used shall be submitted.

#### **5-1.7 Existing Conditions**

Existing Conditions shall be recorded, in the presence of the Engineer, and shall include all structures and other facilities adjacent to areas of alteration or removal. Such records shall contain the location of existing utilities, the elevation of the top of foundation walls, the location and extent of cracks and other damage, and a description of surface conditions that exist prior to the start of work. Copies of the record shall be submitted and the conditions prior to starting work shall be verified.

#### **5-1.8 Subsurface Data**

Subsurface soil data is available with client for contractor's review. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

#### **5-1.9 Clearing**

Areas to be cleared shall include, but not be restricted to:

- (i) Borrow areas and quarries,
- (ii) Surfaces of stockpiles,
- (iii) Disposal areas outside the reservoir area,
- (iv) Areas to be backfilled, and
- (v) Areas to be occupied by the permanent and temporary construction

Excavation specified shall be done on a classified basis, in accordance with the following designations and classifications.

Common excavation shall include the satisfactory removal and disposal of all materials not classified as rock excavation.

Rock excavation shall include blasting, excavating, grading, and disposing of material classified as rock and shall include the satisfactory removal and disposal of boulders 1/2 cubic meter or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling and blasting; and hard materials (see Definitions). The removal of any concrete or masonry structures, except pavements, exceeding 1/2 cubic meter in volume that may be encountered in the work shall be included in this classification. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, such material shall be uncovered and the Engineer notified by the Contractor. The Contractor shall not proceed with the excavation of this material until the Engineer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to

uncover such material, notify the Engineer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Engineer for the areas of work in which such deposits occur.

Blasting shall be performed in accordance with EM 385-1-1 and in conformance with Government safety regulations. The Contractor shall submit a Blasting Plan, prepared and sealed by a registered professional engineer that includes calculations for overpressure and debris hazard. Blasting mats shall be provided and non-electric blasting caps shall be used. The Contractor shall obtain written approval prior to performing any blasting and shall notify the Engineer 24 hours prior to blasting. The plan shall contain provisions for storing, handling and transporting explosives as well as for the blasting operations. The Contractor shall be responsible for damage caused by blasting operations.

## PART 2 PRODUCTS

Materials for backfill and fill shall be free of clay clods, rock or gravel larger than 50 millimeter in any dimension, debris, waste, and other deleterious matter and shall be satisfactory soil materials as follows:

**Table 5-3**

Area Classification	Backfill or Fill Materials
In excavations, unless otherwise specified	Excavated or borrow material that has been sampled, Tested, and approved as "Satisfactory Soil Material"
Against face of structures where footing drains from top of porous fill for footing drains to indicated elevation, and from face of structure a distance equal to three footing drain diameters.	Filtering material
Against surfaces having applied waterproofing for a distance of at least 150 millimeter from surface	Sand
In foundation subdrain trenches over porous fill drain pipe.	Filtering material
Under grassed areas	Excavated or borrow material that has been sampled, tested, and approved as "Satisfactory Soil Material"
Under walks, steps, and paved areas	Subbase material or excavated or borrow material that has been sampled, tested, and approved as "Satisfactory Soil Material"
Under building slabs and under culverts	Granular fill and sand bedding
Underdrainage of structures	Filtering material

The satisfactory materials for backfill are as defined in Sub-Clause 5-1.3.1 – Satisfactory Materials.

The unsatisfactory materials for backfill are as defined in Sub-Clause 5-1.3.2 – Unsatisfactory Materials.

Cohesion less soil materials include gravels, gravel-sand mixtures, sands, and gravelly-sands. Moisture-density relations of compacted cohesion less soils, when plotted on graphs, will show straight lines or reverse-shaped moisture density curves.



Cohesive soil materials include clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands. Moisture-density relations of compacted cohesive soils, when plotted on graphs, will show normal moisture-density curves.

Sub base material shall be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, or sand.

Granular fill shall be a washed, uniformly graded mixture of crushed stone or crushed or uncrushed gravel, with 100 percent passing 37.5 millimeter sieve and not more than 5 percent passing 4.75 millimeter sieve.

Unless otherwise specified or shown on drawings, the filtering material shall conform to ASTM C 33 and shall be a uniformly graded mixture of natural or crushed gravel, crushed stone, and natural sand, with 100 percent passing 9.5-millimeter sieve and 2 to 10 percent passing a 150-micrometer sieve. The gradation limits of filtering material for Underdrainage of structures shall be as shown on drawings.

Sand shall be natural sand.

### **PART 3 EXECUTION**

All trees, stumps and brush shall be removed. Unless otherwise directed trees shall not be cut down outside areas specified in Clause 5-1.9 - Clearing and, where directed, trees shall be protected carefully from damage by the Contractor's operations.

Felling of trees shall be restricted to the minimum practicable for the execution of the Works and the limits shall be as directed.

#### **5-3.1.2 Equipment**

A tree-crushing machine may be used at the option of the Contractor in all clearing operations.

#### **5-3.1.2-a Payment**

No Payment will be made for clearing of project sites.

#### **5-3.1.3 Disposal Of Material**

##### **(a) General**

The material cleared from the areas shall be completely removed by transporting from Client's property or burned within the cleared areas unless otherwise approved by the Engineer. All timber from which saw logs, posts, ties or cordwood can be produced will become the property of the Contractor and in the interest of conservation it is required that the Contractor make a reasonable effort to dispose of material for these purposes. The Contractor may cut timber into convenient lengths at the site but approval must be secured prior to the operation of saw mills within the Project area. In no case shall cleared material be thrown into or left in the creeks or river. After the felling operation has been completed, the timber to be burned must be decked for burning within 10 days. All felled timber shall be completely removed. Clean up of floatable debris shall be accomplished by any practical means after reservoir filling. The cutting of branches and debris remaining after clean-up, to reduce their length in order to avoid removal, will not be permitted.

##### **(b) Burning**

The material cleared may be burned within the contract area, and at any time within the contract period provided such burning does not interfere with inhabitants of the area by drastic changes in their accustomed environment, such as addition to air pollution or danger of fire. However, the specific time, location and manner of burning shall be subject to approval from the viewpoints of air pollution,

governing fire laws and safety. In the interest of conservation, the Contractor may, should he desire to do so, make available to the general public without charge, the material scheduled for burning. No burning operations shall be conducted within 30 m of any standing timber or flammable growth. The burning operations shall be subject to all public law governing such operations and the Contractor will be responsible for any damage to life and/or property resulting from fires that are started by his employees or as a result of his operations.

The Contractor shall furnish at the site adequate firefighting equipment, such as back tanks, flaps, shovels, rakes, etc., to properly equip his personnel for fighting fires. Fires shall be guarded at all times and shall be under constant surveillance until they have burned out or have been extinguished. All burning shall be so thorough that the materials will be reduced to ashes, except that occasional charred pieces of logs or branches not exceeding 100 mm in diameter and/or 2.5 m in length will be permitted to remain. Upon approval, charred material will be buried after it is determined that it could not be disposed of by methods used in the normal burning operation. All material disposed of in such manner shall be at approved locations and shall be covered within a minimum of 450 mm of earth.

#### **(c) Burial**

In certain cases, such as along drainage channels in remote areas, cleared material may be disposed of by burial in areas designated for disposal of excess excavation or spoil. When this option is used, care will be taken to insure that all such cleared material will be buried under not less than 450 mm of earth. Approval will be obtained for each area selected for debris disposal for burial prior to beginning such operations. Burial is not allowed in reservoir area. Areas to be used for permanent roadways, levees or embankments will not be used for disposal of material from clearing operations. Areas for disposal of cleared materials by burial will not be located within 92 m of public road crossings or of project areas to be regularly visited by the public.

#### **(d) Removal from Site**

Except as otherwise provided, the Contractor will be permitted to remove felled and trimmed timber from the site of the work. The Contractor will be allowed to stockpile salvaged timber above elevation 137.5m at approved locations, unless otherwise approved by the Engineer. The Procuring entity/Employer will assume no responsibility for the protection and safekeeping of such material. All stockpiled timber must be removed from Procuring entity/Employer lands before final acceptance of the work will be made.

#### **5-3.1.4 Debris**

Combustible debris shall be burned in accordance with Sub-Clause 5-3.1.3 - Disposal Of Material. Noncombustible debris in excess of that disposed of as set forth in Sub-Clause 5-1.3.14 - Structures to be removed shall be disposed of at such locations above elevation 137.5 as may be designated by the Engineer, unless otherwise approved by the Engineer. Debris shall include trash of all kinds.

#### **5-3.1.5 Marketable Materials**

Any of the cleared materials, which the Contractor considers marketable, shall become Procuring entity/Employer's property and shall be removed from the reservoir area.

#### **5-3.2 Stripping of Topsoil**

Where indicated or directed, topsoil shall be stripped to a depth of 150 mm. Stripping more than 150 mm shall be considered as excavation. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

### 5-3.3 General Excavation

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in Clause 5-3.17 – Finishing. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

#### 5-3.3.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 1 meter from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

#### 5-3.3.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed. Where pile foundations are to be used, the excavation of each pit shall be stopped at an elevation 300 mm above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, loose and displaced material shall be removed and excavation completed, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

#### 5-3.3.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

#### 5-3.3.4 Dewatering

Groundwater flowing towards or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference

with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 0.3 m below the working level. Operate dewatering system continuously until construction work below existing water levels is complete.

#### **5-3.3.5 Requirements of Trench Excavation for Laying of Pipes**

The trench for pipe laying shall be excavated as shown on drawings. Trench walls more than 1 meter high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm plus pipe outside diameter (O.D.) for pipes of less than 600 mm inside diameter and shall not exceed 900 mm plus pipe outside diameter for sizes larger than 600 mm inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Procuring entity/Employer.

##### **(a) Bottom Preparation**

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 100 millimeters or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

##### **(b) Excavation for Appurtenances**

Excavation for manholes, catch basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

#### **5-3.3.6 Underground Utilities**

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Report damage to utility lines or subsurface construction immediately to the Engineer.

#### **5-3.3.7 Structural Excavation**

Ensure that footing subgrades have been inspected and approved by the Engineer prior to concrete placement. Backfill and compact over excavations to 95 percent of ASTM D 698 maximum density.

#### **5-3.4 SELECTION OF BORROW MATERIAL**

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas identified in the Contract Documents and selected by the Contractor after approval by the Engineer. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the

sources, including rights-of-way for hauling. Borrow material from approved sources on Procuring entity/Employer-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. No borrow shall be allowed within 400m upstream and 300m downstream of dam and dyke. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

### **5-3.5 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS**

The Contractor shall notify the Engineer sufficiently in advance of the opening of any excavation or borrow pit. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavations of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

Direct payment will not be made for work carried out in accordance with this Clause. The cost of all work in the borrow areas and on the stockpile shall be included in the respective rates for various zones of earth fill.

### **5-3.6 Quarries**

#### **5-3.6.1 General**

The Contractor shall operate any approved quarry in accordance with this Clause to obtain material additional to that usable material available from the required excavation, for use as:

- Rip-rap
  - Drainage materials for fine and coarse filters
  - Concrete aggregate
  - Free draining backfill
  - Road base course
  - Other uses in the works.
- (ii) Contractor may obtain acceptable material from Procuring entity/Employer approved outside commercial quarries, without any additional cost to the haulage and procurement.

#### **5-3.6.2 Method of Operation**

The Contractor's proposed method of working the quarries shall be in accordance with the proposed quarry plan as approved by the Engineer from time-to-time.

Nothing in this Clause shall relieve the Contractor from the responsibility for the adequacy and safety of the rock excavation operations.

### **5-3.7 SHORING**

#### **5-3.7.1 General Requirements**

The Contractor shall submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Shoring shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed, as excavations are backfilled, in a manner to prevent caving.

### **5-3.8 GRADING AREAS**

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Stockpiles of satisfactory, unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination, which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources.

### **5-3.9 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE**

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

### **5-3.10 GROUND SURFACE PREPARATION**

#### **5-3.10.1 General Requirements**

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Engineer. The surface shall be scarified to a depth of 150 mm before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 150 mm, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 300 mm and compacted as specified for the adjacent fill.

### **5-3.11 UTILIZATION OF EXCAVATED MATERIALS**

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Procuring entity/Employer-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

### **5-3.12 BACKFILLING AND COMPACTION**

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesion less materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in Sub-Clause 5-3.19.2 - Preparation of Ground Surface to Receive Fill. Compaction requirements for backfill materials shall also conform to the applicable portions of Sub-clause 5-3.19.2 - Preparation of Ground Surface to

Receive Fill, Clause 5-3.14 - Embankments and Sub-Clause 5-3.15.3 - Compaction shall be accomplished by sheep foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### **5-3.12.1 Backfill of Trench for Pipelines**

Trenches shall be backfilled to the grade shown. The joints and couplings shall be left uncovered during the pressure test. The trench shall not be backfilled until all specified tests on pipeline are performed.

(a) Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

(b) Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

(c) Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows as shown on drawings:

(i) Clean, coarse-grained sand classified as SW or SP by ASTM D 2487

(ii) Clean, coarsely graded natural gravel, crushed stone or a combination thereof having a classification of GW or GP in accordance with ASTM D 2487 for bedding and backfill as indicated. Maximum particle size shall not exceed 75 mm.

(d) Final Backfill

The remainder of the trench shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

(i) Roadways: Backfill shall be placed up to the required elevation as specified. Water flooding or jetting methods of compaction will not be permitted.

(ii) Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesion less soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

### **5-3.12.2 Backfill for Pipeline Appurtenances**

After the manhole, catch basin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 14 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as

specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 5-3.13 SPECIAL REQUIREMENTS FOR EXCAVATION AND BACKFILL

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

#### 5-3.13.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 600 mm from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 500 millimeters of cover is required.

#### 5-3.13.2 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 600 mm from the finished grade, unless otherwise indicated.

#### 5-3.13.3 Sewage Absorption Trenches or Pits

Backfill material consisting of clean crushed rock or gravel having a gradation conforming to the requirements of gradation 4.75 mm for coarse aggregate in ASTM C 33.

#### 5-3.13.4 UNDERDRAINAGE Systems

Clean sand, crushed rock, or gravel meeting the following requirements:

- (i) Perforated or Slotted-Wall Pipe: Backfill meeting requirements of Type I material as specified in Table 5-4. Place granular material as pipe is laid and extend fit for a minimum of one pipe diameter on each side of and 450 mm above the top of the pipe. Place a layer of kraft paper on top of granular filter before continuing with the backfill.
- (ii) Open Joint Pipe: Place both types of granular material specified as pipe is laid forming an aggregate filter around the pipe. Provide Type II material to envelope the pipe a minimum of one-half the pipe diameter or twice the maximum aggregate size, whichever is larger, on each side and on top of the pipe. Place Type I material next to and on top of the Type II material to provide a total fill extending at least one pipe diameter on each side of and 450 mm above the top of the pipe. Place a layer of Kraft paper on top of the granular filter before continuing with the backfill.
- (iii) Any Type Drain Used With Filter Fabric: Clean gravel or crushed stone or gravel conforming to ASTM C 33 coarse aggregate grading size 57, 67, or 7.

**Table 5-4**

ASTM D 422 Sieve Size	Type I Gradation E 11 ASTM C 33	Type II Gradation 57 ASTM C 33
	Percent Passing	Percent Passing
37.5 mm	--	100
25.0 mm	--	90 – 100
9.5 mm	100	25 – 60
4.75 mm	95 – 100	5 - 40
2.36 mm	--	0 - 20
1.18 mm	45 – 80	--
300 micrometers	10 – 30	--
150 micrometers	0 – 10	--



### **5-3.14 EMBANKMENTS**

#### **5-3.14.1 Earth Embankments**

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm. The material shall be placed in successive horizontal layers of loose material not more than 300 mm in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesion less materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in Clause 5-3.15 - Subgrade Preparation. Compaction shall be accomplished by sheep foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### **5-3.15 SUBGRADE PREPARATION**

#### **5-3.15.1 Proof Rolling**

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall), which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a 13.6-meter tons, pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour. When proof rolling, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Engineer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Engineer. Rutting or pumping of material shall be undercut as directed by the Engineer and replaced with fill material. No separate payment will be made for operations of cutting and replacing of affected area.

#### **5-3.15.2 CONSTRUCTION**

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, diskings, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 150 mm below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. The elevation of the finish subgrade shall not vary more than 15 mm from the established grade and cross section.

#### **5-3.15.3 Compaction**

Compaction shall be accomplished by sheep foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

(a) **Subgrade for Pavements**

Subgrade for pavements shall be compacted to at least 95 - percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, the top 200 mm of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

(b) Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 95 - percentage laboratory maximum density for the full depth of the shoulder.

### **5-3.16 SHOULDER CONSTRUCTION**

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in Clause 5-3.15 - Subgrade Preparation above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheep foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

### **5-3.17 FINISHING**

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 30 mm of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in Clause 5-3.15 - Subgrade Preparation. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to smoothness suitable for the application of turfing materials. Settlement or washing that occurs in graded, top soiled, or backfilled areas prior to acceptance of the work shall be repaired and grades re-established to the required elevations and slopes.

#### **5-3.17.1 Subgrade and Embankments**

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until, sub base, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No sub base, base course, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall sub base, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

#### **5-3.17.2 Grading Around Structures**

Areas within 1.5 m outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

### **5-3.18 PLACING TOPSOIL**

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 50 mm depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 200 mm and graded to the elevations and slopes shown. Topsoil shall not be spread when excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

### **5-3.19 FILLING AND BACKFILLING**

#### **5-3.19.1 Preparations Prior to Backfill Placement**

Excavations shall be backfilled as promptly as the work permits but not until completion of the following:

- Approval of construction below finish grade
- Inspection, testing, approval, and recording location of underground utilities
- Removal of concrete formwork
- Removal of shoring and bracing; backfilling of voids with satisfactory soil material; temporary sheet piling driven below bottom of structures; and cutting off and removing of utilities in a manner that prevents settlement of the structure or utilities
- Removal of trash and debris
- Completion of concrete waterproofing

**5-3.19.2 Preparation of Ground Surface to Receive Fill**

Vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials shall be removed from ground surface prior to the placement of fills. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stripped, or broken up in such manner that fill material will bond with the existing material.

When the ground surface has a density less than that specified for the particular area classification, the ground surface shall be broken up, pulverized, moisture-conditioned to near optimum moisture content of the soil material, and compacted to the required depth and percentage of maximum density.

**5-3.19.3 Placement and Compaction**

Backfill and fill materials shall be placed in layers not more than 150 millimeter in loose depth. Before compaction, each layer of backfill or fill material shall be moistened or aerated as necessary to provide the optimum moisture content of the soil material and shall then be compacted to the percentage of maximum density for each area classification as specified. Backfill or fill material shall not be placed on surfaces that are muddy, frozen, icy, or contain frost.

Backfill and fill materials adjacent to structures shall be brought up evenly around structures and shall be carried up to the indicated elevations.

Compaction adjacent to structures, within a horizontal distance from the face of the structure equal to the depth of backfill or fill material (measured from the bottom of footing or bottom of foundation or retaining wall) to final grade, shall be done with power-driven hand tampers.

**5-3.20 Compaction**

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure in AASHTO T 180, Methods B or D.

**5-3.20.1 Percentage of Maximum Density Requirements**

Actual density of each layer of soil material-in-place shall be not less than the following percentages of the maximum density of the same soil material determined by the moisture-density test specified.

**Table 5-6**

Area Classification	Percent Maximum Density	
	Cohesion less Soil Material	Cohesive Soil Material
<b>Structures</b>		
Each layer of back-fill material	95%	95%
<b>Building Slabs and Steps</b>	95%	95%

Top 300 millimeter of subgrade and each layer of backfill material		
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**5-3.20.2 Moisture Control**

Moisture content in soil material at time of compaction shall be within limits specified.

Where the moisture content of a layer of soil material is below optimum before compaction, the required amount of water shall be uniformly applied to the surface of the layer of soil material and the layer of soil disked or otherwise mixed until uniform moisture content is reached.

Moisture of a layer of soil material that is above optimum shall be removed by drying.

**5-3.21 Disposition of Surplus Material**

Surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed from Procuring entity/Employer property as directed by the Engineer.

**5-3.22 Testing**

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Engineer. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Engineer. ASTM D 2937, Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Engineer, that compaction is not as specified, the material shall be removed, replaced and re-compacted to meet specification requirements. Tests on re-compacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the Engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

**5-3. 22.1 Fill and Backfill Material Gradation**

One test per 400 cubic meters stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136 or ASTM D 422 or ASTM D 1140.

**5-3. 22.2 In-Place Densities**

**Table 5-5**

Material Type	Location of Material	Test Frequency
Undisturbed native soil	Structures	Two random tests in building footings and two tests on subgrade within building line

Fills and backfills	Structures (adjacent to)	One test per structure per 200 sq. m taken 300 mm below finished grade.
Subgrades		One test per lift per 250 sq.m
Embankments or borrow	Any	One test per lift per 400 cubic m placed.
Native soil subgrade other than structures and parking	Any	One test or one test per 900 sq.m whichever is greater.
Borrow	Any	One test per lift per 400 cubic m placed.

### 5-3. 22.3 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Engineer.

### 5-3. 22.4 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 400 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

### 5-3. 22.5 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in Clause 5-3.15 - Subgrade Preparation shall be made during construction of the subgrades.

## PART 4 MEASUREMENT AND PAYMENT

### 5-4.1 Clearing

#### 5-4.1.1 Measurement

Measurement for payment, of clearing of the project sites area of structures will be made of the horizontal projection of the areas actually cleared within the reservoir area below the pegged level and within 20m outside the limits of excavation for the permanent works but excluding clearing for temporary access or haul roads, construction facilities and other temporary works, quarries and borrow areas.

#### 5-4.1.2 Payment

Payment for clearing of project sites will be made at the rate per hectare tendered thereof in the priced Bill of Quantities.

Payment will be made for costs associated with furnishing plant, labor, materials and equipments, and performing all operations necessary for clearing as specified.

The cost of clearing areas other than the project sites and area of structures shall be deemed to be included in the rates tendered in the priced Bill of Quantities for the various items of the Works. No separate payment shall be made for clearing areas other than project sites.

#### 5-4.1.3 Unit of Measure

Unit of measure: Hectare

### 5-4.2 Stripping of Topsoil

#### 5-4.2.1 Measurement

Measurement for stripping of topsoil will be made of horizontal projection of actual area stripped within 2m outside the limit of the project sites.

#### **5-4.2.2 Payment**

Payment for stripping will be made at the rate per Cu.m.

No separate payment will be made for stripping of borrow areas.

#### **5-4.2.3 Unit of Measure**

Unit of measure: Cu.m

### **5-4.3 Excavation**

#### **5-4.3.1 Measurement**

Measurement, for payment, of surface excavation will be made of the volume of material excavated to the lines, grades and dimensions shown on the Drawings or directed and shall be taken only in the presence of the Engineer. The Engineer shall be notified at least 24 hours before such measurements are taken. Before commencing and immediately after completion of surface excavation, the Contractor shall take survey measurements sufficient to define the dimensions and elevations of the original and final surfaces.

Measurement will be made separately for common and rock excavation as defined in Clause 5-1.10 – Classification of Excavation.

Also measurement will be made separately for building foundation.

The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

#### **5-4.3.2 Payment**

Payment for the various items of surface excavation will be made at the applicable rates per cubic metre tendered thereof in the priced Bill of Quantities. These rates shall include the cost of all labor, materials, temporary construction, pumping, bailing, draining and all other work necessary to maintain the surface excavations in good order during construction, and of removing such temporary construction if so directed. These rates shall also include the entire cost of clearing and stripping of Soil provided in Clauses 5-3.1 and 5-3.2 of excavating and transporting the materials from the excavation to the point of final use, or to disposal; and, where stockpiles are used. The cost of transporting the material to the stockpiles; of re-handling and of transporting such material to the point of final use; and the entire cost of cleaning up excavated surfaces.

Direct payment will not be made for work carried out in accordance with this Clause. The cost of all work in the quarries including clearing, excavation, separating, selecting, processing, hauling and dumping of unsuitable materials and of soil conservation measures shall be included in the rates tendered in the Bill of Quantities for the items for which the materials from the quarries are used.

#### **5-4.3.3 Unit of Measure**

Unit of measure: Cubic Meter

**5-4.4 Sub base Material****5-4.4.1 Measurement**

Measurement, for payment, of furnishing, placing and compacting sub base will be made of the volume of material in place to the lines grades and dimensions shown on the Drawings or directed.

**5-4.4.2 Payment**

Payment for furnishing, placing and compacting sub base will be made at the rate per cubic meter tendered therefor in the priced Bill of Quantities. Material from required excavation used for sub base will be paid for both as excavation when removed from required excavation and as fill when placed. Payment will not be made for excavating materials from stockpiles or sources other than required excavation.

**5-4.4.3 Unit of Measure**

Unit of measure: Cubic Meter

**5-4.5 Embankment Fill****5-4.5.1 Measurement**

Measurement, for payment, of furnishing, placing and compacting embankment fill will be made of the volume of material in place to the lines grades and dimensions shown on the Drawings or directed.

**5-4.5.2 Payment**

Payment for furnishing, placing and compacting embankment fill will be made at the rate per cubic meter tendered therefor in the priced Bill of Quantities. Material from required excavation used for embankment fill will be paid for both as excavation when removed from required excavation and as fill when placed. Payment will not be made for excavating materials from stockpiles or sources other than required excavation.

**5-4.5.3 Unit of Measure**

Unit of measure: Cubic Meter

**5-4.6 Preparation of Subgrade****5-4.6.1 Measurement**

Measurement for payment of preparation of subgrade will be made in square meter of the actual subgrade prepared.

**5-4.6.2 Payment**

Payment for preparation of subgrade will be made at the rate per square meter tendered therefore in the priced Bill of Quantities.

**5-4.6.3 Unit of Measure**

Unit of measure: Square meter

**5-4.7 Road Shoulder Material****5-4.7.1 Measurement**

Measurement, for payment, of furnishing, placing and compacting road shoulder will be made of the volume of material in place to the lines grades and dimensions shown on the Drawings or directed.

**5-4.7.2 Payment**

Payment for furnishing, placing and compacting road shoulder will be made at the rate per cubic meter tendered therefore in the priced Bill of Quantities. Material from required excavation used for road shoulder will be paid for both as excavation when removed from required excavation and as fill when placed. Payment will not be made for excavating materials from stockpiles or sources other than required excavation.

**5-4.7.3 Unit of Measure**

Unit of measure: Cubic Meter

**5-4.8 Backfill****5-4.8.1 Measurement**

Measurement, for payment, of furnishing, placing and compacting backfill will be made of the volume of material in place to the lines grades and dimensions shown on the Drawings or directed.

**5-4.8.2 Payment**

Payment for furnishing, placing and compacting backfill will be made at the rate per cubic meter tendered therefore in the priced Bill of Quantities. Material from required excavation or from the quarry used for backfill will be paid for both as excavation when removed and as backfill when placed. Payment will not be made for excavating materials from stockpiles or sources other than required excavation.

**5-4.8.3 Unit of Measure**

Unit of measure: Cubic Meter



## SECTION 6 – PROTECTION OF SLOPES AND CHANNELS

### PART 1      GENERAL

#### 6-1.1 Scope

The Contractor shall protect, fill and cut slopes, banks and beds of channels and streams, by methods as shown on the Drawings or as directed. Excavated surfaces shall be protected where shown on Drawings or as directed.

The methods of protection are riprap and stone pitching.

The cost of furnishing and construction protection works, other than those shown on Drawings or as directed by the Engineer, shall be deemed to include in the rates tendered in the priced Bill of Quantities for excavation for parts of the Works where such supports are used.

#### 6-1.2 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

<b>ASTM A 370</b>	(2003a) Mechanical Testing of Steel Products
<b>ASTM A 428/A 428M</b>	(2001) Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles
<b>ASTM A 641/A 641M</b>	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
<b>ASTM A 809</b>	(2003) Standard Specification for Aluminum-Coated (Aluminized) Carbon Steel Wire
<b>ASTM A 856/A 856M</b>	(1998) Zinc-5% Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire
<b>ASTM A 90/A 90M</b>	(2001) Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
<b>ASTM A 974</b>	(2003) Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic Coated or Polyvinyl Chloride (PVC) Coated)
<b>ASTM A 975</b>	(1997; R 2003) Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)
<b>ASTM B 117</b>	(2002) Operating Salt Spray (Fog) Apparatus
<b>ASTM C 127</b>	(2001) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

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<b>ASTM C 136</b>	(2001) Sieve Analysis of Fine and Coarse Aggregates
<b>ASTM C 150</b>	(2004) Standard Specification for Portland Cement
<b>ASTM C 171</b>	(2003) Standard Specification for Sheet Materials for Curing Concrete
<b>ASTM C 172</b>	(2004) Standard Practice for Sampling Freshly Mixed Concrete
<b>ASTM C 231</b>	(2003) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
<b>ASTM C 295</b>	(2003) Petrographic Examination of Aggregates for Concrete
<b>ASTM C 260</b>	(2001) Standard Specification for Air-Entraining Admixtures for Concrete
<b>ASTM C 33</b>	(2003) Concrete Aggregates
<b>ASTM C 31/C 31M</b>	(2003)a Standard Practice for Making and Curing Concrete Test Specimens in the Field
<b>ASTM C 39/C 39M</b>	(2003) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
<b>ASTM C 309</b>	(2003) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
<b>ASTM C 143/C 143M</b>	(2003) Standard Test Method for Slump of Hydraulic Cement Concrete
<b>ASTM C 494/C 494M</b>	(2004) Standard Specification for Chemical Admixtures for Concrete
<b>ASTM C 618</b>	(2003) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
<b>ASTM C 685/C685M</b>	(2001) Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing
<b>ASTM C 94/C 94M</b>	(2004) Standard Specification for Ready-Mixed Concrete
<b>ASTM D 1117</b>	(2001) Standard Guide for Evaluating Nonwoven Fabrics
<b>ASTM D 1242</b>	(1995a) Resistance of Plastic Materials to Abrasion
<b>ASTM D 1499</b>	(1999) Filtered Open-Flame Carbon-Arc Type Exposures of Plastics

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<b>ASTM D 2240</b>	(2003) Rubber Property - Durometer Hardness
<b>ASTM D 412</b>	(1998a; R 2002e1) Vulcanized Rubber and Thermoplastic Elastomers – Tension
<b>ASTM D 746</b>	(1998e1) Brittleness Temperature of Plastics and Elastomers by Impact
<b>ASTM D 792</b>	(2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement
<b>ASTM D 123</b>	(2003) Textiles
<b>ASTM D 4355</b>	(2002) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
<b>ASTM D 4491</b>	(1999) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
<b>ASTM D 4751</b>	(1999a) Determining Apparent Opening Size of a Geotextile
<b>ASTM D 4873</b>	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples
<b>ASTM D 4884</b>	(1996) Strength of Sewn or Thermally Bonded Seams of Geotextiles
<b>ASTM D 3740</b>	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
<b>ASTM D 3787</b>	(2001) Test Method for Bursting Strength of Textiles-Constant-Rate-of-Travel (CRT) Ball Burst Test
<b>ASTM D 4791</b>	(1999) Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
<b>ASTM D 4992</b>	(1994; R 2001) Evaluation of Rock to be Used for Erosion Control
<b>ASTM D 5034</b>	(2001) Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
<b>ASTM D 5312</b>	(1992; R 1997) Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions
<b>ASTM D 5313</b>	(1992; R 1997) Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions
<b>ASTM D 5519</b>	(1994; R 2001) Particle Size Analysis of Natural and Man-Made Riprap Materials
<b>ASTM D 6473</b>	(1999) Standard Test Method for Specific Gravity and

**Absorption of Rock For Erosion Control****ASTM D 75**

(2003) Sampling Aggregates

**ASTM E 548**

(1994e1) General Criteria Used for Evaluating Laboratory Competence

**ASTM G 152**

(2000ae1) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-metallic Materials

**U.S. Army Corps Of Engineers (USACE)****COE CRD-C 148**

(1969) Method of Testing Stone for Expansive Breakdown on Soaking in Ethylene Glycol

**6-1.3 Submittals**

The following shall be submitted for Engineer's review and approval in accordance with Clause 1-1.4 - Submittal Procedures:

**SD-03 Product Data****Riprap****Bedding Material**

Submit the source for materials used in riprap and bedding.

**Conveying and Placing**

Submit the methods and equipment for transporting, handling, depositing, and consolidating the grout prior to first grout placement.

**Admixtures****Curing Materials**

Submit manufacturers' literature for the concrete admixtures and curing materials.

**Batching and Mixing Equipment**

Submit manufacturers' data on the concrete grout batching and mixing equipment.

**Concrete Grout Mixture Proportions**

Ten days prior to placement, submit the mixture proportions that will produce grout of the qualities required.

**SD-04 Samples****Stone**

Submit suitable stone samples prior to delivery of any such material to the worksite if stone is not from one of the stone sources listed at the end of this section.

**Gabions or Mattresses****Alternative Wire Fasteners**

Samples of the materials, used to fabricate the gabions or mattresses, shall be furnished to the Engineer 60 days prior to assembly of units onsite so that testing may be prescribed by the Engineer in accordance with either ASTM A 974 or ASTM A 975 depending on which system is being furnished by the Contractor. The Contractor shall arrange testing at approved laboratory at his own cost.

**Geotextile**

If requested, submit geotextile samples for testing to determine compliance with the requirements in this specification. When required, submit samples a minimum of 60 days prior to the beginning of installation of the same textile. Upon delivery of the geotextile, submit duplicate copies of the written certificate of compliance signed by a legally authorized official of the manufacturer. The certificate shall state that the geotextile shipped to the site meets the chemical requirements and exceeds the minimum average roll value listed in Table, 6-5 Minimum Physical Requirements For Drainage Geotextile. Upon request, supply quality control and quality assurance tests for the geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 3 m long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 1.5 m. Samples submitted for testing shall be identified by manufacturers lot designation. For needle punched geotextile, the manufacturer shall certify that the geotextile has been inspected using permanent on-line metal detectors and does not contain any needles.

**SD-06 Test Reports****Gradation Test**

Submit the gradation tests results for riprap or stone.

**Evaluation Testing of Stone**

Quality test on the stone in accordance with Part 2 Sub-Clause 6-2.2.1 (a) - Evaluation Testing of Stone shall be the responsibility of the Contractor. Prior to delivery of such material to the worksite, submit a copy of the laboratory inspection and test reports along with actions taken to correct deficiencies.

**Bedding Material**

Submit test reports attesting that the bedding material meet specified requirements.

**Bulk Specific Gravity**

At least 120 calendar days in advance of shipment of stone to the work site, submit a copy of bulk specific gravity test results for each gradation range of stone proposed to be furnished. The information shall be furnished prior to preparation of pre-production demonstration stockpiles.

**Gabions or Mattresses****Alternative Wire Fasteners**

For each shipment of wire gabions or mattresses delivered to the site, the Contractor shall furnish the Engineer, in duplicate, test reports or records that have been performed during the last year on all material contained within the shipment meets the composition, physical, and manufacturing requirements stated in this specification.

**SD-07 Certificates****Stone****Bedding Material**

Submit certificates of compliance attesting that the materials meet specification requirements.

**Laboratory**

Submit a copy of the documents, that validates that the laboratory proposed by the Contractor can perform the required tests. The individual tests shall be listed for which the validation covers along with the date of the inspection.

**Weigh Scale Certification**

Submit a copy of the certification from the regulation agency attesting to the scale's accuracy.

**Certified Weight Scale Tickets**

Submit a copy of each certified weight scale ticket 3 working day(s) after weighing.

**Stone Fill****Filter Material**

A certificate signed by a legally authorized official of the supplier of the stone fill and the supplier of the gravel bedding material that it meets the quality required and gradation limits specified.

**Geotextile**

Submit the manufacturer's certification of the geotextile material.

**6-1.4 Testing and Studies****6-1.4.1 Stone****(a) General**

All stone shall be durable material as approved by the Engineer. Selected stone from the required excavation may be used if it satisfies all requirements as to quality and dimensions. The Contractor shall show that at proposed source an adequate quantity of material is available and provide quality test data. Stone shall be of a suitable quality to ensure permanence in the structure and in the climate in which it is to be used. It shall be free from cracks, blast fractures, bedding, seams and other defects that would tend to increase its deterioration from natural causes. Inspections for cracks, fractures, seams and defects shall be made by visual examination. If, by visual examination, it is determined that 15 percent or more of the stone produced contains hairline cracks, then all stone produced by the means and measures which caused the fractures shall be rejected. A hairline crack that is defined as being detrimental shall have a minimum width of 0.1 mm and shall be continuous for one-third the dimension of at least two sides of the stone. The stone shall be clean and reasonably free from soil, quarry fines, and shall contain no refuse. The stone shall be clean and adequately free from all foreign matter. Any foreign material adhering to or combined with the stone as a result of stockpiling shall be removed prior to placement.

**(b) Sources**

Stone shall be furnished from the sources designated by the Contractor and accepted by the Engineer, subject to the conditions herein stated. Satisfactory service records on other work may be acceptable. In order for stone to be acceptable on the basis of service records, stone of a similar size must have been placed in a similar thickness and exposed to weathering under similar conditions as are anticipated for this contract, and must have satisfactorily withstood such weathering for a minimum of 10 years.

(i) **Selection of Source**

The Contractor shall designate in writing only one source or one combination of sources from which he proposes to furnish stone. It is the Contractor's responsibility to determine that the stone source or combination of sources selected is capable of providing the quantities and gradation needed and at the rate needed to maintain the scheduled progress of the work.

(ii) **Acceptance of Materials**

Acceptance of a source of stone is not to be construed as acceptance of all material from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels, when such materials are unsuitable for stone as determined by the Engineer. The Engineer also reserves the right to reject individual units of produced specified materials in stockpiles at the quarry, all transfer points, and at the project construction site when such materials are determined to be unsuitable. During the contract period, both prior to and after materials are delivered to the job site, visual inspections and measurements of the stone materials may be performed by the Engineer. If the Engineer, during the inspections, finds that the stone quality, gradation or weights of stone being furnished are not as specified or are questionable, re-sampling and re-testing by the Contractor shall be required. Sampling of the delivered stone for testing and the manner in which the testing is to be performed shall be as directed by the Engineer. The sampling and testing shall be performed at the Contractor's expense. Any material rejected shall be removed or disposed of as specified and at the Contractor's expense.

(c) **Evaluation Testing of Stone**

The tests to which the stone may be subjected will include petrographic analysis, specific gravity, unit weight, absorption, wetting and drying, freezing and thawing and such other tests as may be considered necessary to demonstrate that the stone is of a satisfactory quality which is at least equivalent to stone from the sources listed at the end of this section.

(i) **Unit Weight Bulk Specific Gravity, Saturated Surface Dry (SSD) and Absorption**

Stone shall weigh more than 2500 kN/m<sup>3</sup> have a bulk specific gravity, saturated surface dry, (SSD), greater than 2.48. The stone shall have absorption less than 2 percent unless other tests and service records show that the stone is satisfactory. The method of test for unit weight bulk specific gravity (SSD) and absorption will be ASTM C 127, except the unit weight will be calculated in accordance with Note No. 5 using bulk specific gravity, saturated surface dry.

(ii) **Samples**

Samples of stone from the stone source shall be taken by a representative of the quarry under the supervision of the Engineer for testing and acceptance prior to delivery of any stone from this source to the site of the work. Samples shall consist of at least three pieces of stone, roughly cubical in shape and weighing not less than 70 kg each from each unit that will be used in the production of the required stone. If the source is an undeveloped quarry, or if the operation has been dormant for more than one year such that fresh samples are not available, the Contractor shall expose fresh rock for 6 m horizontally and for the full height of the face proposed for production, prior to the field evaluation. The Engineer may also require documentation of subsurface exploration of an undeveloped quarry in order to determine whether or not sufficient reserves are available. The samples shall be shipped at the Contractor's expense to the laboratory approved by the Engineer.

(iii) **Tests**

The tests will be conducted in accordance with applicable Corps of Engineers methods of tests given in the Handbook for Concrete and Cement or ASTM methods of tests. The cost of testing one new source will be borne by the Contractor.

**(d) Random Sampling**

The stone produced by each source will be sampled by the Engineer for Quality Assurance testing on the basis of a minimum once each year or once during the production of each 25 000 tons (metric) of stone produced each year. The samples will be evaluated based upon petrographic analysis, specific gravity, unit weight, bulk specific gravity (SSD), and absorption.

**(e) Drop Test**

A drop test provides an immediate evaluation of the durability of very large stone during handling of the stone including placement into a structure. For comparability, the test stone(s) shall be dropped from a bucket or by other means from a height of not less than half the average diameter of the stone onto a rigid surface or second stone of comparable size. Dumping from a truck is not acceptable. The stone shall be examined carefully before as well as after the completion of the test. Failure criteria is the development of new cracks, opening of old cracks, and the loss of piece from the surface of the stone. Each stone shall be dropped a total of five times for evaluation purposes with examination after each drop. The Contractor shall provide all necessary equipment and operating personnel to help perform the testing.

**6-1.4.2 Concrete Grout for Stone Protection****(a) General**

Samples of aggregates shall be obtained at the point of batching in accordance with ASTM D 75. Grout shall be sampled in accordance with ASTM C 172. The slump and air content shall be determined when cylinders are molded in accordance with ASTM C 143/C 143M and ASTM C 231, respectively. Compression test specimens shall be made, cured and transported in accordance with ASTM C 31/C 31M. Compression test specimens shall be tested in accordance with ASTM C 39/C 39M. Samples for strength tests shall be taken not less than once each shift in which grout is produced. A minimum of three specimens shall be made from each sample, two shall be tested at 28 days (90 days if pozzolan is used) for acceptance and one shall be tested at 7 days for information.

**(b) Concrete Grout Mixture Proportions**

Concrete grout mixture proportions shall be the responsibility of the Contractor. Mixture proportions shall be submitted for review 30 days prior to being used under this contract. Mixture proportions shall include the dry weights of cementitious material(s); the specific gravities, absorptions, and saturated surface-dry weights of the fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic meters of grout. Also, applicable test reports, such as air content, compressive strength, and unit weight of the grout, shall be submitted to verify the proportions selected will produce grout of the quality specified. The approved grout mixture proportions shall not be changed without approval. The air content shall be between 4.5 and 7.5 percent. The specified compressive strength  $f_c$  shall be 1.8 kg/mm<sup>2</sup> (17.64 kPa) at 28 days (90 days if pozzolan is used). The maximum water cement ratio shall be 0.70. The slump of the grout mix shall be 150 mm plus or minus 25 mm. For maximum coarse aggregate size see Sub-Clause 6-2.6.2 - Aggregates for Concrete Grout.

**(c) Evaluation and Acceptance of Grout**

The acceptance test results will be the average of the strengths of the two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete grout will be considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength  $f_c$  and no individual acceptance test result falls below the specified strength  $f_c$  by more than 350 g/mm<sup>2</sup>. (3.43 kPa)



### 6-1.4.3 Testing of Gabion and Mattresses

Samples of materials used to fabricate the Gabions or Mattresses shall be tested 60 days prior to start of installation. Samples shall be tested in accordance with specification and either ASTM A 975.

Copies of all test results carried out by manufacturer or Contractor shall be furnished to the Engineer for review and approval.

### 6-1.5 Construction Tolerances

The finished surface and stone layer thickness shall not deviate from the lines and grades shown by more than the tolerances listed below. Tolerances are measured perpendicular to the indicated neat lines. Extreme limits of the tolerances given shall not be continuous in any direction for more than five (5) times the nominal stone dimension nor for an area greater than 20 m<sup>2</sup> of the structure surface.

**Table 6-1**

<b>Neat line Tolerances</b>		
<b>Material</b>	<b>Above Neat line mm</b>	<b>Below Neat line mm</b>
Foundation	75	50
Bedding	50	0
Riprap and other Stone Layers	100	75

The intention is that the work shall be built generally to the required elevations, slope and grade and that the outer surfaces shall be even and presents a neat appearance. Placed material not meeting these limits shall be removed or reworked as directed by the Engineer. Payment will not be made for excess material which the Engineer permits to remain in place.

### 6-1.6 Description of Gabions and Mattresses

Gabions and mattresses are wire mesh containers of variable sizes, uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at the project site to form flexible, permeable, monolithic structures. Gabions and mattresses shall be manufactured with all components mechanically connected at the production facility with the exception of the mattress lid, which is produced separately from the base. The supply to the jobsite of unassembled individual wire mesh components (panels) forming gabions and mattresses will not be permitted. Definitions of terms specific to this specification and to all materials furnished on the jobsite, with the exception of the rock to fill the baskets and the filter material, shall refer and be in compliance with ASTM A 975 for double twisted wire mesh Gabions and Revet mattresses, or with ASTM A 974 for welded wire fabric Gabions and Gabion Mattresses. For ease of reference, the term "mattress" will be used in this specification in place of Revet mattress and/or Gabion mattress, where the statement is of general nature and it is not specific to the double twisted or welded wire mesh products.

#### 6-1.6.1 Double Twisted Wire Mesh Gabions and Mattresses

They are classified according to the wire coating, which is applied prior to manufacturing the mesh. Coating styles are as follows:

Style 1, consists of wire mesh made from wire which is zinc coated before being double twisted into mesh. Fasteners, lacing wire, and stiffeners are produced from zinc-coated wire;

Style 2, consists of wire mesh made from wire which is coated with Zn-5Al-MM before being double twisted into mesh. Fasteners, lacing wire, and stiffeners are also produced from Zn-5Al-MM coated wire;

Style 3, consists of wire mesh, lacing wire, and stiffeners as Style 1 and over coated with PVC. Fasteners shall be of stainless steel wire;

Style 4, consists of wire mesh made from wire which is aluminum-coated before being double twisted into mesh. Fasteners, lacing wire, and stiffeners are also produced from aluminum-coated wire.

Style 1 for the wire coating is normally recommended for:

- (a) permanent gabion or mattress structures, for works installed in non-aggressive or non-polluted environments, and this condition remains unaltered over time;
- (b) temporary gabion or mattress structures, for works in moderately aggressive environments, depending on the minimum design life of the structure.

Style 2 for the wire coating is normally recommended for:

- (1) permanent gabion or mattress structures, for works installed in moderately aggressive environments;
- (2) temporary gabion or mattress structures, for works in aggressive environments, depending on the minimum design life of the structure.

Style 3 for the wire coating is normally recommended for both permanent and temporary gabion structures, for works installed in aggressive or polluted environments, or when the aggressiveness of the site is moderately unpredictable or variable from low to high.

Style 4 for the wire coating is very seldom used in the gabion industry. Its life expectancy shall be adequately documented to guarantee its consistency and reliability.

The determination of the rate of aggressiveness (non-aggressive, moderately, or highly aggressive) shall be made on a project-to-project basis, due to the many variables involved and the lack of criteria of general validity. It is normally recommended for the choice to be based on all the available data and on the experience of existing gabion structures in similar environments.

#### **6-1.6.2 Welded Wire Fabric Gabions and Mattresses**

The welded wire fabric gabions and mattress shall not be used in the project.

#### **6-1.7 Shipment, Handling, and Storage of Geotextile**

Only approved geotextile rolls shall be delivered to the project site. All geotextile shall be labeled, shipped, stored, and handled in accordance with ASTM D 4873. No hooks, tongs, or other sharp instruments shall be used for handling geotextile.

### **PART 2 PRODUCTS**

#### **6-2.1 Bedding Material**

##### **6-2.1.1 General**

Bedding material shall consist of a washed gravel or crushed stone.

##### **6-2.1.2 Material**

Bedding material shall be composed of tough, durable particles, adequately free from thin, flat and elongated pieces, and shall contain no organic matter nor soft, friable particles in quantities considered objectionable by the Engineer. The aggregates shall meet the quality requirements of ASTM C 33. Gradation shall conform to the gradation limit shown on drawings:

The bedding material shall be well-graded between the limits shown. At least one test shall be performed on each 1000 tons to be delivered to the project site or placed for each specified gradation in accordance with ASTM C 136. A representative sample weighting not less than 45 kg shall be removed from the bedding layer placed at locations directed by the Engineer. All points on individual grading curves obtained from representative samples of bedding material shall lie between the boundary limits as defined by smooth curves drawn through the tabulated gradation limits plotted on gradation envelope shown in drawing. The individual gradation curves within these limits shall not exhibit abrupt changes in slope denoting either gap grading or scalping of certain sizes or other irregularities which would be detrimental to the proper functioning of the bedding layers.

## **6-2.2 Stone**

### **6-2.2.1 General**

#### **(a) Evaluation Testing of Stone**

The Contractor shall have evaluation tests performed on stone samples collected from the proposed source for stone. The quarry investigation shall be performed by a registered geologist or registered Engineer. The tests to which the stone shall be subjected include petrographic examination (ASTM C 295), bulk specific gravity (SSD), unit weight, absorption (ASTM C 127), resistance of stone to freezing and thawing ASTM D 5312, and if argillaceous limestone and sandstone are used, resistance to wetting and drying ASTM D 5313.

The laboratory to perform the required testing shall be validated based on compliance with ASTM E 548 and relevant paragraphs of ASTM D 3740, and no work requiring testing shall be permitted until the laboratory has been inspected and validated. The inspection of the facilities shall be at the expense of the Contractor.

#### **(i) Bulk Specific Gravity Range**

All stone shall have a minimum bulk specific gravity, saturated surface dry (SSD), of 2.50 and a maximum bulk specific gravity of not more than 2.90 based upon water having a unit weight of 1000 kN/m<sup>3</sup>. The method of test for bulk specific gravity (SSD) shall be ASTM C 127.

#### **(ii) Unit Weight and Absorption**

Stone shall weigh more than 2500 kN/m<sup>3</sup> have a bulk specific gravity, saturated surface dry, greater than 2.60. The stone shall have an absorption less than 1 percent unless other tests and service records show that the stone is satisfactory. The method of test for unit weight and absorption shall be ASTM C 127, except the unit weight shall be calculated in accordance with Note No. 5 using bulk specific gravity, saturated surface dry.

#### **(iii) Petrographic Examination**

Stone shall be evaluated in accordance with ASTM C 295 which shall include information required by ASTM D 4992, paragraph 10. COE CRD-C 148 shall be used to perform Ethylene glycol tests required on rocks containing smectite as specified in ASTM D 4992 and on samples identified to contain swelling clays.

#### **(iv) Resistance of Rock to Wetting and Drying**

Stone shall have a maximum loss of 1 percent when determining the durability of stone when subject to wetting and drying in accordance with ASTM D 5313, except the surface area of one side of the sample shall be between 0.093 mm<sup>2</sup> and 1.486 mm<sup>2</sup>.

#### **(v) Samples**

Samples of stone from the proposed source of stone shall be taken by a representative of the Quarry under the supervision of the Engineer for testing and acceptance prior to delivery of any stone from this source to the site of the work. Information provided with the samples shall include the location within the quarry from which the sample was taken along with a field examination of the quarry. The field examination shall include the information outline in ASTM D 4992, paragraph 7. Samples shall

consist of at least three pieces of stone, roughly cubical in shape and weighing not less than 70 kg each from each unit that shall be used in the production of the required stone. If the source is an undeveloped quarry, or if the operation has been dormant for more than one year such that fresh samples are not available, the Contractor shall expose fresh rock for 6 m horizontally and for the full height of the face proposed for production, prior to the field evaluation. The Engineer may also require documentation of subsurface exploration of an undeveloped quarry in order to determine whether or not sufficient reserves are available. The samples shall be shipped at the Contractor's expense to a laboratory by the Engineer to perform the required tests.

**(vi) Tests**

The tests shall be conducted in accordance with applicable ASTM and Corps of Engineer's methods of tests given in the Handbook for Concrete and Cement, and shall be performed at a laboratory validated by the Engineer. The cost of testing shall be borne by the Contractor.

**(b) Quarry Operations**

Quarry operations shall be conducted by the Contractor in a manner that shall produce stone conforming to the requirements specified and may involve selective quarrying, handling, processing, blending, and loading as necessary, all of which shall be as specified in Section 5, Excavation and Miscellaneous Earthworks. Blasting and handling of rock shall be controlled by the Contractor to produce rock of the size ranges and quality specified. Techniques such as the use of proper hole diameter, hole depth, hole angle, burden and spacing distances, types and distribution of explosives, delay intervals and sequence, removal of muck piles between each shot, and special handling techniques are required as necessary to produce the specified materials. All aspects of blasting operations shall be specifically designed so that the end product is not damaged from the blasting technique and that the stone is suitable for the intended purpose.

**(i) Curing Stone**

The Contractor shall conduct curing operations on freshly quarried stone to allow it to release stored energy and moisture and to allow the stone to demonstrate that it will not fracture during the energy release and drying-out phase. Stones of sizes which are individually picked shall be temporarily stockpiled at the quarry site a minimum of 3 calendar days before being shipped to the project site, unless this requirement is waived by the Engineer. Such waiver will be granted only if the stone has characteristics that make curing unnecessary.

**(ii) Temporary Storage at Quarry**

Storage of stone materials subsequent to shipment from the quarry and prior to permanent placement in the required work shall be subject to approval of the Engineer. Underwater storage of stone materials is prohibited.

**(c) Gradation Test**

The Contractor shall perform a gradation test or tests on the riprap, stone, at the quarry in accordance with Sub-Clause 6-3.12.5 - Gradation Tests for stone. The sample shall be taken by the Contractor in the presence of the Engineer. The Contractor shall notify the Engineer not less than 3 days in advance of each test. At least one gradation tests shall be performed per 250,000 tons (metric) of each size of riprap, placed, but not less than one test shall be performed. The gradation tests shall be reported using the forms, approved by the Engineer. The sample shall consist of not less than 25 tons (metric) of riprap, and shall be collected in a random manner which will provide a sample which accurately reflects the actual gradation arriving at the jobsite. Failure of the test on the initial sample and on an additional sample will be considered cause for rejection of the quarry and/or quarry process, and all riprap, represented by the failed tests shall be set aside and not incorporated into the work. Any additional tests required because of the failure of an initial test sample will not be considered as one of the other required tests. If collected by the truckload, each truckload shall be representative of the gradation requirements. The Engineer may direct additional testing of the riprap, at the project site if the riprap, appears, by visual inspection, to be out of gradation. The additional tests shall be

performed on in-place materials at the locations directed, or on random loads selected by the Engineer. In-place test areas shall be not less than 3.6 m by 3.6 m and shall include the full thickness of the placed riprap, layer, without disturbing or including the underlying material and shall meet the minimum sample size specified above. Each pit excavated for an in-place test sample shall be refilled and reworked to provide a surface void of signs of disturbance. One in-place gradation shall be performed on each 3800 cubic meters 7500 tons (metric) or portion thereof placed. If the gradation test fails, additional gradation tests will be required at the Contractor's expense to delineate the limits of unacceptable stone. The additional gradation tests shall not count as part of the minimum number of gradation tests required. The unacceptable stone shall either be reworked to bring the stone within the specified gradation or the stone shall be removed from the project site as determined by the Engineer. The Contractor shall provide all necessary screens, scales and other equipment, and operating personnel, and shall grade the sample. Certification and test results shall represent riprap, shipped from the quarry. Certification and tests results must be received by the Engineer at the jobsite before the riprap, is used in the work.

**(d) Proportional Dimension Limitations**

The maximum aspect ratio (greatest dimension: least dimension) of any piece of stone for size ranges which are not graded with a screen or grizzly, shall be not greater than 3:1 when measured across mutually perpendicular axis. Not more than 25 percent (25%) of the stones within a gradation range shall have an aspect ratio greater than 2.5:1. A maximum of 10 percent flat and elongated pieces by weight will be acceptable. A flat and elongated piece of riprap is defined as having a ratio of width to thickness or length to width greater than 3:1. ASTM D 4791 shall be used as a guide to perform the test.

**(e) Riprap and Stone Stockpile**

Storage of riprap and stone at the worksite is not to be confused with off-site stockpiling of riprap or stone. If the Contractor elects to provide off-site stockpiling areas, the Engineer shall be notified by the Contractor of all such areas. The Contractor's stockpile shall be a maximum of 3.6 m high and formed by a series of layers of truckload dumps, where the rock essentially remains where it is placed. Subsequent layers shall be started 3 m from the edge of the previous layer so that the rock will not roll down the edges of the previous layers. The first layer shall be a maximum of 1.8 m high. After being stockpiled, any riprap which has become contaminated with soil or refuse shall not be put into the work unless the contaminating material has been removed from the riprap prior to placement.

**(i) Worksite Stockpile**

Riprap or stone delivered to the work sites, which requires temporary storage shall be placed in a container suitable for storing the riprap without waste, or a sand-clay-gravel or crushed stone pad may be constructed for the storage area and removed upon completion of the work. If the sand-clay-gravel or crushed stone pad method is used, the pad shall have a minimum thickness of at least 150 mm. The container or sand-clay-gravel or crushed stone pad method shall be subject to approval prior to delivery of the riprap. Upon completion of the work, the storage areas shall be cleaned of all storage residues and returned to their natural condition. Temporary storage of riprap at the worksite will be allowed, provided the stockpile toe of the riprap be no closer than 20m from the closest edge of the excavation's or stream's top slope, and the amount shall not exceed 200 t unless otherwise approved.

**(ii) Off-Site Stockpile**

In areas where riprap is stockpiled for placement, the area shall have excess rock removed prior to completion of work. All rock and spalls greater than 75 mm in diameter shall be removed. Where rocks may have become buried due to soft ground or operation of the equipment, the rock shall be disposed of as directed or put in a disposal area. After the rock has been removed, the storage area shall be graded, dressed, and filled to return the ground surface as near as practical to the condition that existed prior to construction.

**6-2.2.2 Riprap**

Only quarried stone shall be used. Riprap quality shall be as specified in Clause 6-1.4 – Testing and Studies, Sub-Clause 6-1.4.1 - Stone. Stone shall be well graded and shall conform to the tables below.

**Table 6-2**

PERCENT LIGHTER BY WEIGHT (SSD)	LIMITS OF STONE Weight KG					
	RIPRAP "M40"	RIPRAP "M90"	RIPRAP "M300"	RIPRAP "M450"	RIPRAP "M900"	RIPRAP "M3400"
100	40 – 20	90 – 35	300 – 120	450 - 180	900-400	3400 -1350
50	20 – 10	40 – 20	130 – 60	200 – 90	400-200	1400 - 680
15	10 – 3	20 – 5	60 – 20	95 – 30	200-70	680 - 225

**6-2.3 NOT USED****6-2.4 Materials for Gabions and Mattresses****6-2.4.1 Double Twisted Wire Mesh Gabions and Mattresses**

Double twisted wire mesh Gabions and Mattresses shall be of style as shown in drawings or as directed by the Engineer and manufactured with a non-raveling mesh made by twisting continuous pairs of wires through three half turns (commonly called double twisted) to form a hexagonal-shaped opening. Gabion and mattress sizes, wire diameters, mesh opening sizes, and tolerances shall comply with the requirements of ASTM A 975 (Tables 1, 3, 4, 5, 6, and Sections 9). Gabions and Mattresses shall meet the following test requirements:

**Metallic coating** - The coating weights shall conform to the requirements of ASTM A 641/A 641M, Class 3 (Style 1), ASTM A 856/A 856M (Style 2), ASTM A 90/A 90M or ASTM A 428/A 428M as applicable, and ASTM A 809 (Style 4).

**PVC for Coating** - The PVC coating shall show no cracks or breaks after the wires are twisted in the fabrication of the mesh. The initial properties of PVC coating material shall have a demonstrated ability to conform to the following requirements:

- (a) Specific Gravity - In the range from 1.30 to 1.35 dN/dm<sup>3</sup>, when tested in accordance with test method ASTM D 792;
- (b) Tensile Strength - Not less than 20.6 MPa when tested in accordance with test method ASTM D 412;
- (c) Modulus of Elasticity - Not less than 18.6 MPa when tested in accordance with test method ASTM D 412;
- (d) Hardness - Shore "D" between 50 and 60, when tested in accordance with test method ASTM D 2240;
- (e) Brittleness Temperature - Not higher than -9 degrees C, or lower temperature when specified by the purchaser, when tested in accordance with test method ASTM D 746.
- (f) Resistance to Abrasion - The percentage of the weight loss shall be less than 12%, when tested in accordance with test method ASTM D 1242;
- (g) Salt Spray Exposure and Ultra Violet Light Exposure - The PVC shall show no effect after 3,000 h of salt spray exposure in accordance with ASTM B 117. The PVC shall show no effect of exposure to ultra violet light with test exposure of 3,000 h, using apparatus Spectral Irradiance of Open Flame Carbon Arc with Daylight Filters and 63 degrees C, when tested in accordance with practice ASTM D 1499 and ASTM G 152;
- (h) Evaluation of Coating after Salt Spray and Ultraviolet Exposure Test - After the salt spray test and exposure to ultraviolet light, the PVC coating shall not show cracks nor noticeable change of color, or blisters or splits. In addition, the specific gravity, tensile strength, hardness and

resistance to abrasion shall not change more than 6%, 25%, and 10% respectively, from their initial values.

Wire Tensile Strength - The tensile strength of the wire used for the double twisted mesh, lacing wire, and stiffener, when tested in accordance with Test Methods and definitions ASTM A 370, shall be in accordance with the requirements of ASTM A 641/A 641M (Style 1), ASTM A 809 (Style 4), and ASTM A 856/A 856M (Style 2), for soft temper wire.

Mesh strength and panel to panel joint strength - The minimum strength requirements of the mesh, selvedge wire to mesh connection, panel to panel connection, and punch test, when tested in accordance with ASTM A 975 Section 13.1, shall be as shown in Table 6-3. The strength values reported in kN/m are referred to the unitary width of the specimen. The panel to panel test shall demonstrate the ability of the fastening system to achieve the required strength, and indicate the number of wire revolutions for the lacing wire or the ring spacing for ring fasteners used. The same number of wire revolutions or ring spacing shall be used in the field installation.

**Table 6-3**

<b>Minimum Strength Requirements of Mesh and Connections</b>			
<b>Test description</b>	<b>Gabions, metallic coated kN/m</b>	<b>Gabions, PVC Coated kN/m</b>	<b>Revet mattresses (metallic and PVC coated) kN/m</b>
Tensile strength parallel to twist (kN/m)	51.1	42.3	33.6
Tensile strength perpendicular to twist (kN/m)	26.3	20.4	13.1
Connection to selvedges (kN/m)	20.4	17.5	10.2
Panel to panel (using lacing wire or ring fasteners) (kN/m)	20.4	17.5	10.2
Punch Test (kN)	26.7	23.6	17.8

#### **6-2.4.2 Testing of wire Fasteners**

Test records made within one year by certified laboratories will be used to determine the acceptability of the fastening system. Samples of wire fasteners and samples of material for fabricating the gabions and mattresses with their certified test records shall be submitted at least 60 days in advance to the Engineer for approval.

#### **6-2.4.3 Stone Fill**

##### **(a) General**

Rock to fill gabions and mattresses shall be durable and of suitable quality to ensure permanence in the structure and climate in which it is to be used.

##### **(b) Stone Quality**

Stone fill, crushed stone, shall meet the quality requirements of ASTM C 33, and quality requirements of stone given in Sub-Clause 6-1.4.1 (c).

##### **(c) Gradation**

Gradation of stone for gabions shall be performed every 1000 tons placed under this contract in accordance with ASTM C 136. Sizes of rock to fill gabions and mattresses are chosen on the basis of

the mesh sizes, the structure's thickness, and within the limits shown in Table 6-4. Within each range of sizes, the rock shall be large enough to prevent individual pieces from passing through the mesh openings. Each range of sizes may allow for a variation of 5% oversize rock by weight, or 5% undersize rock by weight, or both.

**(i) Oversize Rock**

In all cases, the sizes of any oversize rock shall allow for the placement of three or more layers of rock within each gabion compartment and two or more layers of rock within each mattress compartment dependent upon the height of the mattress.

**(ii) Undersize Rock**

In all cases, undersize rock shall be placed within the interior of the gabion or mattress compartment and shall not be placed on the exposed surface of the structure. There shall be a maximum limit of 5% undersize or 5% oversize rock, or both, within each gabion or mattress compartment. The required rock gradation is reported in Table 6-4.

**Table 6-4**

<b>Required Rock Gradation For Gabions And Mattresses</b>		
Type of structure	Thickness (height) m	Rock sizes mm
Mattresses	0.17	75 – 130
Mattresses	0.23	75 – 130
Mattresses or Gabions	0.30	100 – 200
Gabions	0.50 or higher	100 – 200

**6-2.5 Materials for Geotextile**

**6-2.5.1 General**

The geotextile shall be a non-woven pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall equal or exceed the minimum average roll values listed in Table 6-5, Minimum Physical Requirements For Drainage Geotextile. Strength values indicated in the table are for the weaker principal direction.

**Table 6-5**

<b>Minimum Physical Requirements For Drainage Geotextile</b>			
PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
Tensile	N	>500	ASTM D 5034 grab test 25.4 mm square and 304.8 mm per minute constant rate at traverse.
Elongation	Percent	>15	ASTM D 5034 determine apparent breaking elongation.
Puncture	N	>180	ASTM D 3787 except polished steel ball replaced with a 8 mm diameter solid steel cylinder with a hemispherical tip centered within the ring clamp.
Tear	N	>111.2	ASTM D 1117 trapezoidal tear strength.
PERMEABILITY	cm/sec	> 0.05	ASTM D 4491
APPARENT OPENING SIZE	Mm	<1mm	ASTM D 4751



ULTRAVIOLET DEGRADATION	Percent	50 at 500 Hrs	ASTM D 4355
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### 6-2.5.2 Geotextile Fibre

Fibers used in the manufacturing of the geotextile shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

### 6-2.5.3 Seams

The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. Seams shall be tested in accordance with method ASTM D 4884. The strength of the seam shall be not less than 90 percent of the required grab tensile strength of the unaged geotextile in any principal direction.

### 6-2.5.4 Securing Pins

The geotextile shall be secured to the embankment or foundation soil by pins to prevent movement prior to placement of revetment materials. Other appropriate means to prevent movement such as staples, sand bags, and stone could also be used. Securing pins shall be inserted through both strips of overlapped geotextile along the line passing through midpoints of the overlap. Securing pins shall be removed as placement of revetment materials are placed to prevent tearing of geotextile or enlarging holes maximum spacing between securing pins depends on the steepness of the embankment slope. The maximum pins spacing shall be equal to or less than the values listed in Table 6-6, Maximum Spacing For Securing Pins. When windy conditions prevail at the construction site, the number of pins should be increased upon the demand of the Engineer. Terminal ends of the geotextile shall be anchored with key trench or apron at crest, toe of the slope and upstream and downstream limits of installation.

<b>Table 6-6</b>	
<b>Maximum Spacing For Securing Pins</b>	
Embankment	Spacing, meter
Steeper than 1V on 3H	0.6
1v on 3h to 1V on 4H	1.0
Flatter than 1V on 4H	1.5

## 6-2.6 Concrete Grout

### 6-2.6.1 Cementitious Materials

Cementitious materials will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports, that the materials meet the requirements of the specification under which it is furnished.

#### (a) Portland Cement

ASTM C 150, Type I

**(b) Pozzolan**

ASTM C 618, Class C or F, including requirements of Tables 1A and 2A. Pozzolan in amount not to exceed 25 percent, based on absolute volume, may be substituted for an equivalent amount of portland cement in the grout mixture proportions.

**6-2.6.2 Aggregates for Concrete Grout**

The fine aggregates for grout shall meet the quality and gradation requirements of either ASTM C 33. The coarse aggregates shall meet the quality and gradation requirements of ASTM C 33, Class designation 4M, Size No. 4.75 to 19.0 mm.

**6-2.6.3 Admixtures**

Admixtures to be used, when required or approved, shall comply with the following:

- (a) Air-Entraining Admixture: ASTM C 260.
- (b) Water-Reducing or Retarding Admixture: ASTM C 494/C 494M, Type A, B, or D.

**6-2.6.4 Curing Materials**

Curing materials shall be as follows:

- (a) Impervious Sheet Materials: ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.
- (b) Membrane-Forming Curing Compound: ASTM C 309, Type 1-D or 2, Class A.

**6-2.6.5 Water**

Water for mixing and curing shall be fresh, clean, potable, and free from injurious amounts of oil, acid, salt, alkali.

**PART 3 EXECUTION****6-3.1 Riprap Demonstration Section**

Prior to placement of stone, the Contractor shall construct a section of stone protection consisting of to demonstrate his proposed operations for production placement. The section shall demonstrate procedures and capability of grading, placing stone within the tolerances specified. The demonstration section shall be 15 m in length and shall conform to all applicable specifications.

**6-3.1.1 Methods and Equipment**

Methods and equipment employed for placement shall demonstrate the adequacy for use in placement of and shall conform with the requirements specified. The quantities of all materials placed within the section shall be accurately tabulated and provided immediately to the Engineer for comparison with computed quantities.

**6-3.1.2 Demonstration Section Evaluation**

The Contractor shall not proceed with placing stone prior to the approval of the demonstration section. Within a period of 7 days after completion of the section, the Engineer shall determine the adequacy of the section to function as part of the permanent construction. The Contractor shall be notified as to the acceptability of the section and may be directed to modify methods of construction and remove the section if necessary.

**6-3.1.3 Removal of Demonstration Section**

If removal of the demonstration section is required, it shall be conducted in such a manner as to maintain the integrity of the underlying subgrade. The Contractor shall make his own arrangements for disposal in areas not located on the site.

### **6-3.2 Base Preparation**

Areas on which bedding material and riprap are to be placed shall be graded and/or dressed to conform to cross sections shown on the contract drawings within an allowable tolerance of plus 50 mm and minus 100 mm from the theoretical lines and grades. The prepared base shall be approved by the Engineer. Where such areas are below the allowable minus tolerance limit they shall be brought to grade by fill with earth similar to the adjacent material and then compacted to a density equal to the adjacent in place material. Subaqueous areas on which bedding material and riprap are to be placed shall be graded and/or dressed to conform to cross sections shown on the contract drawings within an allowable tolerance of plus 300 mm and minus 600 mm from the specified line and grades. Where such areas are below the allowable minus tolerance limit they shall be filled with sand fill. As an alternative, these areas may be filled with bedding material. No payment will be made for any material thus required. Immediately prior to placing the bedding layers, the prepared base will be inspected by the Engineer and no material shall be placed thereon until that area has been approved.

### **6-3.3 Placement of Bedding Layers**

#### **6-3.3.1 General**

A bedding layer, consisting of a layer of gravel or crushed stone, shall be placed on the prepared base as described below, in accordance with the details shown on the contract drawings, and within the limits shown on the contract drawings or staked in the field.

A tolerance of plus 50 mm and minus 25 mm from the slope lines and grades shown on the contract drawings will be allowed in the finished surface of the bedding, except that the extreme of this tolerance shall not be continuous over an area greater than 18 m<sup>2</sup>.

#### **6-3.3.2 Placement of Bedding Material on Prepared Base**

Bedding material shall be spread uniformly on the prepared base to the lines and grades as indicated on the contract drawings and in such manner as to avoid damage to the prepared base. Placing of gravel or crushed stone by methods which tend to segregate the particle sizes within the bedding layer or cause mixing of the separate layers will not be permitted. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. Any damage to the surface of the prepared base during placing of the material shall be repaired before proceeding with the work. Compaction of material placed on the prepared base will not be required, but the material surface shall be finished to present an adequately even surface, free from mounds or windrows.

### **6-3.4 Placement of Riprap**

#### **6-3.4.1 General**

Riprap shall be placed on the bedding layers specified in Clause 6-2.1 – Bedding Material within the limits shown on the contract drawings.

#### **6-3.4.2 Placement**

Riprap shall be placed in a manner which will produce a well-graded mass of rock with the minimum practicable percentage of voids, and shall be constructed, within the specified tolerances, to the lines and grades shown on the contract drawings or staked in the field. Riprap shall be placed by means of truck, crane operated skip-pan (box), dragline bucket, clamshell, rock-bucket, hydraulic excavator ("Gradall"), trackhoe, or other approved equipment. Pneumatic tired front end loaders may be used provided that in the opinion of the Engineer no degradation of the rock occurs. Riprap shall be placed to its full course thickness in one operation and in such manner as to avoid displacing the bedding material. The large stones shall be well distributed and the entire mass of stones in their final position

shall be graded to conform to the gradation specified in Clause 6-3.4 – Placement of Riprap, Sub Clause 6-3.4.1 - General. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Placing riprap in layers will not be permitted. Placing riprap by dumping it into chutes, or by similar methods likely to cause segregation of the various sizes, shall not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope shall not be permitted. No equipment shall be operated directly on the completed stone protection system. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during final placing; or by other methods of placement which will produce the specified results. Each truckload shall be representative of the gradation requirements. All dump trucks used in placing the riprap shall be equipped with bottom hinged tailgates. The gate releasing mechanism shall be arranged so that it may be operated only from, at, or near the front of the truck. Rearranging of individual stones shall be required to the extent necessary to obtain a well-graded distribution of stone sizes as specified above. However, manipulating stone by means of dozers or other blade equipment shall not be permitted. Unless otherwise authorized by the Engineer, riprap shall be placed in conjunction with the construction of the embankment and with only sufficient lag in construction of the stone protection as may be necessary to prevent mixing of embankment and stone protection materials. The Contractor shall maintain the stone protection until accepted by the Engineer and any material displaced prior to acceptance and due to the Contractor's negligence shall be replaced at his expense and to the lines and grades shown on the contract drawings.

#### 6-3.5 Construction of Stone Pitching

The surfaces to be stone pitched shall be trimmed and shaped where necessary and the stoned set in a mortar consisting of 3 parts of clean fine aggregate to 1 part of cement by volume.

### 6-3.9 Placement of Hand-Placed Riprap

#### 6-3.9.1 General

Hand-placed riprap shall be placed on the bedding material specified in Clause 6-2.1 - Bedding Material within the limits shown. Stone shall conform to the requirements of Clause 6-2.2.2 - Riprap. Except for spalls for wedging, stone shall be roughly rectangular in shape of which the least dimension shall be not less than one-third the length.

#### 6-3.9.2 Placement

The riprap shall be carefully placed by hand in such a manner that adjacent stones are in close contact and, in general, have their greatest dimensions across the slope. "Through stones" shall be well-distributed throughout the mass and the sum of their cross sections, parallel to the slope being protected, shall be not less than two-thirds of such area. As used in this specification a "through stone" is defined as a stone whose dimension normal to the surface being riprapped is not less than the full depth of the riprap. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material placed on the slope shall be immediately adjacent to previously placed material in such a manner to ensure a relatively homogenous mass. The riprap along the lower edge of an area shall consist of the largest stones set in a trench so as to form a band. Except for spalls used to fill voids between larger stone, no stone shall be used in the exposed face of the riprap which will extend less than one-half the thickness of the riprap. Spaces between the larger stones shall be filled with spalls and smaller stones of the largest feasible size to form a compact mass. Spalls and small stone shall not be placed in nests in lieu of larger size stone.

**6-3.11 Grouting of Stone Protection****6-3.11.1 Producing, Conveying and Placing of Grout****(a) Producing Grout**

The batching and mixing equipment shall provide sufficient capacity to prevent cold joints. Materials shall be stockpiled and batched by methods that will prevent segregation or contamination of aggregates and insure accurate proportioning of the ingredients of the mixture. No mixing water in excess of the amount required by the job mix shall be added to the grout mixture during mixing, hauling, or after arrival at the delivery point, except as required and approved.

**(i) Ready-Mixed Concrete Grout**

Ready-mixed concrete grout shall conform to ASTM C 94/C 94M except as otherwise specified.

**(ii) Volumetric Batching and Continuous Mixing**

Volumetric batching and mixing shall conform to ASTM C 685.

**(iii) On-site Batching and Mixing**

The Contractor shall have the option of using an on-site batching and mixing facility. The facility shall provide sufficient capacity to prevent cold joints and be able to batch the cement and aggregate by weight, and the water and admixtures by weight or volume. The method of measuring materials, the batching operation, and the mixer shall be approved in accordance with Clause 6-1.3 - Submittals. On-site plant shall conform to the requirements of either ASTM C 94/C 94M or ASTM C 685.

**(b) Preparation for Placing**

Adequate precautions shall be taken to prevent grout from penetrating the bedding layer. The rock shall be flushed with water to remove the fines from the rock prior to placing the grout. The rock shall be kept moist just ahead of the actual placing, but no flowing or standing water shall be present during the grout operation. All equipment needed to place, protect, and cure the grout shall be at the placement site and in good operating condition. The entire preparation shall be accepted by the Engineer prior to placing the grout.

**(c) Conveying and Placing**

Grout placement shall not be permitted when, weather conditions prevent proper placement, except upon approval. The grout mixture shall not be placed until the stone protection has been inspected and approved. Grout shall be in place within 15 minutes after discharge from the mixer. Grout shall not be dropped more than 1.5 m vertically unless suitable equipment is used to prevent segregation.

**(i) Conveying**

When the grout is mixed or transported by a truck mixer, the grout shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregate and water. When the air temperature is 29 degrees C or greater) or under conditions contributing to quick stiffening of the grout, the time between the introduction of the cement and discharge of the grout shall not exceed 45 minutes. The Engineer may allow a longer time, provided the setting time of the grout is increased a corresponding amount by the addition of an approved set-retarding admixture. Grout shall be deposited as close as possible to its final position by methods that will prevent segregation of the aggregates or loss of mortar.

**(ii) Placing**

The riprap shall be kept moist just ahead of the actual grout placement, but the grout shall not be placed in standing or flowing water. Grout placed on inverts or other nearly level areas may be placed in one course. On slopes, the grout shall be placed in two (2) courses in successive lateral strips approximately 3 m in width starting at the toe of the slope and progressing to the top. The grout shall be delivered to the place of final deposit and discharged directly on the surface of the riprap, using a splash plate of metal or wood to prevent displacement of the rock directly under the discharge. The

flow of grout shall be directed with brooms, spades or baffles to prevent it from flowing excessively along the same path and to assure that all intermittent spaces are filled. Sufficient barring shall be done to loosen tight pockets of riprap and otherwise aid the penetration of grout so that all voids shall be filled and the grout fully penetrates the riprap [as specified][from the base of the riprap layer to at least two-thirds of the thickness of the stone layer]. All brooming on slopes shall be uphill and after the grout has stiffened, the entire surface shall be rebroomed to eliminate runs, to fill voids caused by sloughing, and to remove grout from the top surface and pockets or depressions of the upper stones.

**(d) Hot Weather Requirements**

When the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, is expected to exceed 100 g/m<sup>2</sup> per hour, provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

**6-3.11.2 Curing and Protection of Grouted Stone Protection**

Beginning immediately after placement and continuing for at least 7 days, all grout shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start of grout placement. After completion of any strip or panel, no workman or other load shall be permitted on the grouted surface for a period of twenty-four (24) hours. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied. Preservation of moisture for grout surfaces shall be accomplished by one of the following methods:

- (a) Continuous sprinkling and ponding.
- (b) Application of absorptive mats or fabrics kept continuously wet.
- (c) Application of sand kept continuously wet.
- (d) Application of impervious sheet material conforming to ASTM C 171.
- (e) Application of membrane-forming curing compound conforming to ASTM C 309. The compound shall be sprayed on the moist surface as soon as free water has disappeared, but shall not be applied to any surface until finishing of that surface is completed. The compound shall be applied at a uniform rate of not less than 300 ml/m<sup>2</sup> of surface and shall form a continuous adherent membrane over the entire surface. Curing compound shall not be applied to surfaces requiring bond to subsequently placed grout. If the membrane is damaged during the curing period, the damaged area shall be re-sprayed at the rate of application specified above.

**6-3.12 TESTS AND INSPECTIONS**

**6-3.12.1 Concrete Grout**

**(a) General**

Individuals who sample and test grout as required by this section shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to ACI minimum guidelines for certification of Concrete Transportation Construction Inspector or ACI Concrete Construction Inspector Level II.

**(b) Preparations for Placing**

Riprap shall be inspected in sufficient time prior to each grout placement by the Contractor in order to certify that it is ready to receive the grout.

**(c) Air Content**

Air Content shall be checked at least twice during each shift that grout is placed. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 231. Whenever a test result is outside the specification limits, the grout shall not be delivered to the area to be grouted and an adjustment shall be made to the air-entrainment admixture.

**(d) Slump**

Slump shall be checked twice during each shift that concrete grout is produced. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143/C 143M.

**(e) Placing**

The placing foreman shall not permit placing to begin until he has verified that adequate equipment and workmen are available.

**6-3.12.2 Pre-Production****(a) Bulk Specific Gravity**

During the process of selecting a source or sources of stone for the project, the Contractor shall make an investigation to determine the lowest and highest bulk specific gravity (SSD) of stone available at the source or sources he proposes to utilize for each gradation range of stone. Tests shall be performed at an approved testing laboratory in accordance with ASTM D6473 (1999). The testing results shall be submitted in accordance with Clause 6-1.3 - Submittals. Test results, which display an extraordinarily wide range of values, may necessitate additional testing to determine whether the source contains stratas with stones of an acceptable range of bulk specific gravity.

**(b) Material Quality**

Before selecting a source for preparation of a demonstration stockpile, the Contractor shall be reasonably certain that the source is capable of meeting the quality and source requirements specified in Clauses 6-1.4 (b) and (c) - Sources and Evaluation Testing of Stone respectively, including their respective Sub-Clauses.

**(c) Demonstration Stockpile at Source**

Following submittal of the Contractor's Quality Control (CQC) Plan and the Contractor's selection of a source, but prior to the Engineer's approval of a source and the CQC Plan, the Contractor shall make arrangements to provide a pre-production demonstration stockpile for each of the stone size ranges for the project. The stockpiles shall be located at the source of the stone and be shaped in windrow fashion. The stones with a size range greater than 2.7 tons shall be placed in a single layer with 300 mm of clear space around each stone. Stones under 2.7 tons in weight shall not be stacked higher than 1200 mm. The stones placed in the demonstration stockpiles shall be representative of the overall quality of materials in the source and shall not consist of the best specimens unless it is reasonable to determine that the source will provide the required amount of stone of the applicable size range with a degree of quality no less than that existent in the demonstration stockpile.

The stones placed in the stockpile shall have been preselected by the Contractor's Quality Control Plan (CQCP) inspector or supervisor and acceptable stones over 230 kg in size shall have been marked with spray paint on three mutually perpendicular sides with a coded mark to denote acceptability for a certain size range. A stockpile of representative reject stones marked with a red "X" shall also be maintained at the site as examples of unacceptable materials or shapes.

**(d) Evaluation of Demonstration Stockpile at Source**

The Contractor shall notify the Engineer when stockpiles are ready for evaluation. The Contractor's approved Quality Control Plan (QCP) supervisor and all QCP inspectors shall accompany the Engineer during the Engineer's evaluation of the demonstration stockpiles. The Contractor shall arrange to have individual stones turned as necessary to accommodate the Engineer's evaluation. The Engineer's will mark rejected stones with a red "X" and such stones shall be removed to the reject stockpile or to a crusher if one is available. If more than 2 unacceptable stones are found within a stockpile, the entire stockpile will be rejected by the Engineer and a replacement stockpile will be created for re-evaluation. If the replacement stockpile is rejected, the Contractor shall revise and resubmit its Quality Control Plan (QCP) and shall create another replacement demonstration stockpile for evaluation. If the third demonstration stockpile for a particular size range at a single source is found unacceptable, the source will be disapproved for such size range and a new source shall be submitted for approval. In addition the Contractor shall submit the name and qualifications for a person to replace the QCP supervisor. The Contractor may, of its own accord, choose a replacement source at the time a first or second demonstration stockpile is found unacceptable. The replacement of demonstration stockpiles or stone sources shall be at no additional cost to the Procuring entity/Employer and with no change in the time of completion.

**(e) Approval of Demonstration Stockpile at Source**

At the time the Engineer finds the contents of a demonstration stockpile to be unacceptable, either through visual examination or through laboratory testing, the Contractor will be notified in writing that the source, the QCP plan and QCP staff are approved, whereupon the Contractor may proceed with production of materials for the project provided they are consistent with demonstration stockpiles.

**(f) Duration of Demonstration Stockpile at Source**

Other than for being shipped as the final quantities of materials to be placed in the work, each demonstration stockpile shall remain unchanged at the source until all other required material of the size range represented by the stockpile has been shipped from the source.

**6-3.12.3 Placement Control**

The Contractor shall establish and maintain quality control for all work performed at the job site under this section to assure compliance with contract requirements. He shall maintain records of his quality control tests, inspections and corrective actions. Quality control measures shall cover all construction operations including, but not limited to, the placement of all materials to the slope and grade lines shown and in accordance with this section.

**6-3.12.4 Bedding Layers****(a) General**

The Contractor shall perform gradation tests to assure compliance with contract requirements and shall maintain detailed records. The bedding material, filter materials and/or sand fill shall be sampled in accordance with ASTM D 75 and tested in accordance with ASTM C 136. The Contractor shall perform the tests before and after surveys of each layer of stone protection material placed.

**(b) Reporting**

Reporting shall be in accordance with Sub Clause 6-2.2.1 (c) - Gradation Test.

**6-3.12.5 Gradation Tests for Stone**

Gradation tests for riprap and other stones shall be performed in accordance with ASTM D



5519, Test Method A.

## **PART 4 MEASUREMENT AND PAYMENT**

### **6-4.1 Bedding Layer**

#### **6-4.1.1 Measurement**

Bedding Material placed for bedding layer will be measured for payment separately for different areas of work as the volume determined by multiplying the area, as measured in the field, of the surface on which the bedding layer is placed, by the thickness measured perpendicular to the surface of the bedding layer, or sand as dimensioned on the Drawings.

#### **6-4.1.2 Payment**

Payment for bedding layer placed will be made at the applicable contract unit price for different areas of work as tendered in Bill of Quantities. Price and payment shall include all costs of furnishing, hauling, placing and maintaining the bedding material until placement of the riprap cover is completed and accepted. No payment will be made for excess thickness of bedding material, nor for material required to replace subgrade material lost by rain wash, wind erosion, over excavation or otherwise.

#### **6-4.1.3 Unit of Measure**

Unit of measure: Cubic Meter.

### **6-4.2 Riprap**

#### **6-4.2.1 Measurement**

Measurement, for payment, for furnishing and placing riprap of different types will be made separately as placed in different areas of work to the lines, grades, and thicknesses shown on the drawings or as established by the Engineer.

#### **6-4.2.2 Payment**

Payment for furnishing and placing riprap of different types will be made at the rates per cubic meter tendered therefor for different areas of work, in the Bill of Quantities which rates shall include the cost of all operations required to furnish, produce, and place the riprap as specified

#### **6-4.2.3 Unit of Measure**

Unit of measure: Cubic Meter.

### **6-4.3 Grouted Riprap**

#### **6-4.3.1 Measurement**

Measurement, for payment, for furnishing and placing grouted riprap will be made separately of grouted riprap placed in different areas of work to the lines, grades, and thicknesses shown on the drawings or as established by the Engineer.

#### **6-4.3.2 Payment**

Payment for furnishing and placing grouted riprap will be made at the rate per cubic meter tendered therefor in the Bill of Quantities which rate shall include the cost of all operations required to furnish, produce, and place the grouted riprap inclusive of stones and mortar as specified

**6-4.3.3 Unit of Measure**

Unit of measure: Cubic Meter.

**6-4.4 Gabion and Mattress Protection****6-4.4.1 Measurement**

Gabions or Mattresses meeting the requirements of these specifications and acceptably placed within the limits indicated on the drawings or otherwise established in the field, will be measured separately for payment by the cubic meter of stone filled gabions in place or mattresses in different areas of work.

**6-4.4.2 Payment**

Payment will be made at the rates quoted separately for Gabions and Mattresses in different areas of work in Bill of Quantities for costs associated with gabion or mattress protection, including the costs of furnishing, assembling, and placing the wire baskets, the stone fill, and all other materials, labor, equipment, tools, supplies, and incidental costs in connection with completing this item of work.

**6-4.4.3 Unit of Measure**

Unit of measure: Cubic Meter.

**6-4.5 Geotextile Filters****6-4.5.1 Measurement**

Installed geotextiles filters will be measured for payment in place to the nearest square meter of protected area as delineated in the drawings.

**6-4.5.2 Payment**

Payment will be made at the rate quoted which will constitute full compensation to the contractor for providing all plant, labor, material, and equipment and performing all operations necessary for the complete and satisfactory installation of the geotextile filters. The following items are included in the rate for geotextile filters and will not be counted a second time in the process of determining the extent of geotextile filters placed: Material and associated equipment and operation used in laps, seams, or extra length; securing pins and associated material, equipment, and operations; and material and associated equipment and operations used to provide cushioning layer of sand or gravel or both to permit increase in allowable drop height of stone. No payment will be made for geotextiles filters replaced because of waste, contamination, damage, repair, or due to Contractor's fault or negligence.

**6-4.5.3 Unit of Measure**

Unit of measure: Square Meter.

**SECTION 7 – EMBANKMENT CONSTRUCTION****PART 1 GENERAL****7-1.1 Scope**

This Section specifies requirements for the construction of embankment including the preparation of the foundation. The specifications for fills other than dam embankment are covered in Section 5, Excavation and Miscellaneous Earthwork.

**7-1.2 References**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM INTERNATIONAL (ASTM)**

ASTM C535	(2003) e1 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM – C88	(1999) a Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C127	(2001) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 698	(2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D4318	(2000) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4647-93	(1998) e1 Standard Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test
ASTM D422-63	(2002) Standard Test Method for Particle-Size Analysis of Soils
ASTM D698	(2000) e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> ))
ASTM D4253	(2000) Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	(2000) Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D5550 or Solids by	(2000) Standard Test Method for Specific Gravity of Soil Gas Pycnometer

ASTM D854	(2000) Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
ASTM D1556 or	(2000) Standard Test Method for Density and Unit or Weight of Soil in Place by the Sand-Cone Method
D2167 (1994, R2000)	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

#### **U.S. ARMY CORPS OF ENGINEERS (USACE)**

EM 1110-2-1906 (1970; R 1986) Laboratory Soils Testing

#### **7-1.3 Submittals**

Submissions, which the Contractor is required to make in relation to embankments and other fills in accordance with Clause 1-1.4 - Submittal Procedures, are specified below:

#### **SD-01 Details of Proposed Methods**

The Contractor shall submit:

- (a) Proposed methods of placing and compacting fill including a schedule of plant and equipment to be used.
- (b) Programme for quality control of earthworks.
- (c) Proposed sources of all embankment and other fill materials including rip-rap and methods of selective excavation and processing.
- (d) Proposed programme of embankment construction.
- (e) Programme and details of construction of test fills.

#### **SD-02 Shop Drawings**

- (a) Record drawings of the agreed ground level surveys prior to excavation and prior to the placement of fill in those areas.
- (b) Record drawings of all agreed level surveys taken for the purposes of measurement of quantities of fill.

Survey records as specified above shall be submitted to the Engineer within 7 days of the completion of the survey work recorded on them.

#### **SD-04 Samples**

The Contractor shall submit samples of materials proposed for use as fill, where specifically required by the Engineer.

#### **SD-07 Certificates**

The Contractor shall submit:

- (a) Laboratory test results.
- (b) Field test results.

### **7-1.4 Definitions**

The term "embankment" as used in these specifications is defined as the earth and rock fill portions of the structure and includes all types of earth fill and filter materials for the structure and all other specified or directed earth and rock fills within the limits of the project sites, excepting those stone and filter materials used for slope protection, which are described in Section 6-Protection of Slopes and Channels. "Compacted fill" includes all fill, except backfill, deposited in layers and compacted by rolling or tamping. The types of compacted earth fill are:

- (a) "Homogeneous/ Impervious fill" for the impervious section of the embankment.
- (b) "Filter drainage layers" forming the horizontal and/or vertical or inclined pervious drainage blankets and transition zones designed to prevent the detrimental movement of soil particles.

### **7-1.5 General Provisions**

#### **7-1.5.1 Lines and Grades**

The embankment shall be constructed to the lines, grades and cross sections indicated unless otherwise directed. The Engineer reserves the right to increase or decrease the foundation widths or the embankment slopes or make such other changes in the embankment sections as may be deemed necessary to produce a safe structure.

#### **7-1.5.2 Conduct on the Work**

The Contractor shall maintain and protect the embankment in a satisfactory condition at all times until final completion and acceptance of all work under the contract. If in the opinion of the Engineer the hauling equipment causes horizontal shears or slick sides, rutting, quaking, heaving, cracking or excessive deformation of the embankment, the Contractor shall limit the type, load or travel speed of the hauling equipment on the embankment. Any approved embankment material which is lost in transit or rendered unsuitable after being placed in the embankment and before final acceptance of the work, shall be replaced by the Contractor in a satisfactory manner and no additional payment will be made therefor. The Contractor shall excavate and remove from the embankment any material which the Engineer considers objectionable and shall also dispose of such material and refill the excavated area as directed, all at no cost to the Procuring entity/Employer. The Contractor shall remove, at his own expense, any embankment material placed outside of prescribed slope lines.

#### **7-1.5.3 Haul Roads**

Haul roads shall be located and constructed as approved. They shall be designed to maintain the intended traffic, to be free draining and shall be maintained in good condition throughout the contract period, unless otherwise directed. Haul roads within the area of contact between the embankment and its foundation and abutments shall be removed and the area shall be treated as specified in Sub-Clause 7-3.1 - Preparation of Foundation, Partial Fill Surface, and Abutments.

#### **7-1.5.4 Stockpiling from Approved Borrow Sources**

When the excavation from approved borrow sources progresses at a faster rate than placement in the fill is being accomplished, such excavated material shall be stockpiled at approved locations adjacent to the work until its use is authorized. No payment will be made for such stockpiling nor for the reloading and hauling of this material to its final position in the embankment.

## **PART 2 PRODUCTS**

### **7-2.1 Materials**

Classification of soils will be in accordance with ASTM D 2487.

**7-2.1.1 General**

The origin of any fill material in no way determines where it may be used in the embankment. Materials for embankment fills shall be secured from required excavations and from the borrow areas proposed by the Contractor and approved by the Engineer. The intention is to use the most suitable materials obtainable from these sources. Material to be wasted will be specifically designated at the time the material is excavated. Materials containing brush, roots, sod or other perishable materials will not be considered suitable. The suitability of the materials shall be subject to approval and their disposition in the embankment will be as directed. The Contractor shall excavate in the borrow areas in the location approved by the Engineer, whenever such control is necessary to obtain the type of material required for the embankment. Mixing of materials during the excavating process at the borrow area may be required.

**7-2.1.2 Homogeneous Fill**

Material for compacted homogeneous fill shall consist of clays, silty clays, or clayey silts obtained from the designated borrow areas or from the required excavation for structures. Silts and clays containing sand may be used, if such materials are sufficiently impermeable and suitable for compacting with a tamping or rubber-tired roller.

The materials when compacted in homogeneous fill shall have the following properties:

- (i) Material shall contain a minimum of 35% by dry weight of soil particles passing a ASTM Standard No. 200 sieve (size 0.075 mm).
- (ii) Plasticity index of 10 percent or greater as determined in accordance with ASTM D4318 (2000).
- (iii) The liquid limit determined by ASTM D4318 (2000) shall not exceed 70 percent.
- (iv) The material shall be non-depressive. It shall have pin-hole dispersion classification ND1 or ND2 when tested in accordance with ASTM D4647-93 (1998) e1.

**7-2.1.3 Not Used****7-2.1.4 Filter Drainage Layers**

Filter materials shall be composed of tough, durable particles; shall be reasonably free from thin, flat and elongated pieces; and shall contain no organic matter nor soft, friable particles in quantities considered objectionable by the Engineer. Filter materials shall consist of sand, gravel, or crushed stone, well graded between the limits specified by gradation envelopes shown in drawings.

Gradation of the material shall be determined in accordance with EM 1110-2-1906. All points on individual grading curves obtained from representative samples of filter material shall lie between the boundary limits as defined by smooth curves drawn through the tabulated grading limits plotted on a mechanical analysis diagram. The individual grading curves within these limits shall not exhibit abrupt changes in slope denoting skip grading, scalping of certain sizes or other irregularities which would be detrimental to the proper functioning of the filter.

**PART 3 EXECUTION****7-3.1 Preparation of Foundation, Partial Fill Surfaces and Abutments****7-3.1.1 Earth**

After excavation or stripping of the embankment foundation and excavation of the cut-off trench to the extent indicated or otherwise required, the sides of stump holes, test pits, and other similar cavities or depressions shall be broken down, where so directed, so as to flatten out the slopes, and the sides of the cut or hole shall be scarified to provide bond between the foundation material and the fill. Unless otherwise directed, each depression shall be filled with either homogeneous/ impervious material, filter drainage layer or rock material dependent upon the type of material which is to be placed immediately above the foundation. The fill shall be placed in layers, moistened, and compacted in accordance with the applicable provisions of Sub-Clauses 7-3.2, 7-3.3, 7-3.4 - Placement, Moisture Control, and Compaction. Materials which cannot be compacted by roller equipment because of inadequate clearances shall be spread in 150 mm layers and compacted with power tampers to an extent equal to that of the contiguous embankment fill material. After filling of depressions and cut-off trench and immediately prior to placement of compacted fill in any section of the embankment, the foundation of such section shall be loosened thoroughly by scarifying, plowing, discing or harrowing to a minimum depth of 150 mm, and the moisture content shall be adjusted to the amount specified in Sub-Clause 7-3.3 - Moisture Control for the appropriate type of material, except in areas where this requirement is waived by the Engineer. After removal of roots or other debris turned up in the process of loosening, the entire surface of the embankment foundation area shall be compacted by 6 complete coverages of the compaction equipment as specified for the appropriate type of fill. Prior to placement of compacted fill on or against the surfaces of any partial fill section, all soft or loose material, all material containing cracks or gullies, and all material that does not conform with the specified zoning of the embankment shall be removed. The remaining surface of the partial fill shall be loosened by scarifying, plowing, discing or harrowing to a minimum depth of 150 mm, and the moisture content shall be adjusted as specified in Sub-Clause 7-3.3 - Moisture Control for the appropriate type of material. The surface of the partial fill section upon which fill is to be placed shall then be compacted as hereinafter specified for the appropriate type of fill. No separate payment will be made for loosening and rolling the foundation area, the abutment area, or the surfaces of partial fill sections, but the entire cost thereof shall be included in the applicable contract price for fill.

**7-3.1.2 Rock**

All rock surfaces upon which or against which embankment materials are to be placed shall be cleaned in accordance with the applicable provisions of Section 5 Excavation and Miscellaneous Earthworks. Prior to the placement of embankment material upon or against a rock surface, all open joints and cracks in that surface shall be filled with mortar to the depths cleaned. Those portions of such rock surfaces where, in the opinion of the Engineer, the compaction of the embankment

materials cannot be accomplished satisfactorily with power tampers or other specified compaction equipment, shall be filled with mortar or concrete as directed to the extent necessary to permit satisfactory use of the compaction equipment. In no case shall a thin coat of mortar be left on smooth, intact rock surfaces. Large rock overhangs and protrusions shall be removed by the use of pre-splitting or line drilling techniques in such a manner as to minimize damage to the underlying rock, or the spaces beneath overhangs and around protrusions shall be filled with tamped concrete so that satisfactory compaction of embankment materials can be accomplished. Vertical surfaces shall not be more than 1.5 meters in height, and benches of sufficient width shall be provided as necessary so that the average slope of any rock face is not steeper than 2 vertical on 1 horizontal. Mortar and concrete, including forming as necessary, shall conform with the applicable provisions of Section 8-Concrete Work.

### **7-3.2 Placement**

#### **7-3.2.1 General**

No fill shall be placed on any part of the embankment foundation until such areas have been inspected and approved. The gradation and distribution of materials throughout the compacted earth fill section of the project structures shall be such that the embankment will be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material of the same class. Successive loads of material shall be dumped at locations on the fill as directed or approved. No fill shall be placed upon a frozen surface, nor shall snow, ice, or frozen earth be incorporated in the embankment.

#### **7-3.2.2 Frozen Material**

Embankment shall not be placed on a foundation, which contains frozen material. This prohibition encompasses all foundation types, including the natural ground, all prepared subgrades, whether in an excavation or on an embankment, and all layers of previously placed and compacted earth fill which become the foundations for successive layers of earth fill. All material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, or winter shutdowns or earthwork operations, shall be removed to a depth that is acceptable to the Engineer and replaced with new material. Alternatively, the material shall be thawed, dried, reworked, and recompacted to the specified criteria before additional material is placed. The Engineer will determine when placement of fill shall cease due to cold weather. The Engineer may elect to use average daily air temperatures, and/or physical observation of the soils for his determination.

#### **7-3.2.3 Rate of Placement**

Unless otherwise directed, the embankment shall be maintained at approximately the same level regardless of the number of types of materials being placed, unless this provision is waived in writing by the Engineer. Method of placement shall be such that contamination of various fill zones is avoided.

#### **7-3.2.4 Homogeneous/ Impervious Fill**

Impervious fill shall be placed in the impervious section, cut-off trench, and impervious blanket. In general, the more impervious materials shall be placed towards the center of the impervious section and the less impervious materials toward the rock fill sections so that a transition in permeability is effected from the core to the rock fill sections.



**7-3.2.5 Not Used****7-3.2.6 Not Used****7-3.2.7 Filter Drainage Layers**

Sand filters, gravel filters, and sand and gravel filters shall be placed in the embankment in the manner described and to the lines and grades indicated.

**7-3.2.8 Spreading**

After dumping, the materials shall be spread by bulldozers or other approved means in approximately horizontal layers over the entire fill areas. Unless otherwise directed, the thickness of these layers before compaction with tamping type rollers shall not be more than 250 mm for impervious materials nor more than 200 mm for other embankment materials. Unless otherwise directed, the thickness of layers before compaction with rubber-tired rollers shall not be more than 250 mm for impervious materials, nor more than 300 mm for other embankment materials except backfill. Rock fill and filters, including spalls, shall be spread in layers not more than 300 mm in thickness. As soon as practicable after commencement of construction of any section of the embankment, the central portion thereof shall be raised or crowned with grades not to exceed 3 percent so that the surface of the fill will drain freely and shall be so maintained throughout construction. If the compacted surface of any layer of material, exclusive of filter material and rock fill, is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or by any other approved method, before the succeeding layer is placed. At all times during the dumping and spreading processes, the Contractor shall maintain a force of men adequate to remove all roots and debris from all embankment materials and all stones of greater than 10 mm in maximum dimension from impervious materials. Stone so removed shall be placed in the outer slopes of the rock fill and the roots and debris shall be removed from the embankment and disposed of in an approved manner. The entire surface of any section of the embankment under construction shall be maintained in such condition that construction equipment can travel on any part of any one section. Ruts in the surface of any layer shall be removed by scarifying before placing and compacting additional material.

**7-3.3 Moisture Control**

The materials in each layer of the fill shall contain the amount of moisture, within the limits, specified below or as directed, necessary to obtain the specified compaction. Material that is not within the specified limits after compaction shall be reworked, regardless of density.

**7-3.3.1 Homogeneous/ Impervious Sections**

The moisture content after compaction shall be as uniform as practicable throughout any one layer of impervious materials. The moisture content after compaction as determined by ASTM D 2216 shall be within the limits of 2 percentage points above optimum and 1 percentage point below optimum moisture content. Material that is too wet shall be spread on the embankment and permitted to dry, assisted by discing or harrowing, if necessary, until the moisture content is reduced to an amount within the specified limits. When the material is too dry, the Contractor will be required to sprinkle water in each layer of the fill. Harrowing, or other approved methods will be required to work the moisture into the material until a uniform distribution of moisture is obtained. Water applied on a layer of fill shall be accurately controlled in amount so that free water will not appear on the surface during or subsequent to rolling. Should too much water be added to any part of the embankment, so that the material is too wet to obtain the desired compaction, the rolling on that section of the embankment shall be delayed until the moisture content of the material is reduced to an

amount within the specified limits. If it is impracticable to obtain the specified moisture content by wetting or drying the material on the fill, the Contractor may be required to prewet or dry back the material at the sources of excavation. If, in the opinion of the Engineer, the top or contact surfaces of the partial fill section become too dry to permit suitable bond between these surfaces and the additional fill to be placed thereon, the Contractor shall loosen the dried materials by scarifying or discing to such depths as may be directed; he shall dampen the loosened material to an acceptable moisture content; and he shall compact this layer in accordance with the applicable requirements of Sub-Clause 7-3.4 - Compaction, Sub-Clause 7-3.4.2 - Impervious Fill, to densities comparable to the underlying embankment.

#### **7-3.3.2 Not Used**

#### **7-3.3.3 Not Used**

#### **7-3.3.4 Filter Drainage Layers**

Moisture control of graded gravel filter and bedding layers will not be required and sluicing will not be permitted. Moisture control of filters containing a predominate amount of sand particles will be as required as under.

For moisture control, material shall be wetted by sprinkling water after spreading on the embankment and the moisture content of each layer shall be maintained at the optimum for compaction during rolling. Prewetting of material at the sources of excavation or borrow will not be required. Sprinkling shall be done with hoses connected to header pipes along the faces of the embankment, by water trucks with pressure spray bars, or by any other approved method. All connections in the water supply system, including the hose connections to the header pipes, shall be watertight. Jets shall not be directed at the embankment with such force that the finer materials will be washed out. The capacities of pumps and sizes of header pipes shall be sufficient to supply the required amount of water at all times.

### **7-3.4 Compaction**

#### **7-3.4.1 Equipment**

Compaction equipment shall conform to the following requirements and shall be used as prescribed in subsequent paragraphs.

#### **(a) Tamping Rollers**

(i) Towed - Tamping rollers shall consist of two or more non-vibratory roller drums mounted side-by-side in a suitable frame and towed by either a crawler-type or rubber tired tractor having sufficient power to pull the roller satisfactorily when the drums are fully ballasted. Each drum shall be free to pivot about an axis parallel to the direction of travel. Rollers operated in tandem sets shall be controlled in a manner such that the prints produced by the tamping feet of the tandem units are staggered. Each drum of a roller shall have an outside diameter of not less than 1500 mm and shall be not less than 1500 mm in length. The space between two adjacent drums, when on a level surface, shall not be less than 300 mm nor more than 375 mm. Each drum ballasted with fluid shall be equipped with at least one pressure-relief valve and with at least one safety head. The safety head shall be equal to union-type safety heads equipped with rupture discs suitable for rupturing pressures between 350 and 500 kPa. The pressure - relief valve is a manually operated valve and shall be opened periodically. Personnel responsible for opening pressure-relief valves shall be periodically instructed to

ascertain that valve openings are free from plugging to assure that any pressure developed in roller drums is released at each inspection. At least one tamping foot shall be provided for each 186 000 square millimeters of drum surface. The length of each tamping foot from the outside surface of the drum shall be not more than 275 mm and shall be maintained at not less than 225 mm. The bearing surface of each tamping foot shall be flat with a surface area not less than 4500 square millimeters nor more than 6500 square millimeters. During the operation of rolling, the spaces between the tamping feet shall be maintained clear of materials which would impair the effectiveness of the tamping rollers. The weight of a roller when fully loaded shall be not less than 58 400 N/m of drum length, and the weight of a roller empty shall be not more than 36,500 N/m of drum length. The bearing surface, tamping foot size, the drum loading, and the operation of the rollers shall be as required to obtain the desired compaction. If more than one roller is used on any one layer of fill, all rollers so used shall be of the same type and essentially of the same dimensions. Rollers shall be drawn by crawler-type or rubber-tired tractors at a speed not to exceed 8 km/h. The use of rubber-tired towing equipment shall be discontinued if the tires leave ruts that prevent uniform compaction by the tamping roller, and the substitution of crawler-type towing equipment may be directed.

- (ii) Self-propelled - The use of self-propelled non-vibratory tamping rollers conforming with the following specification will be permitted, and their design and operation shall be subject to approval, and subject to the right, at any time during the prosecution of the work, to direct such modifications to the tamping feet or variations in roller drum weight where applicable, as may be found necessary to secure optimum compaction of the earth fill materials. If use of self-propelled tamping rollers causes shearing of the fill, laminations in the fill, or results in inadequate compaction, the Engineer may direct that such rollers be removed from the fill and that appropriate towed tamping rollers be used. Two- or three-drum side-by-side units that are either in drive position or drawn by separate power equipment shall have a clearance between adjacent drums not less than 300 mm nor more than 375 mm. Two-drum or four-drum equipment separated by cab and differential and arranged in tandem must have its static weight equally distributed to all compaction drums and must have the tandem drums positioned such that the prints of the tamping feet produced by the tandem drums are staggered. The surface on which the tamping feet are mounted shall have a minimum outside diameter of 1200 mm and at least one tamping foot for each 186,000 square millimeters of drum surface. The distance between the centers of any two adjacent tamping feet shall be not less than 225 mm. The length of each tamping foot from the outside mounting surface of the drum shall be not more than 275 mm and shall be maintained at not less than 225 mm. The bearing surface of each tamping foot shall be flat and have a surface area not less than 4500 square millimeters nor more than 9000 square millimeters. Cupped recesses within the bearing surface of each tamping foot will be permitted but shall not exceed 13 mm in depth.

During rolling operations, the spaces between the tamping feet shall be maintained clear of materials which would impair the effectiveness of the tamping roller. The weight of all roller drums during compaction of fill materials shall be maintained uniform and with the weight per foot of drum length not less than 62,800 N. For self-propelled rollers with drums capable of being ballasted with fluid, each drum shall be equipped with at least one pressure-relief valve and with at least one safety head. The safety head shall be equal to union type safety heads equipped with rupture discs suitable for rupturing pressures between 350 and 500 kPa. The pressure relief valve is a manually operated valve and shall be opened periodically. Personnel responsible for opening pressure-relief valves shall be periodically instructed to ascertain that valve openings are free from plugging to assure that any pressure developed in roller drums is released at each inspection. For self-propelled rollers in which steering is accomplished through the use of rubber-tired wheels, the tire pressure shall not exceed 275 kPa. The use of the compactor shall be discontinued if the tires leave ruts that prevent uniform compaction by the tamping roller and the substitution of appropriate towed tamping rollers may be directed. When a self-propelled roller is provided with a dozer blade, coverages made with the blade in operation shall not be counted as compaction coverages. Self-propelled rollers shall be operated at a speed not to exceed 8 km/h.

**(b) Vibratory Rollers**

Vibratory rollers for compacting rockfills, pervious sand and gravel fills, or filter and transition drainage layers shall be equipped with a smooth steel compaction drum and shall be operated at a frequency of vibration during compaction operations between 1100 and 1500 vpm. Vibratory rollers may be either towed or self-propelled and shall have an unsprung drum weight that is a minimum of 60 percent of the rollers' static weight. Towed rollers shall have at least 90 percent of their weight transmitted to the ground through the compaction drum when the roller is standing in a level position hitched to the towing vehicle. Rollers for compacting rockfill, sand and gravel fills, or filter and drainage layers shall have a minimum static weight of 90 kN, a minimum dynamic force of 180 kN when operating at 1400 vpm, and an applied force not less than 130 kN/m of compaction drum length. The level of amplitude and vibration frequency during compaction will be maintained uniform throughout the embankment zone within which it is operating. Rollers shall be operated at speeds not to exceed 2.4 km/h. The equipment manufacturer shall furnish sufficient data, drawings, and computation for verification of the above specifications, and the character and efficiency of this equipment shall be subject to approval.

**(c) Rubber-tired Rollers**

Rubber-tired rollers shall have a minimum of four wheels equipped with pneumatic tires. The tires shall be of such size and ply as can be maintained at tire pressures between 550 and 700 kPa for a 110 kN wheel load during rolling operations. The roller wheels shall be located abreast and be so designed that each wheel will carry approximately equal load in traversing uneven ground. The spacing of the wheels will be such that the distance between the nearest edges of adjacent tires will be greater than 50 percent of the tire width of a single tire at the operating pressure for a 110 kN wheel load. The roller shall be provided with a body suitable for ballast loading such that the load per wheel may be varied, from 80 to 110 kN. The roller shall be towed at speeds not to exceed 8 km/h. The character and efficiency of this equipment shall be subject to approval.

**(d) Power Tampers**

Compaction of material, in areas where it is impracticable to use a roller or tractor, as provided in Sub-Clause 7-3.1.1 - Earth, shall be performed by the use of approved power tampers.

#### **7-3.4.2 Homogeneous/ Impervious Fill**

After a layer of impervious fill material has been dumped and spread, it shall be harrowed if required, to break up and blend the fill materials, unless harrowing, as specified under Sub-Clause 7-3.3.1 - Impervious Sections, is performed to obtain uniform moisture distribution. Harrowing shall be performed with a heavy disc plow, or other approved harrow, to the full depth of the layer. If one pass of the harrow does not accomplish the breaking up and blending of the materials, additional passes of the harrow may be required, but in no case will more than three passes of the harrow on any one layer be required for this purpose. When the moisture content and the condition of the layer is satisfactory, the lift shall be compacted to at least 98 percent of maximum density as determined by ASTM D 698, prior to placement of the next layer. Determination of in-place density shall be in accordance with ASTM D 1556, ASTM D 2167, and ASTM D 2922. Portions of the fill which are not accessible to the roller shall be placed in 150 mm layers loose measurement and compacted with power tampers to a degree equal to that obtained on the other portions of the compacted fill by rolling as specified. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section when there is sufficient area to permit these operations to proceed simultaneously.

#### **7-3.4.3 Not Used**

##### **7-3.4.4 Filter and Transition Drainage Layers**

The requirements for compacted Pervious fills will apply to these materials except for bedding layers under dumped riprap. Bedding layers under dumped riprap will require no special compaction other than controlled movement of dumping and spreading equipment.

#### **7-3.5 Slides**

In the event of slides in any part of the embankment prior to final acceptance of the work the Contractor shall remove material from the slide area, as directed, and shall rebuild such portion of the embankment. In case it is determined that the slide was caused through the fault of the Contractor the removal and disposal of material and the rebuilding of the embankment shall be performed without cost to the Procuring entity/Employer; otherwise this work will be paid for at the applicable contract unit prices for compacted fill.

#### **7-3.6 Test fills**

The Contractor shall carry out compaction trials prior to the beginning of embankment construction using the specified roller and any other provisionally approved compaction device.

Test fills shall be a minimum of 20 m long and the compacted width shall be at least three roller widths. An additional roller width of fill shall be placed adjacent to each edge of the compacted fill. The minimum test fill thickness for each combination of variables to be tested shall be three fill layer thicknesses.

For impervious fill, the Contractor shall demonstrate that the methods he proposes to use for excavating, processing, watering, transporting, placing and compacting will achieve the specified requirements.

For filters the densities of each zone achieved by various compactive efforts and with the addition of varying amounts of water shall be measured, together with particle size determinations before and after compaction.

Before commencing any trials, the Contractor shall submit his proposals to the Engineer for approval.

No separate payment will be made for test fills.

### 7-3.7 Testing

Following tests shall be carried out on materials for various zones of embankment:

- (i) Gradation Tests – ASTM D422-63 (2002)
- (ii) Liquid Limit and Plastic Limit – ASTM D4318 (2000)
- (iii) Los Angeles Abrasion - ASTM C535 (2003) e1
- (iv) Sodium Sulphate Soundness Test - ASTM – C88 (1999) a
- (v) Compaction Test – ASTM D698 (2000) e1
- (vi) Maximum and minimum dry density – ASTM D4253 (2000) and D4254 (2000)
- (vii) Specific gravity and absorption of rock / aggregate samples - ASTM C127 (2001)
- (viii) Specific gravity of soil solids – ASTM D5550 (2000) or D854 (2000)
- (ix) Field density Test – ASTM D1556 (2000) or D2167(1994, R2000)
- (x) Pinhole Dispersion Test – ASTM D4647-93 (1998) e1

Representative tests shall be performed at the sites and at the frequency indicated below:

Test	Frequency of Test Rockfill			Rockfill
	Impervious fill	Fine Filter	Coarse Filter	
Gradation	(i) 1 test for every 2000m <sup>3</sup> of fill or,	(i) 1 test for every 500m <sup>3</sup> of fill or,	(i) 1 test for every 500m <sup>3</sup> of fill or,	Total 5 tests
	(ii) at least one test for every shift of compaction, whichever is greater	(ii) at least one test for every shift, whichever is greater	(ii) at least one test for every shift, whichever is greater	
Sodium Sulphate Soundness	-	Total 5 tests	Total 5 tests	Total 5 tests
Liquid Limit and Plastic Limit	One set of tests every 2000m <sup>3</sup> of fill	-	-	-
Los Angeles Abrasion	-	-	Total 5 tests	Total 5 tests
Specific Gravity	10 tests	10 tests	10 tests	10 tests
Pinhole Dispersion	10 tests	-	-	-

Field density Test	(i) One test per 500m <sup>3</sup> of material placed or,	(i) One test per 500m <sup>3</sup> of material placed or,	(i) One test per 500m <sup>3</sup> of material placed or,	-
	(ii) At least one test for every shift of compaction, whichever is greater	(ii) At least one test for every shift, whichever is greater	(ii) At least one test for every shift, whichever is greater	
Compaction Test in Laboratory	One test for every 5 field density tests	-	-	-
Maximum and Minimum dry density test	-	One test for every 5 field density tests	One test for every 5 field density tests	-

Engineer may vary the frequency of tests depending on variation in fill material and change in material source.

The tests for which facility is not available at field laboratory, shall be arranged by the Contractor at other laboratories approved by the Engineer. No payment will be made for the tests carried out as required under this Clause.

#### PART 4 MEASUREMENT AND PAYMENT

##### 7-4.1 Compacted Fill, Impervious

###### 7-4.1.1 Measurement

Compacted fill, impervious, will be measured for payment in place based upon the established limit lines on the cross sections shown or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation including the cut-off trench and accomplishment of foundation preparation except scarifying and the lines, grades and slopes of the accepted embankment.

###### 7-4.1.2 Payment

Payment will be made at the tendered rate in the Bill of Quantities and covers all costs associated with preparing the foundation of the embankment; excavating from borrow pit and transporting from area of excavation to area of placement, spreading, harrowing, sprinkling, compacting, removing objectionable materials; and all other incidental work required for the construction, protection, and maintenance of the embankment. This payment is in addition to any payment for excavating and transporting of the material as specified in Section 5 – Excavation and Miscellaneous Earthworks. No separate payment will be made for uncompacted fill and all costs incidental to spreading, protecting, and maintenance of such fill shall be included in the contract price for excavation of the material for structures.

#### 7-4.1.3 Unit of Measure

Unit of measure: cubic meter.

### 7-4.2 Filters

#### 7-4.2.1 Measurement

Fine Filter and Transition Zone Filter will be measured for payment in place based upon the established limit lines and the payment lines indicated on the cross sections shown or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation and accomplishment of foundation preparation (except scarifying) and the lines, grades and slopes of the accepted embankment.

#### 7-4.2.2 Payment

Payment will be made at the corresponding tendered rate in the Bill of Quantities and covers all costs associated with excavating, transporting, mixing and processing the materials to the required gradation, spreading, compacting, removing objectionable materials, and all other incidental work required for the construction, protection, and maintenance of the filter.

#### 7-4.2.3 Unit of Measure

Unit of measure: cubic meter.



**SECTION 8 - CONCRETE WORK****PART 1 GENERAL****8-1.1 Scope**

This section contains requirements for the manufacture, transportation, placement, finishing, repair and curing of concrete; for the detailing, supply and placing of reinforcement; for formworks; for joints, joint materials, joint treatment; for design of Precast-Prestressed concrete; and for all other work associated with cast-in-place and precast concrete.

**8-1.2 References**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ACI INTERNATIONAL (ACI)**

ACI 117	(1990) Standard Tolerances for Concrete Construction and Materials & Commentary
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214R	(2002) Evaluation of Strength Test Results of Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 347	(2001) Guide to Formwork for Concrete
ACI SP-66	(1994) ACI Detailing Manual
ACI 318/318R	(2002) Building Code Requirements for Structural Concrete and Commentary
ACI 318M/318RM	(2002) Metric Building Code Requirements for Structural Concrete and Commentary

**AMERICAN WELDING SOCIETY (AWS)**

AWS D1.4 (1998) Structural Welding Code - Reinforcing Steel

**AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)**

AASHTO (2003) Standard Specification for Highway Bridge- 17<sup>th</sup> Edition

**ASTM INTERNATIONAL (ASTM)**

ASTM A 185 (2002) Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A 370 (2003a) Mechanical Testing of Steel Products

ASTM A 416/A 416M (2002) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

ASTM A 421 (1998a) Uncoated Stress-Relieved Steel Wire for Prestressed Concrete

ASTM A 497 (2002) Steel Welded Wire Reinforcement, Deformed, for Concrete

ASTM A 615/A 615M (2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 616/A 616M (1996a) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 617/A 617M (1996a) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 706/A 706M (2004)a Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 722/A 722M (1998; R 2003) Uncoated High-Strength Steel Bar for Prestressing Concrete

ASTM B 152/B 152M (2000) Copper Sheet, Strip, Plate, and Rolled Bar

ASTM C 920 (2002) Elastomeric Joint Sealants

ASTM C 928 (2000) Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs

ASTM C 1059 (1999) Latex Agents for Bonding Fresh to Hardened Concrete

ASTM C 1064/C 1064M (20031) Temperature of Freshly Mixed Portland Cement

## Concrete

ASTM C 1074	(1998) Estimating Concrete Strength by the Maturity Method
ASTM C 1077	(2003) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 109/C 109M	(2002) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. [50-mm] Cube Specimens)
ASTM C 117	(2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 123	(2003) Lightweight Particles in Aggregate
ASTM C 127	(2001) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2001e1) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1997) Clay Lumps and Friable Particles in Aggregates
ASTM C 150	(2002ae1) Portland Cement
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2002) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2003) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 295	(2003) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for

	Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Concrete Aggregates
ASTM C 39/C 39M	(2003) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	(1999) Organic Impurities in Fine Aggregates for Concrete
ASTM C 42/C 42M	(2003) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 535	(2003e1) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 566	(1997) Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 597	(1997) Pulse Velocity Through Concrete
ASTM C 618	(2003) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 666	(2003) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 684	(2003) Standard Test Method for Making, Accelerated Curing, and Testing Concrete Compression Test Specimens
ASTM C 685	(2000) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 803/C 803M	(2003) Penetration Resistance of Hardened Concrete
ASTM C 805	(2002) Rebound Number of Hardened Concrete
ASTM C 87	(2003) Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 881/C 881M	(2002) Epoxy-Resin-Base Bonding Systems for Concrete

ASTM C 94/C 94M	(2003a) Ready-Mixed Concrete
ASTM D412	(2002)e1 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D2240	(2003) Standard Test Method for Rubber Property—Durometer Hardness
ASTM D471	(1998)e1 Standard Test Method for Rubber Property—Effect of Liquids
ASTM D518	(1999) Standard Test Method for Rubber Deterioration—Surface Cracking
ASTM D573	(1999) Standard Test Method for Rubber-Deterioration in an Air Oven
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2628	(1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 1998) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D 75	(2003) Sampling Aggregates
ASTM D 4791	(1999) Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM E 11	(2001) Standard Specification for Wire Cloth and Sieves for Testing Purposes

**NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)**

NIST HB 44	(2004) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices
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**NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)**

NRMCA CPMB 100	(2000) Concrete Plant Standards
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**PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)**

PCI MNL-120 (1999) Design Handbook - Precast and Prestressed Concrete

**U.S. ARMY CORPS OF ENGINEERS (USACE)**

COE CRD-C 100 (1975) Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing

COE CRD-C 104 (1980) Method of Calculation of the Fineness Modulus of Aggregate

COE CRD-C 130 (2001) Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles

COE CRD-C 143 (1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregated

COE CRD-C 318 (1979) Federal Specifications for Cloth, Burlap, Jute (or Kenaf)

COE CRD-C 400 (1963) Requirements for Water for Use in Mixing or Curing Concrete

COE CRD-C 521 (1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

COE CRD-C 513 (1974) Specifications for Rubber Waterstops

COE CRD-C 572 (1974) Specifications for Poly vinyl chloride Waterstops

COE CRD-C 94 (1966) Specification for Surface Retarders

COE CRD-C 55 (1992) Test Method for within – Batch Uniformity of Freshly Mixed Concrete

**8-1.3 Submittals**

The following shall be submitted by the Contractor for Engineer's review and approval in accordance with Clause 1-1.4 - Submittal Procedures:

**SD-02 Shop Drawings**

• **Concrete Lift Drawings**

Showing sizes and limits of various concrete pours, position of joints etc.

• **Formwork**

Drawings and design computations for all formwork required shall be submitted at least 30 days either before fabrication on site or before delivery of prefabricated forms. If reshoring is permitted, the method, including location, order, and time of erection and removal shall also be submitted for review.

- **Fabrication and Placement of Reinforcement**

The Contractor shall submit shop drawings which include: reinforcement steel placement drawings; reinforcement steel schedules showing quantity, size, shape, dimensions, weight per meter, total weights and bending details; and details of bar supports showing types, sizes, spacing and sequence.

- **Erection of Precast Concrete**

The Contractor shall prepare and submit for approval complete shop drawings that show the precast unit manufacturer's recommended details and materials for the work required by Clause 8-1.8 - Delivery, Storage, and Handling of Precast-Prestressed Members. The shop drawings shall include: design computations; marking of the units for the placing drawings; anchorages for work of other trades; anchorages to support construction; size and location of steel tendons; methods of stressing; location and sizes of all openings 300 mm wide or larger to be cast into members; formwork; joints between units and other construction; reinforcing steel details; method of curing; and, pickup points and lifting devices.

- **Installation Drawings**

Installation drawings for tendons and accessories shall be submitted and approved prior to commencing the work.

### **SD-03 Product Data**

- **System of Identification of Materials**

A system of identification, which shows the disposition of specific lots of approved materials in the work, shall be established and submitted before completion of the contract.

- **Materials for formwork**

Manufacturer's literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, and form coating, and form-lining materials.

- **Concrete Mix Proportioning**

Concrete mixture proportions shall be determined by the Contractor and submitted for review and approval by the Engineer. The concrete mix quantities of all ingredients per cubic meter and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate the mass of cement, pozzolan and ground granulated blast-furnace (GGBF) slag when used, and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

- **Batch Plant**

The Contractor shall submit batch plant data to the Engineer for review for conformance with applicable specifications.

- **Concrete Mixers Capacity**

The Contractor shall submit concrete mixer data, which includes the make, type, and capacity of concrete mixers proposed for mixing concrete.

- **Conveying Equipment**

Data on the conveying equipment and methods for transporting, handling, and depositing the concrete.

- **Placing Equipment**

Data on placing equipment and methods.

- **Tests and Inspections**
- **Testing Technicians**
- **Concrete Transportation Construction Inspector (CTCI)**

Statements that the concrete testing technicians and the concrete inspectors meet the specified requirements.

- **Construction Joint Treatment**

The method and equipment proposed for joint cleanup and waste disposal shall be submitted for review and approval.

- **Curing and Protection**

The curing medium and methods to be used shall be submitted for review and approval.

- **Hot-Weather Placing**

If concrete is to be placed under hot-weather conditions, the proposed materials and methods shall be submitted for review and approval.

- **Cold Weather Protection**

When concrete is to be placed under cold-weather conditions, a description of the materials and methods proposed for protection of the concrete shall be furnished 60 days in advance of anticipated need date for review.

- **Finishing**

- **Splicing Water stops**

Procedures for splicing water stops shall be as recommended by the Manufacturer of the water stop and submitted for approval.

- **Erection Plan for Precast Concrete**

The Contractor shall prepare a detailed erection plan which shall be submitted at least 15 days prior to the date that erection of members is to begin.

- **Design Calculations for Precast Concrete**

Design calculations shall be submitted prior to the initiation of manufacture of members to be used under this contract.

- **Construction Records for Precast Concrete**

Construction records of the manufacturing, handling, and erection of the precast-prestressed concrete members shall be submitted.

- **Prestressing Method and Equipment**

Descriptions of proposed Prestressing method and equipment shall be submitted and approved prior to the start of Prestressing operations.

- **Materials Disposition Records**

Records which identify the incorporation of approved materials into the work shall be submitted before completion of the contract.

- **Prestressing Operations Records**

Complete records of the Prestressing operations shall be submitted before completion of the contract.



**SD-04 Samples**

- **Aggregates**
- **Cementitious Materials, Admixtures, and Curing Compound**

Samples of materials for Engineer testing and approval.

- **Sample formwork Panels**

After shop drawings have been reviewed, sample panels for Class A finish with applied architectural treatment shall be built on the project site where directed.

Panels shall be of sufficient size to contain joints and shall be not less than 2 meters long and 1.5 meters wide. The panels shall be of typical wall thickness and constructed containing the full allocation of reinforcing steel that will be used in the structure, with the forming system that duplicates in every detail the one that will be used in construction of the structure. The same concrete mix proportion and materials, the same placement techniques and equipment, and the same finishing techniques and timing shall be used that are planned for the structure. Construction of Class A finish will not be permitted until sample panels have been approved. Sample panels shall be protected from construction operations in a manner to protect approved finish, and are not to be removed until all Class A finish concrete has been accepted.

- **Field Molded Sealants and Primer**

Four litres of field-molded sealant and 1 litre of primer (when primer is recommended by the sealant manufacturer) shall be provided for testing.

- **Waterstops**

Waterstop materials and splice samples shall be submitted for inspection and testing and shall be identified to indicate manufacturer, type of material, size and quantity of material and shipment represented. Each materials sample shall be a piece not less than 300 mm long cut from each 60 m of finished waterstop furnished, but not less than a total of 1.2 linear meters of each type and size furnished. For spliced segments of waterstops to be installed in the work, one spliced sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site shall be furnished for inspection and testing. The spliced samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each spliced sample shall be not less than 300 mm long.

**SD-06 Test Reports**

- **Mixture Proportions**

The recommended mixture proportions, sources of materials, and all test results shall be submitted for approval.

- **Quality of Aggregates**

Aggregate quality tests shall be submitted at least 30 days prior to start of concrete and shot Crete placement.

- **Inspection of Forms**

The Contractor shall submit field inspection reports for concrete forms and embedded items.

- **Formwork Not Supporting Weight of Concrete**

If forms are to be removed in less than 24 hours, which are not supporting the weight of concrete, the evaluation and results of the control cylinder tests or maturity instrumentation shall be submitted to and approved before the forms are removed.

- **Accelerator Compatibility**

The Contractor shall establish the compatibility of the job cement and the proposed accelerators.

- **Mixer Uniformity**

The results of the initial mixer uniformity tests shall be submitted at least 5 days prior to the initiation of placing.

- **Material Tests, Inspections, and Verifications for Reinforcement**

Certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications shall be furnished for each steel shipment and identified with specific lots prior to placement. Three copies of the heat analyses shall be provided for each lot of steel furnished and the Contractor shall certify that the steel conforms to the heat analyses.

- **Premolded Expansion Joint Filler Strips**

- **Compression Seals and Lubricant**

- **Prestressed Concrete**

The results of concrete strength testing by the contractor shall be submitted not more than 5 days after the tests are completed.

- **Tests and Inspections**

Test results and inspection reports shall be submitted daily and weekly.

- **Stressing Tendons and Accessories**

Certified Materials Test Reports shall be submitted for all required materials tests, showings note the specific standards followed in the performance of tests, and stating unambiguously show that materials comply with the applicable specifications. Such Test Reports shall be submitted for each material shipment and be identified with specific lots prior to use of materials in the work.

#### **SD-07 Certificates**

- **Cementitious Materials**

Cementitious Materials, including Cement and Pozzolan, and Ground Granulated Blast-Furnace Slag will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished. Certification and mill test reports shall be from samples taken from the particular lot furnished. No Cementitious materials shall be used until notice of acceptance has been given by the Engineer. Cementitious materials will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Engineer, and such sampling will be by Contractor under the supervision of the Engineer. Material not meeting specifications shall be promptly removed from the site of work.

- **Accelerating Admixtures**

Accelerating admixtures shall be certified for compliance with all specification requirements.

- **Curing Materials**

Curing materials shall be certified for compliance with all specification requirements.

- **Steel Reinforcement bars and Fiber Reinforcement**

Steel reinforcement bars and Fiber reinforcement shall be certified for compliance with all specification requirements.

- **Air-Entraining Admixture**

Air-Entraining Admixture shall be certified for compliance with all specification requirements.

- **Other Chemical Admixtures**

Other Chemical Admixtures shall be certified for compliance with all specification requirements.

- **Epoxy Resin**
- **Latex Bonding Compound**

Epoxy Resin and Latex Bonding Compound shall be certified for compliance with all specification requirements.

- **PVC and Rubber Waterstops**
- **Certification of Prestressing Technicians**

Certificates for Prestressing technicians shall be submitted prior to start of Prestressing operations who will use the proposed system in the work shall certify by name that these technicians are thoroughly trained and skilled in the use of the system.

#### **8-1.4 Engineer's Testing and Sampling**

The Contractor is required to carry out necessary testing of constituent materials and concrete and shotcrete to show the compliance with specification's requirements. The mixture proportioning shall be carried out according to Clause 8-2.14 – Concrete Mix Proportioning. The Engineer may require to sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172.

##### **8-1.4.1 Preconstruction Sampling and Testing**

###### **(a) Aggregates**

The Contractor shall furnish materials from a source proposed by the Contractor. Samples from any source of coarse aggregate and any source of fine aggregate selected by the Contractor, consisting of not less than 70 kg of each size coarse aggregate and 35 kg of fine aggregate taken under the supervision of the Engineer in accordance with COE CRD-C 100 shall be delivered to site laboratory when directed by the Engineer. Sampling and shipment of samples shall be at the Contractor's expense. 30 days will be required to complete evaluation of the aggregates.

Testing will be performed at the site laboratory in accordance with the applicable ASTM test methods. Tests to which aggregate may be subjected are listed in Sub-Clause 8-2.2.2 - Quality. The material from the proposed source shall meet the quality requirements of this Clause . Testing of aggregates by the Engineer does not relieve the Contractor of the requirements outlined in Clause 8-3.11 - Tests and Inspections.

###### **(b) Cementitious Materials, Admixtures, and Curing Compound**

At least 60 days in advance of concrete placement, the Contractor shall notify the Engineer of the sources for Cementitious materials, admixtures, and curing compound, along with sampling location, brand name, type, and quantity to be used in the manufacture and/or curing of the concrete.

##### **8-1.4.2 Construction Testing by the Engineer**

Sampling and testing will be performed by the Engineer except as otherwise specified. No material shall be used until notice has been given by the Engineer that test results are satisfactory. The Engineer will sample and test chemical admixtures, curing compounds, and Cementitious materials.

**(a) Chemical Admixtures Storage**

Chemical admixtures that have been in storage at the project site for longer than 6 months shall be retested at the expense of the Contractor when directed by the Engineer and shall be rejected if test results are not satisfactory. Chemical admixtures will be accepted based on compliance with the requirements of Clause 8-2.3 - Chemical Admixtures.

**(b) Cement**

Cement remaining in bulk storage at the mill, prior to shipment, for more than six (6) months or cement stored in local storage by the contractor for more than three (3) months after shipment from the factory may be retested before use and shall be rejected if fails to meet any of the specification requirements. All cement used will be type I and type V as per design requirements.

If cement is to be obtained from more than one source, the initial notification shall state the estimated amount to be obtained from each source and the proposed schedule of shipments.

Cement shall be sampled at the source and stored in sealed bins pending completion of testing. Sampling, testing, and the shipping inspection from the point of sampling, when the point is other than at the site of the work, will be made by or under the supervision of the Engineer. No cement shall be used until notice has been given by the Engineer that test results are satisfactory. In the event of failure, the cement may be resampled and tested at the request of the Contractor, at his expense. When the point of sampling is other than at the site of the work, the fill gates of the sampled bin and conveyances used in shipment will be sealed under Engineer supervision and kept sealed until shipment from the bin has been completed. If tested cement is rehandled at transfer points, the extra cost of inspection shall be at the Contractor's expense. The cost of testing cement excess to project requirements shall also be at the expense of the Contractor.

**(c) Concrete Strength**

Compressive strength test specimens will be made by the Contractor under supervision of Engineer and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength  $f_c$  and no individual test result falls below the specified strength  $f_c$  by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including nondestructive testing, taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

- (i) Investigation of Low-Strength Test Results - When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803/C 803M, or ASTM C 805 may be permitted by the Engineer to estimate the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.
- (ii) Testing of Cores - When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Engineer to least impair the performance of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement.

- (iii) Load Tests - If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Engineer in accordance with the requirements of ACI 318M/318RM. Concrete work evaluated by structural analysis or by results of a load test shall be corrected in a manner satisfactory to the Contacting Officer. All investigations, testing, load tests, and correction of deficiencies will be performed and approved by the Engineer at the expense of the Contractor, except that if all concrete is in compliance with the plans and specifications, the cost of investigations, testing, and load tests will be at the expense of the Engineer.

### 8-1.5 Design Requirements of Concrete Mix

#### 8-1.5.1 Concrete Strength

Specified compressive strength  $f'_c$  shall be as follows. Mix proportion shown for concrete Grade A ,B,C,D,E are just indicative to show the minimum contents ,nevertheless ,the contractor is to follow the mix design trial as per 8-2.12.5 Concrete Proportioning.

Unless otherwise specified concrete mixes shall conform to the strength requirements given in the following table

Nominal Mix	Minimum cube strength required (in psi)				General use
	Laboratory Tests		Work Tests		
	7 days	28 days	7 days	28 days	
1:1:2	4000	6000	3000	4500	In paving.
1:1½:3	3350	5000	2500	3750	For reinforced concrete other than in paving
1:2:4	2700	4000	2000	3000	
1:3:6	-	2500	-	2000	For mass concrete
1:4:8	-	2000	-	1500	For Lean concrete

28 days 6 inches x 12 inches (15cm x 30 cm) cylinder strength corresponding to 28 days cube Strength in the Table are given hereunder: -

28 days cube strength (Psi)	6" x 12" cylinder strength (Psi)
4500	4000
3750	3000
3000	2200
2000	1500

#### 8-1.5.2 Maximum Water-Cement (W/C) Ratio

Maximum W/C shall be as follows:

Water-Cement Ratio, by Mass	Structure or Portion of Structure
0.45 ± 0.02	Parts of the Structures exposed to severe weathering; <ul style="list-style-type: none"> <li>- Top one meter of walls</li> <li>- Bridge piers</li> <li>- Roadway</li> </ul>
0.50 ± 0.02	General exterior portion of the Structure; <ul style="list-style-type: none"> <li>- Spillway apron</li> <li>- Retaining wall</li> </ul>
0.55 ± 0.02	Special exterior construction

	<ul style="list-style-type: none"> <li>- Parts of structure covered with backfill</li> <li>- Parts of structure continually submerged</li> </ul>
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These W/C's may cause higher strengths than that required by Sub-Clause 8-1.5.1 - Concrete Strength.

**8-1.6 Construction Tolerances**

Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal. Tolerances are not cumulative. The most restrictive tolerance controls. Tolerances shall not extend the structure beyond legal boundaries. Except as specified otherwise, plus tolerance increases the amount or dimension to which it applies, or raises a level alignment and minus tolerance decreases the amount or dimension to which it applied, or lowers a level alignment. A tolerance without sign means plus or minus. Where only one signed tolerance is specified, there is no limit in the other direction. The unformed finished surfaces subject to high-velocity flow (12 m/s) shall be finished to meet the tolerances for A-HV surfaces specified in Table, "Tolerances for Finished Formed Concrete Surfaces".

The definitions of the terms used in the following tabulations are used as defined and used in ACI 117. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing.

**Tolerances for Foundations**

(1)	Lateral alignment	
	As cast to the center of gravity as specified; 0.02 times width of footing in direction of misplacement but not more than	
	.....	50 mm
	Supporting masonry construction .....	13 mm
(2)	Level alignment	
	Top of footings supporting masonry .....	13 mm
	Top of other footings .....	+13 mm
		-50 mm
(3)	Cross-sectional dimensions	
	Horizontal dimensions of formed members .....	+50 mm
		-13 mm
	Horizontal dimensions of unformed members cast against soil	
	600 mm or less .....	+75 mm
		-13 mm
	Greater than 600 mm but less than 1800 mm .....	+150 mm
		-13 mm
	Over 1.8 m .....	+300 mm
		-13 mm
	Vertical dimension (thickness) .....	-5 percent
(4)	Relative alignment	
	Slope of footing side and top surfaces with respect to the specified plan .....	25 mm/3000 mm

**Tolerances for Cast-in-Place Reinforced Concrete for Buildings**

(1)	Vertical alignment	
	For heights 30 m	
	Lines, surfaces, and arrises .....	25 mm

	Outside corner of exposed corner columns and control joint grooves in concrete exposed to view .....	13 mm
	For heights greater than 30 m	
	Lines, surfaces, and arrises, 1/1,000 times the height at any point but not more than .....	150 mm
	Outside corner of exposed corner columns and control joint grooves in concrete, 1/2,000 times the height at any point but not more than .....	75 mm
(2)	Lateral alignment	
	Members .....	25 mm
	In slabs, centerline location of openings 300 mm or smaller and edge location of larger openings .....	13 mm
	Sawcuts, joints, and weakened plane embedment in slabs.....	19 mm
(3)	Level alignment	
	Top of slabs	
	Elevation of slabs-on-grade .....	19 mm
	Elevation of top surfaces of formed slabs before removal of supporting shores .....	19 mm
	Elevation of formed surfaces before removal of shores .....	19 mm
	Lintels, sills, parapets, horizontal grooves, and other lines exposed to view .....	13 mm
(4)	Cross-sectional dimensions	
	Members, such as columns, beams, piers, walls (thickness only) and slabs (thickness only)	
	300 mm dimension or less .....	+10 mm -6 mm
	More than 300 mm but not over 900 mm dimension .....	+13 mm -10 mm
	Over 900 mm dimension .....	+25 mm -19 mm
(5)	Relative alignment	
	Stairs	
	Different in height between adjacent risers .....	3 mm
	Different in width between adjacent treads .....	6 mm
	Grooves	
	Specified width 50 mm or less .....	3 mm
	Specified width more than 50 mm but not more than 300 mm .....	6 mm
	Sawcuts, joints, and weakened plane on slab	
	Lateral, gradual .....	19mm in 3000mm
	Lateral, abrupt .....	0 mm
(6)	Openings through members	
	Cross-sectional size of opening .....	+25 mm -6 mm
	Location of centerline of opening .....	13 mm

**Tolerance for Finished Formed Concrete Surfaces**

(1)	Vertical alignment Formed surfaces slope with respect to the specified plane	
	Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view .....	7mm in 3000mm
	All other conditions .....	10mm in 3000mm
(2)	Abrupt variation The offset between concrete surfaces under adjacent pieces of formwork for the following classes of surface: (For Class A-HV, positive means raise of elevation in the direction of waterflow, negative means drop of elevation in the direction of waterflow) *Class A-HV, in the direction of waterflow .....	+0 mm -3 mm
	Perpendicular to the direction of waterflow .....	3 mm
	Class A .....	3 mm
	Class B .....	6 mm
	Class C .....	6 mm
	Class D .....	25 mm
	*Includes any high-velocity flow surface.	
(3)	Gradual variation Surface finish tolerances as measured by placing a freestanding (unleveled), 1.5 m straightedge for plane surface or curved template for curved surface anywhere on the surface and allowing it to rest upon two high spots within 72 hr after concrete placement. The gap at any point between the straightedge or template and the surface shall not exceed: *Class A (including Class A-HV) .....	3 mm
	Class B .....	6 mm
	Class C .....	13 mm
	Class D .....	25 mm
	*Includes any high-velocity flow surface.	

**Tolerances for Cast-in-Place, Vertically Slipformed Building Elements**

(1)	Translation and rotation from a fixed point at the base of the structure: For heights 30 m or less .....	50 mm
	For heights greater than 30 m, 1/600 times the height but not more than .....	205 mm
(2)	Lateral alignment Between adjacent elements .....	50 mm
(3)	Cross-sectional dimensions Wall thickness .....	+19 mm -10 mm
(4)	Relative alignment Formed surface slope with respect to the specified plane	19 in 3000 mm



**Tolerances for Mass Concrete Structures Other Than Buildings**

(1)	Vertical alignment	
	Visible surfaces .....	30 mm
	Concealed surfaces .....	65 mm
	Side walls for radial gates and similar watertight joints .....	5 mm
(2)	Lateral alignment	
	Visible surfaces .....	30 mm
	Concealed surfaces .....	65 mm
(3)	Level alignment	
	Visible flatwork and formed surfaces .....	13 mm
	Concealed flatwork and formed surfaces .....	25 mm
	Sills for radial gates and similar watertight joints .....	5 mm
(4)	Relative alignment	
	Formed surface slope with respect to the specified plane	
	Slopes in lateral and level alignments	
	Visible surfaces .....	7mm in 3000 mm
	Concealed surfaces .....	13mm in 3000mm
	Slopes in vertical alignment	
	Visible surfaces .....	13mm in 3000mm
	Concealed surfaces .....	25mm in 3000mm

**Tolerances for Bridges, Erosion-Protection Structures, and Small Hydraulic Structures**

(1)	Vertical alignment	
	Exposed surfaces .....	19 mm
	Concealed surfaces .....	40 mm
(2)	Lateral alignment	
	Centerline alignment .....	25 mm
(3)	Level alignment	
	Profile grade .....	25 mm
	Top of other concrete surfaces and horizontal grooves	
	Exposed .....	19 mm
	Concealed .....	40 mm
	Mainline pavements in longitudinal direction, the gap below 3 m unlevelled straightedge resting on highspots shall not exceed .....	3 mm
	Mainline pavements in transverse direction, the gap below a 3 m unlevelled straightedge resting on highspots shall not exceed .....	6 mm
	Ramps, sidewalks, and Intersection, in any direction, the gap below a 3 m unlevelled straightedge resting on highspots shall not exceed .....	6 mm
(4)	Cross-sectional dimensions	
	Bridge slab thickness .....	+6 mm -3 mm

	Members such as columns, beams, piers, walls, and others (slabs-thickness only) .....	+13 mm
	.....	-6 mm
	Openings through concrete members.....	13 mm
(5)	Relative alignment	
	Location of openings through concrete members .....	13 mm
	Formed surface slope with respect to the specified plane	
	Watertight joints .....	3 in 3000 mm
	Other exposed surfaces .....	13 in 3000 mm
	Concealed surfaces .....	25 in 3000 mm
	Unformed exposed surfaces slopes with respect to the specified plane .....	7mm in 3000mm
	.....	10mm in 6000mm

**Tolerances for Conduits, and Culverts**

(1)	Lateral alignment	
	Centerline alignment	
	Water conveying tunnels, conduits, and culverts .....	13 mm
	Others .....	25 mm
	Inside dimensions .....	0.005 times inside dimension
(2)	Level alignment	
	Profile grade	
	Water conveying tunnels, conduits, and culverts .....	13 mm
	Others .....	25 mm
	Surface of invert .....	6 mm
	Surface of side slope .....	13 mm
(3)	Cross-sectional dimension Thickness at any point	
	Tunnel and culvert lining .....	-0 mm
	Conduits .....	+5 percent thickness but not more than 13 mm
		-2.5 percent thickness but not less than 6 mm

**Tolerances for Precast Members**

(1)	Length of Member	19mm or 1 mm per m, whichever is greater
(2)	Cross-Sectional Dimensions	
	Dimension Less than 900 mm.....	9mm
(3)	Horizontal Alignment (Sweep)	
	Deviation from a straight line parallel theoretical countrelines	13mm or 1mm/m of length which ever is greater
	The maximum gap between members	+25mm
(4)	Camber	
	Deviation from computed camber	1mm per m, but not greater than 12mm

(5)	Camber Differential At midspan between adjacent members	+2mm/m of length but not grater than +19mm
(6)	Position of Tendons Deviation from design position.....	6mm
(7)	Handling Devices Deviation of actual position of handling devices from the designed position .....	150mm
(8)	Anchors and Inserts Actual position of anchors and inserts from position shown in the drawing.....	25mm
(9)	Flange Thickness Plus 6mm or minus 3 mm	+ 6mm -3mm
(10)	Depth of Member at support	6mm
(11)	Distance between Stems	3mm
(12)	Squareness of Ends	6mm

### 8-1.7.1 Design Requirements

#### (a) Precast-Prestressed Members and Connections

Design of members and connections shall be in accordance with ACI 318/318R and PCI MNL-120.

#### (b) Loads

Loadings for members and connections shall include all dead load, live load, applicable lateral loads such as wind and earthquake, applicable construction loads such as handling, erection loads, and other applicable loads.

#### (c) Design Calculations

Design calculations for members and connections not shown in the contract drawings shall be made by a registered professional Engineer experienced in the design of precast-prestressed concrete.

### 8-1.7.2 Performance Requirements

Perform the following testing to ensure the materials and method used meet the requirements of these specifications and will produce precast- prestressed concrete members which are suitable for their intended use.

#### (a) High-Strength Steel Tendons

Testing shall be as specified in Sub-Clause 8-1.3 - Submittals SD-06 Test Reports of Stressing Tendons and Accessories for Prestressed Concrete.

#### (b) Concrete

Concrete shall be sampled and cylinders made in accordance with ASTM C 172 and ASTM C 31/C 31M.

#### (i) Concrete Test Cylinders

A minimum of two concrete test cylinders per bed shall be made to verify the strength of concrete at the time of stress transfer and a minimum of two test cylinders per day or 38 cubic meters of concrete or fraction thereof, whichever results in the most cylinders, shall be made for each mix design to verify the attainment of the specified strength.

#### (ii) Cylinder Making

Cylinders shall be made as near as possible to the location where they will be cured and shall not be disturbed in any way from 1/2 hour after casting until they are either 24 hours old or ready to be tested. Concrete in cylinders may be consolidated by rodding or by vibration as specified in ASTM C 31/C 31M.

**(iii) Cylinder Curing**

- (1) Test cylinders shall be cured with similar methods as the members they represent. In lieu of actual curing with the members, cylinders may be cured in curing chambers correlated in temperature and humidity with the beds. In such a case, the correlation shall be constantly verified by use of recording thermometers in the curing chambers and comparison with the temperature records of beds and by use of the same methods of moisture retention for curing chambers and casting beds.
- (2) For beds cured by steam or radiant heat, cylinders shall be placed at random points along the bed. If there is any indication of variable heat, cylinders shall be placed in the coolest area.
- (3) Test cylinders to indicate compliance with specified 28-day or earlier strength shall remain in the bed with the member until the member is removed. At that time, the cylinders shall be removed from their molds and placed in storage in a moist condition at 23 degrees plus or minus 1.5 degrees C.

**(iv) Testing of Cylinders**

- (1) Testing of cylinders to determine compressive strength shall be performed in accordance with ASTM C 39/C 39M. The strength of concrete at any given age shall be determined as the average of two cylinders, except a single cylinder test can be used to determine stress transfer strength or predictive strengths at less than 28 days.
- (2) Testing machines shall be calibrated in accordance with ASTM C 39/C 39M.

**(c) Air Content**

The air content tests shall be conducted in accordance with ASTM C 231. At least one air content test shall be conducted on the concrete from which each member is cast.

**(d) Precast Panel**

Before casting precast members, one sample precast concrete panel not less than 600 by 600 by 125 mm deep shall be submitted with proposed surface texture, including surface sealer. After approval, the sample panels shall be retained at the job site to serve as the standard of quality for texture, surface finish, and concrete color.

**8-1.8 Delivery, Storage, and Handling of Precast- Prestressed Members**

**8-1.8.1 Transportation**

**(a) Transporting Members**

In transporting members by truck, railroad car, or barge, provision shall be made for supporting the members as described above, except battens can be continuous over more than one stack of units, with adequate bracing to ensure their maintaining the vertical position and damping of dangerous vibrations. Trucks with double bolsters are satisfactory provided the members are fully seated on the outer bolsters at not more than 1 m or the depth of the member from the end and the inner bolster is not more than 2.3 m from the end of the member or the designated pickup point. Adequate padding material shall be provided between tie chains or cables to preclude chipping of concrete.

**(b) Lateral Deflection or Vibration**

Any noticeable indication of lateral deflection or vibration during transportation shall be corrected by rigid bracing between members or by means of lateral trussing.

**8-1.8.2 Storage**

**(a) Storage Areas**

Storage areas for prestressed members shall be stabilized, and suitable foundations shall be provided, so differential settlement or twisting of members will not occur.

**(b) Stacked members**

Stacked members shall be separated and supported by battens placed across the full width of each bearing point. Battens shall be arranged in vertical planes at a distance not greater than the depth of the member from designated pickup points. Battens shall not be continuous over more than one stack of precast units. Stacking of members shall be such that lifting devices will be accessible and undamaged. The upper members of a stacked tier shall not be used as storage areas for shorter members or equipment.

**8-1.8.3 Handling of Members**

The location of pickup points for handling of the members and details of the pickup devices shall be shown in shop drawings. Members shall be handled only by means of approved devices at designated locations. Members shall be maintained in an upright position at all times and picked up and supported as shown in approved shop drawings.

**8-1.9 Design Requirements for Formwork**

The design, Engineering, and construction of the formwork shall be the responsibility of the Contractor. The formwork shall be designed for anticipated live and dead loads and shall comply with the tolerances specified in Clause 8-1.6 - Construction Tolerances. The formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. The adequacy of formwork design and construction shall be monitored prior to and during concrete placement as part of the Contractor's approved Quality Control Plan.

**8-1.10 Construction, Contraction, Expansion and Control Joints****8-1.10.1 Construction Joints**

The location of construction joints except where shown on the drawings shall be at the discretion of the Engineer. At least 60 days before construction of the separate features of the Works begins the Contractor shall submit for approval all Lift drawings showing the location of all his proposed construction joints for the parts of the features.

Certain joints may be shown as compulsory construction joints on the drawings. These joints may not be altered and no concrete shall be placed adjacent to the joint for at least 7 days for features up to 1 m in thickness and for 10 days where the thickness exceeds 1 m.

The constructions for mass concrete with lifts greater than 1.5 m shall be green cut with water jetting within 24 hours of the pour.

The cost of construction joints shall be included in the rate tendered in the priced Bill of Quantities for the concrete in which the joints are required, except that where construction joints requiring waterstops are shown on the Drawings or directed the waterstops will be paid for as provided in Clause 8-4.3.

**8-1.10.2 Contraction Joints**

Contraction joints shall be located and constructed as shown on the Drawings. The joints shall be made by forming the concrete on one side of the joint and allowing it to set before concrete is placed on the other side of the joint. The surface of the concrete first placed at

contraction joints shall be coated with curing compound or bitumen paint to break the bond before the concrete on the other side of the joint is placed.

The cost of contraction joints shall be included in the rate tendered in the priced Bill of Quantities for the concrete in which the joints are required except that payment for waterstops if required, will be made as provided in Clause 8-4.3.

### **8-1.10.3 Expansion Joints**

Expansion joints shall be located and constructed as shown on the Drawings. The joints shall be made by forming the concrete on one side of the joint and allowing it to cure for a minimum of 3 days before concrete is placed on the other side of the joint. The surface of the concrete on either side of the expansion joint shall be separated by an approved joint filler as shown on the Drawings.

The cost of expansion joints shall be included in the rate tendered in the priced Bill of Quantities for the concrete in which the joints are required except that payment for waterstops, bond breaking coat and joint filler if required, will be made as provided in Clauses 9.12 and 9.13 respectively.

## **PART 2 PRODUCTS**

### **8-2.1 Cementitious Materials**

Cementitious materials shall be portland cement, portland-pozzolan cement, portland blast-furnace slag cement, portland cement in combination with pozzolan or GGBF slag and shall conform to appropriate specifications listed below. Use of cementitious materials in architectural concrete shall be restricted to one color, one source, and one type.

#### **8-2.1.1 Portland Cement**

ASTM C 150, Type I or II, except that the maximum amount of C3A in Type I cement shall be 15 percent.

#### **8-2.1.2 Pozzolan**

Pozzolan shall conform to ASTM C 618, Class C, with the optional requirements for multiple factor, drying shrinkage, and uniformity of Table 2A.

### **8-2.2 Aggregates**

#### **8-2.2.1 Aggregate Composition**

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of natural and manufactured sands. Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, air-cooled blast-furnace slag, or a combination thereof.

#### **8-2.2.2 Quality**

Aggregates delivered to the mixer shall meet the following requirements:

<b>Test Limits</b>			
<b>Property</b>	<b>Fine Aggregate</b>	<b>Coarse Aggregate</b>	<b>Tests</b>
Specific Gravity	2.56	2.56	ASTM C 127 ASTM C 128
Loss in Sodium soundness test	< 8%	< 10%	ASTM C88

Clay Lumps and Friable Particles	< 1%	< 0.5%	ASTM C 142
Material Finer than 75- $\mu$ m (No. 200) Sieve	< 2%	< 0.5%	ASTM C 117
Organic Impurities	0%	0 %	ASTM C 40 ASTM C 87
L.A. Abrasion	—	< 10%	ASTM C 131 ASTM C 535
Soft Particles	< 2 %	< 2%	COE CRD-C 130
Other deleterious materials	< 2%	< 1%	ASTM C 295

### 8-2.2.3 Grading

#### (a) Fine Aggregate

The grading of the fine aggregate as delivered to the mixers shall be such that the individual percent retained on any sieve shall not vary more than 3 percent from the percent retained on that sieve in a fixed grading selected by the Contractor with the approval of the Engineer. The fixed grading may be selected at the start of concrete placement and based upon 30 days fine aggregate production or selected after the first 30 days of concrete placement. The minimum individual percent retained on the 2.36 mm (No. 8) sieve shall be 5 percent and on all smaller sieves, except the 75 m (No. 200), shall be 10 percent. In addition to the grading limits, the fine aggregate, as delivered to the mixer, shall have a fineness modulus of not less than 2.25 nor more than 2.85. The grading of the fine aggregate shall also be controlled so that the fineness moduli groups (average of the current test and the previous two tests) of the fine aggregate as delivered to the mixer shall not vary more than 0.10 from the target fineness modulus of the fixed grading selected by the Contractor and approved by the Engineer. The range of each group shall not exceed 0.20. The fineness modulus shall be determined in accordance with COE CRD-C 104. At the option of the Contractor, fine aggregate may be separated into two or more sizes or classifications, but the uniformity of grading of the separate sizes shall be controlled so that they may be combined throughout the job in fixed proportions established during the first 30 days of concrete placement. The selected fixed grading shall be within the following limits, except any individual test result may be outside these limits if within the allowable 3 percent variation from the selected grading.

U.S. Standard Sieve Designation	Permissible Limits Percent By Weight, Passing
9.5-mm (3/8-in.)	100
4.75-mm (No. 4)	95 - 100
2.36-mm (No. 8)	80 - 95
1.18-mm (No. 16)	60 - 80
600-m (No. 30)	35 - 60
300-m (No. 50)	15 - 30
150-m (No. 100)	5 - 10
75-m (No. 200)	0 - 5

#### (b) Coarse Aggregate

The coarse aggregate shall be rescreened just prior to delivery to the concrete batch plant bins. The grading of the coarse aggregate within the separate size groups shall conform to the following requirements as delivered to the mixer.

#### Percent by Weight Passing Individual Sieves

Nominal Gradation
-------------------

U.S. Standard Sieve Designation	4.75 to	19.0 mm to	37.5 mm to	75 mm to
	19.0 mm	37.5 mm	75 mm	150 mm
	(No. 4 to	(3/4 inch to	(1-1/2 inch	(3 inch to
	3/4 inch)	1-1/2 inch)	to 3 inch)	6 inch)
175 mm (7 inch)				100
150 mm (6 inch)				90 – 100
100 mm (4 inch)			100	20 – 55
75 mm (3 inch)			90 - 100	0 – 15
50 mm (2 inch)		100	20 - 55	0 – 5
37.5 mm (1-½ inch)		90 - 100	0 - 15	
25.0 mm (1 inch)	100	20 - 55	0 - 5	
19.0 mm (3/4 inch)	90 - 100	0 - 15		
9.50 mm (3/8 inch)	20 - 55	0 - 5		
4.75 mm (No. 4)	0 - 15			
2.36 mm (No. 8)	0 - 5			



**8-2.2.4 Particle Shape**

The quantity of flat and elongated particles in the separate size groups of coarse aggregate, as determined by ASTM D 4791, using a value of 3 for width-thickness ratio and length-width ratio shall not exceed 25 percent in any size group.

**8-2.2.5 Moisture Content**

The fine aggregate shall not be placed in bins at the batch plant until it is in a stable state of moisture content. A stable moisture content shall be reached when the variation in the percent of total moisture tested in accordance with ASTM C 566 and when sampled at the same location will not be more than 0.5 percent during 1 hour of the 2 hours prior to placing the material in the batch plant bins and the variation in moisture content when sampled at the same location shall not be more than 2.0 percent during the last 8 hour period that the aggregate remains in the stockpile. The coarse aggregate shall be delivered to the mixers with the least amount of free moisture and the least variation in free moisture practicable under the job conditions. Under no conditions shall the coarse aggregate be delivered to the mixer "dripping wet".

**8-2.2.6 Concrete Aggregate Sources**

Concrete aggregates may be furnished from any source capable of meeting the quality requirements stated in Sub-Clause 8-2.2 - Aggregates. After the award of the contract, the Contractor shall designate in writing only one source or combination of sources from which he proposes to furnish aggregates.

**8-2.3 Chemical Admixtures**

Chemical admixtures to be used, when required or permitted, shall conform to the appropriate specification listed.

**8-2.3.1 Air-Entraining Admixture**

The air-entraining admixture shall conform to ASTM C 260 and shall consistently cause the concrete to have an air content in the specified ranges under field conditions.

**8-2.3.2 Accelerating Admixture**

Accelerators shall meet the requirements of ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

**8-2.3.3 Water-Reducing or Retarding Admixture**

Water-Reducing or Retarding Admixtures: ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

High-Range Water Reducing Admixture: ASTM C 494/C 494M, Type F or G except that the 6-month and 1-year strength requirements shall be waived. The admixture may be used only when approved by the Engineer, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan.

**8-2.3.4 Other Chemical Admixtures**

Other chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type 1 or 2. These admixture shall be used only for concrete listed in Sub-Clause 8-2.14.4 - Slump.

**8-2.4 Curing Materials****8-2.4.1 Impervious-Sheet Curing Materials**

Impervious-sheet curing materials shall conform to ASTM C 171, type optional, except polyethylene film shall not be used.

#### **8-2.4.2 Membrane-Forming Curing Compound**

The membrane-forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, coating, or flooring specified. No pigmented compound shall contain a fugitive dye and shall have the reflective requirements in ASTM C 309 waived.

#### **8-2.4.3 Burlap**

Burlap used for curing shall conform to COE CRD-C 318.

#### **8-2.4.4 Water**

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that nonpotable water may be used if it meets the requirements of COE CRD-C 400.

#### **8-2.5 Latex Bonding Compound**

Latex bonding compound agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

#### **8-2.6 Epoxy Resin**

Epoxy resin for use in repairs shall conform to ASTM C 881/C 881M, Type III, Grade I or II.

#### **8-2.7 Reinforcement**

##### **8-2.7.1 Steel Bars**

Steel bars shall comply with the requirements of ASTM A 615/A 615M or ASTM A 616/A 616M including Supplementary Requirements, ASTM A 617/A 617M or ASTM A 706/A 706M, deformed, of the grades, sizes and lengths shown. If the Grade 300 bars shown are unavailable the Contractor may substitute Grade 350 or Grade 400 bars of the same size and spacing as indicated for Grade 300 bars when authorized. The type reinforcement prescribed is shown on drawings.

##### **8-2.7.2 Steel Welded Wire Fabric**

Steel welded wire fabric shall comply with the requirements of ASTM A 185, or ASTM A 497 wire sizes and spacings as shown. For wire with a specified yield strength ( $f_y$ ) exceeding 400 MPa,  $f_y$  shall be the stress corresponding to a strain of 0.35 percent.

##### **8-2.7.3 Accessories**

###### **(a) Bar Supports**

Bar supports shall comply with the requirements of ACI SP-66. Supports for bars in concrete with formed surfaces exposed to view or to be painted shall be plastic-coated wire, stainless steel or precast concrete supports. Precast concrete supports shall be wedged-shaped, not larger than 90 by 90 mm, of thickness equal to that indicated for concrete cover and have an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view shall be the same quality, texture and color as the finish surfaces.

###### **(b) Wire Ties**

Wire ties shall be 16 gage or heavier black annealed wire. Ties for epoxy-coated bars shall be vinyl-coated or epoxy-coated. Ties for zinc-coated bars shall be zinc-coated.

#### **8-2.8 Premolded Expansion Joint Filler Strips**

Premolded expansion joint filler strips shall conform to ASTM D 1751 or ASTM D 1752, Type I, or resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

#### **8-2.9 Joint Seals and Sealants**

**8-2.9.1 Field Molded Sealants and Primer**

Field molded sealants and primer shall conform to ASTM C 920, Type M, Grade NS orP, Class 25, Use T for horizontal joints and Type M, Grade NS, Class 25, Use NT for vertical joints. Field molded sealants and primer shall conform to ASTM C 920, Type M, Grade NS orP, Class 25, Use T for horizontal joints and Type M, Grade NS, Class 25, Use NT for vertical joints. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, nonshrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene foam rubber.

**8-2.9.2 Compression Seals and Lubricant**

Compression seals shall conform to ASTM D 2628; lubricant for installation shall conform to ASTM D 2835.

**8-2.10 Waterstops****8-2.10.1 Non-Metallic Waterstops**

Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572.

**8-2.10.3 G-Seal (Cap Seal)**

(a) Provision of sealing control, expansion, and/or construction joints in concrete to create a continuous diaphragm to prevent fluid migration and accumulation of debris.

**(a) References**

A. American Society for Testing Materials (ASTM)

- (a) Provide flexible, modified PVC (polyvinyl chloride) “G-SEAL” as manufactured by Green streak or approved equivalent, for 25mm opening.
- (b) The modified PVC paving cap seal shall be extruded from an elastomeric plastic material of which the basic resins are prime virgin materials. The compound shall not contain any scrapped or reclaimed material whatsoever.
- (c) Performance Requirements as follows:

Property	Test Method	Requirements
Tensile Strength	ASTM D412-02e1	16Mpa.
Elongation	ASTM D412-02e1	375% min.
Hardness	ASTM D2240-03	81+/-3 Shore A
Oil Swell (ASTM Oil #3, 70 hrs @ 100°C change in volume/weight)	ASTM D471-98e1	+/- 15% by vol. +/- 15% by wt.
Ozone Resistance (20% strain, 300 pphm, 70 hrs @ 40°C)	ASTM D518-99	No Cracking
Abrasion Resistance (10,500 cycles, 1000 g load)	ASTM D 3884-01e1	Material Loss: -0.35 grams max.
Adhesive Bond Strength	ASTM D412-02e1	7 Mpa min.
Results after Heat Aging (24 hrs @ 70 o F)	ASTM D573-99	Tensile Strength retained: 90% Elongation retained: 90% Hardness change:+/-3 ShoreA

- (d) The specific profile style chosen shall weigh a minimum of 0.75 kg per lineal metre.
- (e) The profile shall have a minimum of two fins on the embedded legs for the purpose of anchorage and creating a waterstop.

Provide factory made fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for field assembly.

Provide Green streak “G-SEAL” Adhesive for sealing of all butt splices.

### **8-2.11 Steel Tendons**

Stressing tendons and accessories shall conform to the requirements of ACI 318M/318RM except as specified.

#### **8-2.11.1 Stressing Tendons**

Stressing tendons shall be clean and free of loose rust, scale and pitting. Unbonded tendons shall be permanently protected from corrosion with an approved applied coating.

##### **(a) Seven-Wire Stress-Relieved Strand and Strand Assemblies**

Seven-wire stress-relieved strand and strand assemblies shall conform to ASTM A 416/A 416M, Grade 270, strand diameter as shown on approved drawings. Strand assemblies may be either shop or field assembled with anchor fittings positively attached to strands.

##### **(b) Stress-Relieved Wire and Wire Assemblies**

Stress-relieved wire and wire assemblies shall conform to ASTM A 421, Type BA or WA, wire diameter as shown. Wire assemblies shall be shop assembled with anchor fittings positively attached to wires.

##### **(c) High-Strength Steel Bars**

High-strength steel bars shall conform to ASTM A 722/A 722M, Type I or II, meeting all supplementary requirements.

#### **8-2.11.2 Accessories**

##### **(a) Ducts**

Tendon ducts shall be of ferrous metal, capable of transmitting forces from grout to the surrounding concrete, flexible enough to conform to the tendon profile and strong enough to maintain their shape without deforming, sagging, or collapsing during concrete placement and vibration. The inside diameter of the ducts shall be large enough to provide an internal area at least twice the gross area of multiple wire, bar or strand assemblies and shall be at least 6 mm larger than the diameter of a single wire, bar or strand placed in the ducts. Ducts shall be designed for watertight connections with all fittings. Galvanized ducts will not be permitted.

##### **(b) Anchorages and Couplers**

Anchorages and couplers shall be metal of proven corrosion resistance and compatible with the stressing tendons, capable of fully developing the minimum guaranteed ultimate strength of tendons without excessive slip and approved. Anchorages shall be the button-head, wedge, nut and thread, grip nut, thread-bar, threaded plate or other approved type and shall be provided with bearing plates bars, rings, bells or other positive-attaching anchor fittings. Couplers shall be provided with housings long enough to permit the necessary movements and fittings which allow complete grouting of all components.

**(c) Grout**

Grout for grouting post-tensioned tendons shall consist of a mixture of Portland cement, shrinkage compensating admixture and potable water of which final proportions shall be based on test results of sample mixtures. Cement shall conform to ASTM C 150, Type I or II. The shrinkage compensating admixture shall produce a 2 percent minimum and a 10 percent maximum unconfined expansion when tested in accordance with ASTM C 940, shall not contain aluminum powder, chlorides, fluorides or nitrates, may be dispensed in solid or liquid form and must be approved by the Engineer prior to its use. The water content shall be the minimum necessary for proper placement but the water-cement ratio shall not exceed 0.50 by weight. The pumpability of grout shall be determined in accordance with ASTM C 939. The efflux time of a grout sample immediately after mixing shall not be less than 11 seconds. The minimum 7-day compressive strength of 50 mm grout cubes, molded, cured and tested in accordance with ASTM C 109/C 109M shall be 17.2 MPa.

**8-2.11.3 Tests, Inspections and Verifications**

The Contractor shall have required material tests performed on stressing tendons and accessories by an approved laboratory to demonstrate that the materials are in conformance with the specifications. These tests shall be at the Contractor's expense.

**8-2.12 Concrete Mix Proportioning**

**8-2.12.1 Quality of Mix**

For each portion of the structure, mixture proportions shall be selected so that the strength and W/C requirements listed in Clause 8-1.5 - Design Requirements are met.

**8-2.12.2 Nominal Maximum-Size of Aggregate**

The nominal maximum-size of coarse aggregate to be used in the various parts of the work shall be in accordance with the following tabulation except as directed. The NMSA may be changed for Section requiring a special quality of concrete as directed.

<b>Features</b>	<b>Nominal Maximum-Size Aggregate</b>
Sections 190 mm or less in width or slabs 100 mm or less in thickness or any section with a clear distance between reinforcement less than 55 mm .....	19 mm
Sections over 190 mm or slabs at least 100 mm in thickness. However, this size shall not be used in any section in which the clear distance between reinforcement is less than 55 mm .....	40 mm
Unreinforced SECTION over 300 mm in width and reinforced SECTION over 450 mm in width or slabs 255 mm or greater in thickness. However, this size shall not be used in any section in which the clear distance between reinforcing bars is less than 115 mm .....	75 mm
Massive SECTION exceeding 1.8 m in width and slabs 600 mm in thickness, in which the clear distance between reinforcing bars is at least 225 mm .....	150 mm

**8-2.12.3 Air Content**

The air content by volume shall be determined by ASTM C 231. When the nominal maximum size of coarse aggregate is 37.5 mm or larger, the air content of the sample measured in accordance with ASTM C 231 shall be 5.5 ± 1.5 percent. When the nominal maximum-size coarse aggregate is 19 mm, the air content shall be 6 ± 1 percent. The specified air content shall be present in the concrete when the concrete has been placed in the forms.

**8-2.12.4 Slump**

The slump shall be determined in accordance with ASTM C 143/C 143M and shall be  $50 \pm 25$  mm for massive features and between 25 and 100 mm for all others except where placement by pump is approved, in which case the slump shall be  $114 \pm 38$  mm. In addition, the range of each set of two consecutive tests for each mixture shall be not more than 50 mm. The above-specified slump is that required at the forms.

**8-2.12.5 Concrete Proportioning**

Trial batches and testing requirements for various qualities of concrete specified shall be the responsibility of the Contractor. Samples of aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by the manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios, which will produce a range of strength encompassing those required for the work. The maximum water-cement ratios required in Sub-Clause 8-1.5.2 - Maximum Water-Cement Ratio will be converted to a weight ratio of water to cement plus pozzolan by mass, silica fume, or GGBF slag by mass equivalency as described in ACI 211.1. In the case where GGBF slag is used, the weight of the slag shall be included in the equations for the term P, which is used to denote the mass of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent of the total cementitious material. Trial mixtures shall be proportioned for maximum permitted slump and air content with due consideration to the approved conveying and placement method. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 days and at the design age specified in Clause 8-1.5 - Design Requirements of Concrete Mix in accordance with ASTM C 39/C 39M. From these test results, a curve will be plotted showing the relationship between water-cement ratio and strength.

**8-2.12.6 Required Average Compressive Strength**

In meeting the strength requirements specified in Sub-Clause 8-1.5.1 - Concrete Strength, the selected mixture proportion shall produce a required average compressive strength  $f_{cr}$  exceeding the specified strength  $f_c$  by the amount indicated below.

**(a) Average Compressive Strength from Test Records**

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified strength or strengths ( $f_c$ ) within 6.89 MPa of that specified for proposed work, and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another test age designated for determination of  $f_c$ .

Required average compressive strength  $f_{cr}$  used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f_{cr} = f_c + 1.34S$$

$$f_{cr} = f_c + 2.33S - 3.45$$

Where S = standard deviation

**(b) Average Compressive Strength without Previous Test Records**

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength for shall be determined as follows:

If the specified compressive strength  $f_c$  is less than 20.7 MPa,

$$f_{cr} = f_c + 6.89$$

If the specified compressive strength  $f_c$  is 20.7 to 34.5 MPa,

$$f_{cr} = f_c + 8.27$$

If the specified compressive strength  $f_c$  is over 34.5 MPa,

$$f_{cr} = f_c + 9.65$$

**8-2.13 Materials and Accessories for Formwork**

**8-2.13.1 Forms and Form Liners**

Forms and form liners shall be fabricated with facing materials that will produce a finish meeting the specified irregularities in formed surface requirements as defined in ACI 347. Forms and form liners shall be fabricated with facing materials as specified below. The class of finish shall be as shown on drawings.

**(a) Class "A" Finish**

For this class of finish the form facing material shall be composed of new, well-matched tongue-& groove lumber or new plywood panels conforming to PS1, Grade B-B concrete form, Class 1.

**(b) Class "B" Finish**

This class of finish the form facing material shall be composed of tongue-and-groove or shiplap lumber, plywood conforming to PS1, Grade B-B concrete form, tempered concrete form hard board or steel. Steel lining on wood sheathing will not be permitted.

**(c) Class "C" Finish**

For this class of finish the form facing may be either tongue-and-groove lumber, plywood, concrete form hard board or steel. Wood form facing for curved or warped surfaces shall be composed of splines of lumber which can be bent to the required shape without splitting or cracking.

**(d) Class "D" Finish**

For this class of finish the form facing may be of wood or steel.

**8-2.13.2 Form Coating**

Form coating shall be commercial formulation that will not bond with, stain, cause deterioration, or any other damage to concrete surfaces. The coating shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, the Contractor shall follow the recommendation of the form coating manufacturer.

**8-2.13.3 Accessories**

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 50 mm from any concrete surface either exposed to

view or exposed to water. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

### **PART 3 EXECUTION**

#### **8-3.1 Equipment**

##### **8-3.1.1 Capacity**

the capacity of the batching, mixing, conveying, and placing systems shall be adequate to complete all concrete work in scheduled time.

##### **8-3.1.2 Batch Plant**

Batch plant shall meet the following requirements.

###### **(a) Location**

The concrete plant may be located at the site of the work in the general area indicated on the drawings, or may be located offsite.

###### **(b) Bins and Silos**

Separate bins, compartments, or silos shall be provided for each size or classification of aggregate and for each of the Cementitious materials. The compartments shall be of ample size and so constructed that the various materials will be maintained separately under all working conditions. All compartments containing bulk cement, Pozzolan, ground granulated blast-furnace slag, or silica fume shall be separated from each other by a free-draining air space. All filling ports shall be clearly marked with a permanent sign stating the contents.

###### **(c) Batching Equipment**

###### **(i) Batchers**

Aggregate shall be weighed in separate weigh batchers with individual scales. Bulk cement and/or other Cementitious materials shall each be weighed on a separate scale in a separate weigh batcher. Water shall be measured by weight or by volume. If measured by weight, it shall not be weighed cumulatively with another ingredient. Ice shall be measured separately by weight. Admixtures shall be batched separately and shall be batched by weight or by volume in accordance with the manufacturer's recommendations.

###### **(ii) Water Batchers**

A suitable water-measuring and batching device shall be provided that will be capable of measuring and batching the mixing water within the specified tolerances for each batch. The mechanism for delivering water to the mixers shall be free from leakage when the valves are closed. The filling and discharge valves for the water batcher shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. When a water meter is used, a suitable strainer shall be provided ahead of the metering device.

###### **(iii) Admixture Dispensers**

A separate batcher or dispenser shall be provided for each admixture. Each plant shall be equipped with the necessary calibration devices that will permit convenient checking of the accuracy of the dispensed volume of the particular admixture. The batching or dispensing devices shall be capable of repetitively controlling the batching of the admixtures to the accuracy specified. Piping for liquid admixtures shall be free from leaks and properly valved to prevent backflow or siphoning. The dispensing system shall include a device or devices that will detect and indicate the presence or absence of the admixture or provide a convenient means of visually observing the admixture in the process of being batched or discharged. Each system shall be capable of ready adjustment to permit varying the quantity of admixture to be batched. Each dispenser shall be interlocked with the batching and discharge operations so that each admixture is added separately to the batch in solution in a



separate portion of the mixing water or in fine aggregate in a manner to ensure uniform distribution of the admixtures throughout the batch during the required mixing period. Storage and handling of admixtures shall be in accordance with the manufacturers recommendations.

**(iv) Moisture Control**

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched. A moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measurement of moisture in the fine aggregate. The sensing element shall be arranged so that the measurement is made near the batcher charging gate of the fine aggregate bin or in the fine aggregate batcher.

**(v) Scales**

Adequate facilities shall be provided for the accurate measurement and control of each of the materials entering each batch of concrete. The weighing equipment and controls shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be within 0.2 percent of the scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device. Tests shall be made at the frequency required in Clause 8-3.11 - Tests and Inspections, and in the presence of a Engineer. Each weighing unit shall include a visible indicator that shall indicate the scale load at all stages of the weighing operation and shall show the scale in balance at zero load. The weighing equipment shall be arranged so that the concrete plant operator can conveniently observe the indicators.

**(vi) Operation and Accuracy**

The weighing operation of each material shall start automatically when actuated by a single starter switch and shall end automatically when the designated amount of each material has been reached. These requirements can be met by providing an automatic batching system as defined in NRMCA CPMB 100. There shall be equipment to permit the selection of 3 preset mixes each by the movement of not more than two switches or other control devices. Cumulative weighing will not be permitted. The weigh batchers shall be so constructed and arranged that the sequence and timing of batcher discharge gates can be controlled to produce a ribboning and mixing of the aggregates, water, admixtures, and cementitious materials as the materials pass through the charging hopper into the mixer. The plant shall include provisions to facilitate the inspection of all operations at all times. Delivery of materials from the batching equipment shall be within the following limits of accuracy:

<b>Material</b>	<b>Percent</b>
Cementitious materials .....	1
Water .....	1
Aggregate smaller than 37.5 mm size .....	2
Aggregate larger than 37.5 mm size .....	3
Chemical admixtures .....	3

**(vii) Interlocks**

Batchers and mixers shall be interlocked so that:

- (1) The charging device of each batcher cannot be actuated until all scales have returned to zero balance within 0.2 percent of the scale capacity and each volumetric device has reset to start or has signaled empty.
- (2) The charging device of each batcher cannot be actuated if the discharge device is open.
- (3) The discharge device of each batcher cannot be actuated if the charging device is open.
- (4) The discharge device of each batcher cannot be actuated until the indicated material is within the allowable tolerances.
- (5) One admixture is batched automatically with the water.

- (6) Each additional admixture is batched automatically with a separate portion of the water or with the fine aggregate.
- (7) The mixers cannot be discharged until the required mixing time has elapsed.

**(viii) Recorder**

An accurate recorder or recorders shall be provided and shall conform to the following detailed requirements:

- (1) The recorder shall produce a graphical or digital record on a single visible chart or tape of the weight or volume of each material in the batchers at the conclusion of the batching cycle. The record shall be produced prior to delivery of the materials to the mixer. After the batchers have been discharged, the recorder shall show the return to empty condition.
- (2) A graphical recording or digital printout unit shall be completely housed in a single cabinet that shall be capable of being locked.
- (3) The chart or tape shall be so marked that each batch may be permanently identified and so that variations in batch weights of each type of batch can be readily observed. The chart or tape shall be easily interpreted in increments not exceeding 0.5 percent of each batch weight.
- (4) The chart or tape shall show time of day at intervals of not more than 15 minutes.
- (5) The recorder chart or tape shall become the property of the Procuring entity/Employer.
- (6) The recorder shall be placed in a position convenient for observation by the concrete plant operator and the Engineer's inspector.
- (7) The recorded weights or volumes when compared to the weights or volumes actually batched shall be accurate within 2 percent.

**(ix) Batch Counters**

The plant shall include devices for automatically counting the total number of batches of all concrete batched and the number of batches of each preset mixture.

**(x) Rescreening Plant**

A rescreening plant shall be located, arranged, and operated in a manner that all coarse aggregate will be routed through the plant and that its operation will ensure delivery to the mixers of graded coarse aggregate free from excessive variation and conforming to the size groups and grading of Clause 8-2.2 - Aggregates and with moisture content conforming to the provisions of Sub-Clause 8-2.2.5 - Moisture Content. Coarse aggregate may be rescreened and delivered to the batch plant bins one size group at a time or two or more adjacent size groups at a time. Simultaneous rescreening of nonadjacent size groups is not permitted. All material passing the bottom screen of the smallest size of coarse aggregate being screened shall be wasted.

**(xi) Washing Plant**

All coarse aggregates shall be washed immediately prior to entering the rescreening plant. The rewashing plant shall contain adequate water nozzles and vibrating screens to remove foreign materials and coatings from aggregate particles. Water used for washing shall meet the requirements of Subclause 8-2.4.4 - Water.

**(xii) Trial Operation**

Not less than 7 days prior to commencement of concrete placing, a test of the batching and mixing plant shall be made in the presence of the Engineer to check operational adequacy. The number of full-scale concrete batches required to be produced in trial runs shall be as directed, will not exceed 20, and shall be proportioned as directed. All concrete produced in these tests shall be wasted or used for purposes other than inclusion in structures covered by this specification. All deficiencies found in plant operation shall be corrected prior to the start of concrete placing operations. No separate payment will be made to the Contractor for labor or materials required by provisions of this Clause. The Contractor shall notify the Engineer of the trial operation not less than 7 days prior to the start of the trial operation.

**(xiii) Protection**

The weighing, indicating, recording, and control equipment shall be protected against exposure to dust, moisture, and vibration so that there is no interference with proper operation of the equipment.

**(d) Plant Layout Drawings**

Drawings, in triplicate, showing the layout of the plant the Contractor proposes to use on the work shall be submitted by the Contractor for review. The drawings shall show the locations of the principal components of the construction plant; offices; shop and storage building; housing facilities, if any; and storage areas and yards which the Contractor proposes to construct at the site of the work and elsewhere. The Contractor shall also furnish for review drawings, in triplicate, showing the general features of his aggregate processing plant; aggregate transporting; storage and reclaiming facilities; aggregate rinsing and dewatering plant, if required; coarse aggregate rescreening plant, if required; concrete batching and mixing plant; concrete conveying and placing plant; and when precooling of concrete is required, the cooling plant. The drawing shall appropriately show the capacity of each major feature of the plant including the rated capacity of the aggregate production plant in tons (metric) per hour of fine and coarse aggregates; rated capacity of the aggregate transporting, storage and reclaiming facilities; volume of aggregate storage; capacity of cement and pozzolan storage; rated capacity of the concrete batching and mixing plant in cubic meters per hour; rated capacity of the concrete transporting and placing plant in cubic meters per hour; and when used rated capacity of plant for precooling of concrete. Drawings in triplicate showing any changes in plant made during design and erection or after the plant is in operation shall be submitted for review. Two sets of the drawings will be retained and one set will be returned to the Contractor with comments.

**8-3.1.3 Mixers**

Mixers shall be stationary mixers or truck mixers. Each mixer shall combine the materials into a uniform mixture and discharge this mixture without segregation. Mixers shall not be charged in excess of the capacity recommended by the manufacturer on the nameplate. Excessive over-mixing requiring introduction of additional water will not be permitted. The mixers shall be maintained in satisfactory operating condition, and mixer drums shall be kept free of hardened concrete. Mixer blades or paddles shall be replaced when worn down more than 10 percent of their depth when compared with the manufacturer's dimension for new blades. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired or replaced.

**(a) Stationary Mixer Uniformity Requirements**

The size of the batch, the mixing time, the charging sequence, and other factors identified by the contractor shall be adjusted to provide concrete that meets the uniformity limits specified herein. All testing shall be performed in accordance with COE CRD-C 55. When regular testing is performed, the concrete shall meet the limits of any five of the six uniformity requirements. When abbreviated testing is performed, the concrete shall meet only those requirements listed for abbreviated testing. The initial mixer evaluation test shall be a regular test and shall be performed prior to the start of concrete placement. The concrete proportions used for the evaluation shall contain the largest size aggregate on the project and shall be as directed. Regular testing shall consist of performing all six tests on three batches of concrete. The range for regular testing shall be the average of the ranges of the three batches. Abbreviated testing shall consist of performing the three required tests on a single batch of concrete. The range for abbreviated testing shall be the range for one batch. If more than one mixer is used and all are identical in terms of make, type, capacity, condition, speed of rotation, etc., the results of tests on one of the mixers shall apply to the others, subject to approval. Mixer evaluations shall be performed by the Contractor in accordance with Sub-Clause 8-3.11.2(k) - Mixer Uniformity. However, the initial evaluation will be performed by the Engineer. The Contractor shall provide labor and equipment as directed to assist the Engineer in performing any evaluation made by the Engineer.

<b>Parameter</b>	<b>Regular Tests Allowable Maximum Range for Average of 3 Batches</b>	<b>Abbreviated Tests Allowable Maximum Range For 1 Batch</b>
Unit weight of air-free mortar, kg/m <sup>3</sup>	32	32
Air content, percent	1.0	---
Slump, mm	25	---
Coarse aggregate, percent	6.0	6.0
Compressive strength at 7 days, percent	10.0	10.0
Water content, percent	1.5	---

**(b) Truck Mixers**

Truck mixers and the mixing of concrete therein shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it shall be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Truck mixers shall not be used to mix or agitate concrete with greater than 37.5 mm nominal maximum-size aggregate or concrete with a slump of 50 mm or less. The acceptability of truck mixers shall be determined by uniformity tests in accordance with ASTM C 94/C 94M.

**8-3.1.4 Sampling Facilities**

**(a) Concrete**

The Contractor shall provide suitable facilities and labor for obtaining representative samples of concrete in accordance with ASTM C 172 for Contractor quality control (QC) and Engineer quality control (QA) testing.

**(b) Coarse Aggregate**

Suitable facilities shall be provided for readily obtaining representative samples of coarse aggregate for test purposes immediately prior to the material entering the mixer. The facilities shall include automatic equipment capable of obtaining, sieving, and weighing samples of the coarse aggregate as follows:

Aggregate Size	Approximate Size of Sample
4.75 to 19.0 mm	250 kg
19.0 to 37.5 mm	250 kg
37.5 to 75 mm	500 kg
75 to 150 mm	1000 kg

The equipment shall be capable of running a complete sieving, of any required sample, without the necessity of intermittent loading. To accomplish this, adequate areas of individual sieves and controlled feeding of samples shall be provided. The assembly shall be designed to permit selection, screening, and weighing of any individual sample in 10 minutes or less. The equipment shall be designed by a company engaged in the design and manufacture of aggregate sieving devices. The Contractor shall have complete responsibility for providing equipment that will accomplish the desired purpose. Sieves shall meet the applicable requirements of ASTM E 11, except for the frame size requirements. The equipment shall be arranged so that all controls will be enclosed and operable from a single position commanding a view of the screen device and the scale or scales. Communication shall be provided from the batch plant operation to this control area. The Contractor shall be responsible for charging of the assembly as directed, disposal of waste material, and proper service and maintenance of the assembly. Each sieve shall be provided with individual controls for frequency and angle. The contractor shall run correlation tests with equipment as used for ASTM C 136 before concrete placement begins and at least every 60 days while concrete is being placed. The correlation test will determine the optimum angle, volume of feed, and the frequency for each sieve.

**8-3.1.5 Transporting Equipment**

Transporting equipment shall be designed, operated, and maintained so that it does not cause or permit segregation or loss of material. The concrete shall not be dropped vertically more than 1.5 m except where suitable equipment is provided to prevent segregation and where specifically authorized.

**(a) Buckets**

Bottom-dump buckets shall conform to the following requirements: the interior hopper slope shall be not less than 70 degrees from the horizontal; the minimum dimension of the clear gate opening shall be at least five times the nominal maximum size of the aggregate, and the area of the gate opening shall not be less than 0.2 square meters; the bucket gates shall be grout-tight when closed, shall be of the double clamshell type, and shall be manually, pneumatically, or hydraulically operated; and the gate-opening mechanism shall be designed to close the gates automatically when the control is released or when the air or hydraulic line is broken. If gate actuation is dependent on integral air or hydraulic reservoirs, the capacity of the reservoirs shall be sufficient to open and close the gates three times without recharging the reservoir.

**(b) Trucks**

Truck mixers or agitators used for transporting central-mixed concrete shall conform to the applicable requirements of ASTM C 94/C 94M. Truck mixers shall not be used to transport concrete with larger than 37.5 mm nominal maximum-size aggregate or 50 mm or lower slump. Nonagitating trucks may be used for transporting central-mixed concrete over a smooth road when the hauling time is less than 15 minutes and the slump is less than 75 mm. Bodies of nonagitating trucks shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.



**(c) Chutes**

When concrete can be placed directly from a truck mixer, agitator, or nonagitating truck, the chutes supplied by the truck manufacturer as standard equipment may be used. A discharge deflector shall be used when required by the Engineer. Separate chutes and other similar equipment shall not be permitted for conveying concrete except when specifically approved and in no case shall slump be increased to accommodate their use.

**(d) Belt Conveyors**

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer or delivery truck to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete or loss of mortar at the transfer point(s) and the point of placing. The idler spacing shall not exceed 900 mm. Belt speed shall be a minimum of 90 m per minute and a maximum of 230 m per minute. Belt width shall be a minimum of 600 mm if the NMSA is 150 mm and shall be a minimum of 400 mm if the NMSA is 75 mm or less. The NMSA required in mixture proportions will not be changed to accommodate the belt width.

**(e) Pump Placement**

Concrete may be conveyed by positive-displacement pump when approved. Pump placement will be approved only for areas where placement by bucket or conveyor is difficult or impractical. The pumping equipment shall be piston or squeeze-pressure type. The pipeline shall be rigid-steel pipe or heavy-duty flexible hose. Aluminum pipe shall not be used. The inside diameter of the pipe shall be at least 3 times the nominal maximum size of the coarse aggregate in the concrete to be pumped but not less than 100 mm.

**8-3.2 Forms****8-3.2.1 Installation****(a) Form Construction**

Forms shall be constructed true to the structural design and required alignment. The form surface and joints shall be mortar tight and supported to achieve safe performance during construction, concrete placement, and form removal. The Contractor shall continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class or classes specified in Sub-Clause 8-2.15.1 - Forms and Form Liners and tolerances specified in Clause 8-1.9 - Design Requirements for Form work. Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

**(b) Chamfering**

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rock fill is placed in contact with concrete surfaces. Chamfered joints shall be terminated 300 mm outside the limit of the earth or rock fill so that the end of the chamfers will be clearly visible.

**(c) Coating**

Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that, in cold weather when freezing temperatures are

anticipated, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

### **8-3.2.2 Form Removal**

Forms shall not be removed without approval. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum time or minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed as specified. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M at the Engineer's Site Laboratory. After obtaining approval, the Contractor may use maturity instrumentation instead of control cylinders to determine the compressive strength of the concrete. ASTM C 1074 procedures shall be used for estimating concrete strength by means of the maturity method. All expenses associated with instrumenting the concrete and evaluating the strength using maturity relationships shall be the responsibility of the Contractor.

#### **(a) Formwork Not Supporting Weight of Concrete**

Formwork for walls, columns, sides of beams, gravity structures, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed. Form removal before 24 hours will be allowed for simple floor slab, sidewalks, and driveways provided the ambient temperature during this period has not fallen below 10 degrees C at any time since placement and evidence from compressive tests on field-cured concrete control cylinders or maturity instrumentation indicates that the concrete has attained a compressive strength of at least 8 MPa. Control cylinders shall be prepared for each set of forms to be removed before 24 hours. The stability of the concrete shall be evaluated by a structural Engineer prior to removal of the forms.

#### **(b) Formwork Supporting Weight of Concrete**

Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders or maturity instrumentation indicate evidence the concrete has attained at least 70 percent of the compressive strength required for the structure.

### **8-3.2.3 Inspection**

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Engineer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

## **8-3.3 Preparation for Placing**

### **8-3.3.1 Vibrators**



An adequate number of vibrators shall be on hand to meet placing requirements, and spare vibrators shall be available to maintain production in the event of breakdown. There shall be adequate air pressure available for air vibrators and adequate voltage for electric vibrators. Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed in conformance with the following requirements:

<b>Application</b>	<b>Head Diameter Millimeters</b>	<b>Frequency VPM</b>	<b>Amplitude Millimeters</b>
Thin walls, beams, etc.	32 - 64	9,000 - 13,500	0.5 - 1.0
General construction	50 - 88	8,000 - 12,000	0.6 - 1.2
Heavy Section	75 - 150	7,000 - 10,500	0.75 - 1.5
Mass concrete	125 - 175	5,500 - 8,500	1.0 - 2.0

The frequency and amplitude shall be within the range indicated in the tabulation as determined in accordance with Clause 8-3.11 - Tests and Inspections.

### **8-3.3.2 Fabrication and Placement of Reinforcement**

Reinforcement steel and accessories shall be fabricated and placed as specified and shown and approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI SP-66 and ACI 318M/318RM or as directed. Steel shall be fabricated to shapes and dimensions shown, placed where indicated within specified tolerances and adequately supported during concrete placement. At the time of concrete placement all steel shall be free from loose, flaky rust, scale (except tight mill scale), mud, oil, grease or any other coating that might reduce the bond with the concrete.

#### **(a) Hooks and Bends**

Steel bars, except for zinc-coated or epoxy-coated, shall be mill or field-bent. Zinc-Coated and epoxy-coated bars shall be mill-bent prior to coating. All steel shall be bent cold unless authorized. No steel bars shall be bent after being partially embedded in concrete unless indicated or authorized.

#### **(b) Welding**

Welding of steel bars will be permitted only where indicated or authorized. Welding shall be performed in accordance with AWS D1.4 except where otherwise specified or indicated.

#### **(c) Placing Tolerances**

##### **(i) Spacing**

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 25 mm.

##### **(ii) Concrete Cover**

The minimum concrete cover of main reinforcement steel bars shall be as shown. The allowable variation for minimum cover shall be as follows:

<b>MINIMUM COVER</b>	<b>VARIATION</b>
150 mm	plus 13 mm
100 mm	plus 10 mm
75 mm	plus 10 mm
50 mm	plus 6 mm
38 mm	plus 6 mm
25 mm	plus 3 mm
19 mm	plus 3 mm

#### **(d) Splicing**

Splices in steel bars shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Procuring entity/Employer subject to approval by Engineer.

**(i) Lap Splices**

Lap splices shall be used only for bars smaller than size 45 and welded wire fabric. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than 1/5 the required length of lap or 150 mm.

**8-3.3.3 Embedded Items**

Before placing concrete, care shall be taken to determine that all embedded items are securely fastened in place as indicated in the drawings or required. Embedded items shall be free of oil and other foreign matter such as loose coatings of rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Any air or water lines or other materials embedded in structures as authorized construction expedients shall conform to the above requirements and upon completion of their use shall be backfilled with concrete or mortar as directed. Welding will not be permitted on embedded or otherwise exposed metals which are in contact with concrete surfaces. Tack welding of or to embedded items will not be permitted.

**8-3.3.4 Concrete on Earth Foundations**

Earth foundations upon which concrete is to be placed shall be clean, damp, and free from frost, ice, and standing or running water. Prior to placement of concrete, the earth foundation shall have been satisfactorily compacted in accordance with the provisions of Section 5-Excavatin and Miscellaneous Earthworks.

**8-3.3.5 Concrete on Rock Foundations**

Rock surfaces upon which concrete is to be placed shall be clean and free from oil, standing or running water, ice, mud, drummy rock, coatings, debris, and loose, semidetached, overhanging, or unsound fragments. Faults or joints shall be cleaned to a satisfactory depth and to firm rock on the sides as directed by the Engineer. Immediately before concrete is placed, all rock surfaces shall be cleaned thoroughly by the use of air-water jet, high-pressure water jet, or sandblasting as described in Sub-Clause 8-3.3.6 - Construction Joint Treatment. All rock surfaces shall be kept continuously wet for at least 24 hours immediately prior to placing concrete thereon. All approximately horizontal surfaces shall be covered immediately before the concrete is placed with a 13 mm layer of mortar composed of the same sand and cementitious materials used in the concrete. The sand-cementitious materials ratio and the water-cementitious material ratio of the mortar shall be approximately the same as those used in the concrete mixture. The mortar shall be covered with concrete before the mortar has reached its initial time of setting.

**8-3.3.6 Construction Joint Treatment**

**(a) Joint Preparation**

Concrete surfaces to which other concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning by sandblasting, high-pressure water jet, or air-water cutting. Surface cutting by air-water jets will not be permitted for concrete surfaces congested with reinforcing steel or if they are relatively inaccessible. If, for any other reason, it is considered undesirable to disturb the surface of a lift before it has hardened, the use of sandblasting or high-pressure water jet after hardening will be required. Regardless of the method used, the resulting surface shall be free from all laitance and inferior concrete so that clean, well-bonded coarse aggregate particles are exposed uniformly over the lift surface. Application of the joint treatment method shall be such that the edges of the larger particles of aggregate are not undercut. Where joint preparation occurs more than 2 days prior to placing the next lift or where the work in the area subsequent to the joint preparation causes dirt or debris to be deposited on the surface, the surface shall be cleaned as the last operation prior to placing the next lift. The surface of the construction joint shall be kept continuously wet for the first 12 hours of the 24 hours prior to placing concrete, except that the surface shall be damp with no free water at the time of placement.

**(b) Air-Water Cutting**

Air-water cutting of a construction joint shall be performed at the proper time, generally between 4 and 12 hours after placement and only on horizontal construction joints. This period may be modified if a retarder is used to prolong the setting of the cement at surface of the concrete. The air pressure used in the jet shall be 620 to 760 kPa, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, the Contractor shall furnish samples of the material to be used and shall demonstrate the method to be used in its application. After cutting, the surface shall be washed and rinsed until the wash water is no longer cloudy. If air-water cutting does not produce acceptable results, the surface shall be prepared by high-pressure water jet or sandblasting.

**(c) High-Pressure Water Jet**

A stream of water under a pressure of not less than 21 MPa may be used for cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the high-pressure water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

**(d) Wet Sandblasting**

This method of joint preparation may be used when the concrete has reached sufficient strength to prevent undercutting of coarse aggregate particles. The operation shall be continued until all accumulated laitance, coatings, stains, debris, and foreign materials are removed. The surface of the concrete shall then be washed thoroughly to remove all loose material. This method may be used on both horizontal and vertical surfaces.

**(e) Waste Water Disposal**

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall meet all requirements of Section 3 - Environmental Protection.

**8-3.3.7 Joints**

Joint locations and details, including materials and methods of installation of joint fillers and waterstops, shall be as specified, as shown on drawings, and as directed. In no case shall any fixed metal be continuous through an expansion or contraction joint except as shown on drawings.

**(a) Expansion Joints**

Premolded filler strips shall have oiled wood strips secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces. The wood strips shall be slightly tapered, dressed and of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant or seals to the size shown. Material used to secure premolded fillers and wood strips to concrete shall not harm the concrete and shall be compatible with the joint sealant or seals. The wood strips shall not be removed until after the concrete curing period. The groove shall be thoroughly cleaned of all laitance, curing compound, foreign materials, protrusions of hardened concrete and any dust which shall be blown out of the groove with oil-free compressed air.

**(i) Joints With Field-Molded Sealant**

Joints shall not be sealed when the sealant, air or concrete temperature is less than 4 degrees centigrade. Immediately prior to installation of field molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents or other means as recommended by the

sealant manufacturer. The joints shall be dry prior to filling with sealant. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

**(ii) Joints With Preformed Compression Seals**

The joint seals shall be installed with equipment, which shall be capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal and with no more than five percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant, and the seal shall be installed to the depth indicated with joint installation equipment. Butt joints shall be coated with liberal applications of lubricant.

**(b) Contraction Joints**

Joints requiring bond breaking shall be coated with curing compound or with bituminous paint. Waterstops shall be protected during application of bond breaking material to prevent them from being coated.

**(c) Waterstops**

Waterstops shall be carefully and correctly positioned during installation to eliminate faulty installation that may result in joint leakage. The bottom of each waterstop shall be embedded a minimum of 150mm in firm rock or sealed to other cut-off systems. All waterstops shall be installed so as to form a continuous watertight diaphragm in each joint. Adequate provision shall be made to support and protect the waterstops during the progress of work. Any waterstop punctured or damaged shall be replaced or repaired at the Contractor's expense. The concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

**(i) Splices**

Joints in waterstops shall be spliced together by qualified splicers using the approved splicing procedures to form a continuous watertight diaphragm. Splices shall be as followed:

**(1) Non-Metallic Waterstops**

All splices shall be made on a bench in a temporary shop provided at the site of the installation or at the manufacturer's plant. A miter guide and portable power saw shall be used to cut the ends to be joined to insure good alignment and contact between joined surfaces. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions and the like) shall be maintained across the splice.

**(2) Rubber Waterstops**

Splices shall be vulcanized in accordance with the approved procedure.

**(3) Polyvinylchloride Waterstops**

Splices shall be made by heat-sealing the adjacent surfaces in accordance with the approved procedure. A thermostatically controlled electrical heat source shall be used to make all splices. The correct temperature at which splices should be made will differ with the material concerned but the applied heat should be sufficient to melt but not char the plastic. Waterstops shall be reformed at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled and bent by hand in as sharp an angle as possible, shall show no sign of separation.

**8-3.4 Transporting and Placing Concrete**

**8-3.4.1 Transporting**

Methods and equipment for conveying and depositing the concrete into the form shall be subject to approval. The capacity of the transporting system shall be sufficient to supply concrete at a rate to prevent cold joints forming during placement. A properly designed and sized elephant trunk and rigid drop chute bottom section which will prevent free-fall within the elephant trunk and rigid drop chute will be used if concrete is to drop more than 1.5 m. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the concrete shall discharge into a pipe or elephant trunk that is long enough to extend through the reinforcing bars to within 1.5 m of the placing surface. In no case will concrete be discharged to free fall through the reinforcing bars.

**(a) Transporting by Bucket**

There shall be provided indicating and signaling devices for the control of identification of types or classes of concrete as they are mixed and discharged into buckets for transfer to the forms. Each type or class of concrete shall be visually identified by placing a colored tag or marker on a bucket as it leaves the mixing plant so that the concrete may be positively identified in the forms and placed in the structure in the desired position.

**(b) Transporting by Pump**

The nominal maximum-size coarse aggregate will not be reduced or mixture proportions changed to accommodate a pump except as specifically determined appropriate. The distance and height to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation the equipment shall be thoroughly cleaned and flushing water shall be wasted outside the forms.

**(c) Transporting by Belt Conveyor**

Methods and equipment for transporting the concrete by belt conveyor into the form shall be subject to approval.

**8-3.4.2 Placing**

The capacity of the placing system shall be sufficient to supply concrete at a rate which will prevent cold joints in any placement. Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the material to segregate. Concrete shall be deposited as close as possible to its final position in the forms, and in so depositing, there shall be no vertical drop greater than 1.5 m except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively placed and consolidated in horizontal layers not exceeding 1.5 m in thickness with a minimum of lateral movement. The amount of concrete deposited shall be such that it can be readily and thoroughly consolidated and shall not exceed 3 cubic meters in one pile. All concrete-placing equipment and methods shall be subject to approval. Concrete placement will not be permitted during heavy rains or dust storm or when the air temperature falls below 5 degree C or rise above 38 degree C.

**(a) Time Interval Between Mixing and Placing**

Concrete mixed in stationary mixers and transported by nonagitating equipment shall be placed within 30 minutes after it has been mixed, unless otherwise authorized. When concrete is truck mixed or when a truck mixer or agitator is used for transporting concrete mixed by stationary mixers, the concrete shall be delivered to the site of the work, and discharge shall be completed within 1 hour after introduction of the cement to either the water or aggregate.

**(b) Placing Temperature**

Unless specified otherwise for particular parts of the works, the temperature of the concrete when delivered to the forms shall be as low as practicably can be produced but in no case at a temperature in excess of 13 degree C for mass concrete and 24 degree C for the other structures. The requirements

specified below for different types of concrete sections. The temperature of the fresh concrete shall be measured in accordance with ASTM C 1064/C 1064M.

**(c) Hot-Weather Placing**

All hot weather concrete shall comply with the requirements of ACI 305R. In hot weather, the contractor shall take steps to ensure adequate protection of concrete work. Hot weather is defined as any combination of high air temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise resulting in abnormal properties. To that end the Contractor shall provide sun shades over stockpiles of aggregates, batching and mixing plant, cement silos, and mixing water tanks and pipelines; insulate facilities and, in addition, shall carry out one or more of the following procedures which shall be submitted to the Engineer for approval:

- Shade and /or wet the outside of the formwork.
- Apply a fine moisture (fog) spray of clean water at a temperature not exceeding 25 degree C in order to cool and moisten the surrounding air and the sub-surface, to cool the formwork and reinforcement, to lessen rapid evaporation from unformed concrete surface and keep concrete surfaces cool.
- Refrigerate the mixing water.
- Add chip, crushed, tube, or other forms of ice up to the full amount of added mixing water.
- Placement only at night.

**(d) Concrete Lifts**

All concrete shall be deposited in approximately horizontal layers about 0.5 m in thickness in stepped progression at such a rate that the formation of cold joints will be prevented. Slabs shall be placed in one lift, unless 0.8m or more deep. Where 2.3 m or greater lift depths are permitted, the Contractor shall furnish approved cantilever forms that are jointed or hinged approximately midheight to facilitate placement against surfaces sloping more than 10 degree from vertical. At the beginning of the placing of a lift, the top half of a hinged or jointed form shall be retracted to such a position that it does not interfere with the operation of buckets placing concrete adjacent to the form. A minimum of five successive horizontal layers in stepped progression shall be used for 2.3m lifts. Where 1.5 m lifts are required, a minimum of three successive horizontal layers in stepped progression shall be used. Each new layer of concrete shall be placed on the oldest exposed layer. The maximum exposed bulkhead face of concrete between adjacent monoliths shall not exceed 12m except as otherwise approved.

**(e) Consolidation**

Immediately after placing, each layer of concrete shall be consolidated by internal vibrating equipment. Vibrators shall not be used to cause concrete to flow for significant distances within the forms. Hand spading may be used if necessary together with internal vibration along formed surfaces permanently exposed to view. Form vibrators shall not be used unless forms are specifically designed for this use and unless specifically approved. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding unhardened layer if such exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly. Slabs 200 mm or less in depth shall be consolidated by approved methods.

**(f) Placing Concrete in Unformed Curved Sections**

The unformed portion of the ogee crest, spillway bucket, and similar features shall be finished by placing concrete slightly above grade, consolidating and striking off to grade by accurate screeding.

Screeding may be accomplished by semimechanical devices or by a mechanical screed that consolidates and screeds the surface in one operation. Ribs embedded in the fresh concrete as guides for screeds will not be permitted.

### **8-3.5 Finishing**

#### **8-3.5.1 Unformed Surfaces**

The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 5 degrees C. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 1.0 kg/square meter per hour, provisions for windbreaks, shading, fog spraying, or evaporation retarding film shall be made in advance of placement to prevent plastic shrinkage cracks, and such protective measures shall be taken before, during, and immediately after finishing as operations require. All unformed surfaces of concrete that are not to be covered by additional concrete or backfill shall have a float finish, unless a trowel finish is specified, and shall be true to elevation as shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. The concrete shall be thoroughly consolidated before finishing operations commence or before leaving it for future concrete or backfill placement.

##### **(a) Float Finish**

Surfaces to receive a float finish shall be screened and darbied or bull floated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be of aluminum or magnesium. After the water sheen has disappeared, the concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true even plane.

##### **(b) Trowel Finish**

A trowel finish shall be applied to the surfaces where shown in drawings. Concrete surfaces shall first be given a float finish. After surface moisture has disappeared, the surface shall be troweled to a smooth, even, dense finish, free from blemishes, including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Surfaces or edges likely to be injured during the construction period shall be protected from damage.

##### **(c) Broom Finish**

A broom finish shall be applied to the following surfaces where indicated in drawings. The concrete surface to be broom finished shall first be given a float finish. The surface shall then be broomed with a stiff fiber-bristle broom.

##### **(d) High Velocity Finishes**

Unformed surfaces subjected to high velocity flow (12 m/s) and shown in drawings shall receive a trowel finish.

#### **8-3.5.2 Formed Surface Repair**

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

**(a) Classes A, A-HV, & B Finishes**

Surfaces as shown in the drawings to have classes A, A-HV, and B finishes, shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 10 000 square mm in area and less than 13 mm deep; bug holes exceeding 13 mm in diameter shall be chipped and filled with dry-packed mortar; holes left by removal of tie rods shall be reamed and filled with the below specified material; defective and unsound concrete areas larger than described shall be defined by 13 mm deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of ASTM C 881/C 881M, Type V; a latex bonding agent meeting the requirements of ASTM C 1059, Type II; or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with the Sub-Clause 8-3.5.2(d) - Material and Procedure for Repairs.

**(b) Class C Finish**

Surfaces as shown in the drawings, to have Class C finish shall have defects repaired as follows: defective areas, voids, and honeycombs smaller than 15 000 square mm and less than 50 mm deep; bug holes exceeding 38 mm in diameter shall be chipped and filled with dry-packed mortar; and holes left by removal of the tie rods shall be reamed and filled with dry-packed mortar. Defective and unsound concrete areas larger than 15 000 square mm and deeper than 38 mm shall be defined by 13 mm deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of ASTM C 881/C 881M, Type V; a latex bonding agent meeting the requirements of ASTM C 1059, Type II; or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with the Sub-Clause 8-3.5.2(d) - Material and Procedure for Repairs.

**(c) Class D Finish**

Surfaces as shown in the drawings to have class D finish, shall have surface defects repaired as follows: defective areas, voids, and honeycombs greater than 30 000 square mm in area or more than 50 mm deep shall be defined by 13 mm deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of ASTM C 881/C 881M, Type V; a latex bonding agent meeting the requirements of ASTM C 1059, Type II; or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with Sub-Clause 8-3.5.2(d) - Material and Procedure for Repairs.

**(d) Material and Procedure for Repairs**

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Engineer. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. Metal tools shall not be used to finish permanently exposed surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 5 degrees C



during placement, finishing, and curing. Packaged materials meeting the requirements of ASTM C 928 may be used in lieu of dry-packed mortar when approved. Other methods and materials for repair may be used only when approved in writing. Repairs of the so called "plaster-type" will not be permitted.

### 8-3.6 Curing and Protection

#### 8-3.6.1 Curing Time

All concrete shall be cured by one of the following methods or combination of methods for the period of time given below corresponding to the cementing materials used in the concrete:

Type I Portland cement .....	7 days
Portland cement in combination with silica fume .....	7 days
Type II Portland cement .....	14 days
Portland cement blended with 25 percent or less fly-ash or GGBF slag .....	14 days
Portland cement blended with more than 25 percent fly-ash or GGBF slag .....	21 days

Curing shall begin immediately after placing. The Contractor shall have all equipment needed for adequate curing and protection of the concrete on hand and ready to install before actual concrete placement begins. The curing medium and method, or the combination of media and methods used, shall be as approved in accordance with Clause 8-1.3 - Submittals, SD-03 Product Data, submittal item "Curing and Protection".

#### 8-3.6.2 Moist Curing

Concrete containing silica fume shall be moist cured. Horizontal and nearly horizontal surfaces shall be moist cured by ponding, by covering with a minimum uniform thickness of 50 mm of continuously saturated sand, or by covering with saturated nonstaining burlap or cotton mats. Burlap and cotton mats shall be rinsed to remove soluble substances before using. Other surfaces shall be moist cured when approved or directed. Concrete that is moist cured shall be maintained continuously, not periodically, wet for the duration of the entire curing period. Water for curing shall comply with the requirements of the Sub-Clause 8-2.4.4 - Water. If the water, sand, mats, etc. cause staining or discoloration of permanently exposed concrete surfaces, the surfaces shall be cleaned by a method approved. When wood forms are left in place during curing, the forms shall be kept continuously wet except for sealed insulation curing in cold weather. When steel forms are left in place on vertical surfaces during curing, the forms shall be carefully broken loose from the hardened concrete and curing water continuously introduced into the void. Horizontal construction joints shall be allowed to dry sufficiently to remove free water immediately prior to placing the next lift.

#### 8-3.6.3 Membrane Curing

Membrane curing may be used on surfaces that are not specified or directed to receive moist curing and that are not to receive a grout-cleaned finish. Membrane-forming curing compound shall not be used on surfaces that contain protruding steel reinforcing, that are heated by free steam, that will have additional concrete bonded to them, or that are to be grout-cleaned.

#### (a) Pigmented Curing Compound

Pigmented compound conforming to ASTM C 309, Type 2, Class A, may be used on surfaces that will not be exposed to view when the project is completed. Only pigmented compound of the styrene acrylate or chlorinated rubber formulation conforming to ASTM C 309, Class B, requirements may be used on surfaces that are to be painted or to receive bituminous roofing or water proofing or floors that are to receive adhesive applications of resilient flooring. The curing compound selected by the Contractor for such use shall be compatible with any subsequent paint, roofing, coating, or flooring specified elsewhere in the contract.

**(b) Nonpigmented Curing Compound**

Nonpigmented compound conforming to ASTM C 309, Type ID, containing a fugitive dye may be used on surfaces that will be exposed to view when the project is completed. The reflective requirements of ASTM C 309 are waived. Surfaces cured with non-pigmented compound shall be shielded from direct rays of the sun for 3 days.

**(c) Application**

The curing compound shall be applied to formed surfaces immediately after the forms are removed. The surfaces shall be thoroughly moistened with water, and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared provided steps have been taken when necessary to prevent premature loss of free water due to excessive evaporation as described in Sub-Clause 8-3.5.1 - Unformed Surfaces. The curing compound shall be applied in a two-coat continuous operation by motorized power-spraying equipment or pressure-tank equipment operating at a minimum pressure of 520 kPa with provisions for continuous agitation. The application equipment shall be approved in advance. Hand-operated pressure applicators ("garden sprayers") shall not be used except in small, isolated areas as approved. The compound shall be applied at a uniform coverage of not more than 10 square meters per liter for each coat. The second coat shall be applied perpendicular to the first coat. Concrete surfaces that have been subjected to rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified. All concrete surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other influence that will disrupt the continuity of the curing membrane.

**8-3.6.4 Sealed Insulation Curing**

Whenever freezing temperatures are imminent and where cold weather protection is provided entirely by insulation, all joints in the insulation shall be sealed to retard moisture loss and maintain a seal throughout the curing period.

**8-3.6.5 Protection**

No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. No vibratory earth compaction equipment or pile-driving equipment shall be operated within 30 m horizontally of concrete less than 5 days old. Blasting shall not be permitted within 30 m horizontally of concrete less than 90 days old. Blasting plans shall be approved by the Engineer. All galleries, conduits, and other openings through the concrete shall be kept closed or sealed during the entire construction period. The surface of the concrete shall be protected from rain during placing.

**8-3.6.6 Cold Weather Protection**

Whenever freezing temperatures are imminent all concrete immediately after placing shall be covered for a period of 5 days with insulation and maintain the concrete at temperature of not less than 10 degrees C.

- a. The insulation shall be maintained in such a condition that the temperature shall not drop below 10 degrees C during the period of protection. Edges and corners of the placement shall be protected with a double layer of the insulation specified above for a minimum distance of 0.6 m in all directions.
- b. Concrete placed prior to the starting date shall be insulated from the starting date until it reaches an age of 5 days. Concrete placed after the starting date shall be continuously insulated during and subsequent to placement until it reaches an age of 5 days or until the end of the protection period, whichever comes first.
- c. Insulation and the combined form-insulation system shall remain in place for at least 5 days after placement of the concrete. After 5 days, forms and insulation on vertical surfaces may be removed for periods not to exceed 4 hours in a 24 hour period to allow forms to be moved, and insulation on

horizontal surfaces may be removed for periods not to exceed 8 hours in a 24 hour period to allow reinforcement to be installed, insulation to be installed, lift joints to be prepared, etc. provided that suitable precautions are taken to prevent the concrete from being subjected at any time to ambient temperatures of minus 7 degrees C or below.

d. The first 1.8 m of all steel protruding from insulated concrete shall be insulated. All form bolts and metal ribs on the forms shall be insulated in a like manner. During the period of protection there shall be no holes or openings in the insulation or between the insulation and concrete, which permit ambient air to penetrate the insulation except as noted for construction purposes. Special attention shall be given to seams, corners, and edges to prevent holes or openings in the insulation.

### 8-3.7 Base Plates and Bearing Plates

#### 8-3.7.1 Setting of Plates

After being plumbed and properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be provided full bearing using nonshrink grout. The space between the top of the concrete bearing surface and the bottom of the plate shall not be less than 1/24 of the width of the plate or 13 mm, whichever is greater. Concrete surfaces shall be clean, free of oil, grease, and laitance, and shall be damp. Metal surfaces shall be clean and free of oil, grease, and rust.

### 8-3.8 Block-Out Concrete

#### 8-3.8.1 Composition and Proportions

Block-out concrete shall be composed of portland cement, water, fine and coarse aggregate, and admixtures. The concrete mixture proportions, including admixture, will be provided by the Engineer. An expansive admixture shall be used to cause the blackout concrete to expand to fit snugly in the space that confines it. The expansive admixture shall conform to the requirements of ASTM C 937 for grout fluidifier. Any block-out concrete not placed within 30 minutes after contact of the cement and admixture shall be wasted. The block-out shall be confined on all sides to provide restraint.

#### 8-3.8.2 Placing Block-out Concrete

Blackouts shall be provided as shown on the plans for the embedment of gate seal seats, gate guides, bulkhead guides, beams embedded for bulkhead seals, crane rails, and other embedded metalwork as appropriate. Prior to installation of embedded items, the block-outs or recesses shall be cleaned in accordance with applicable requirements of the Sub-Clause 8-3.3.6 - Construction Joint Treatment. After installation of embedded items and prior to placing any forms, all surfaces of the block-outs or recesses and surfaces of items to be embedded shall be thoroughly cleaned of all loose material, oil, grease, and other contaminants which might reduce the bond between the surfaces of the blackouts or recesses and new concrete. Extreme caution shall be exercised in placing block-out concrete to avoid distortion or displacement of the embedded items.

### 8-3.9 Construction of Precast-Prestressed Concrete

#### 8-3.9.1 Fabrication

Fabrication of precast-prestressed members shall follow the applicable provisions of the PCI MNL-116, except as specified herein.

#### 8-3.9.2 Beds and Forms

##### (a) Casting Beds

All casting beds shall have concrete support on unyielding foundations.

**(b) Forms**

Forms, both fixed and movable, shall be of steel. All forms and beds shall be thoroughly cleaned after each use.

**(c) Bulkheads**

Bulkheads, spacers, templates, and similar equipment having influence on the accuracy of dimensions and alignment shall be regularly inspected and maintained after each casting.

**(d) Alignment**

Accurate alignment of forms shall be maintained during the casting operation to assure compliances with tolerances specified in Clause 8-1.6 – Construction Tolerances. Leakage of the paste in form joints is not acceptable, and measures shall be taken to prevent such leakage. Measures shall also be taken to provide corner chamfers.

**(e) Form Ties**

For exposed members, form ties, if used, shall be of the threaded or snap-off type so no parts will be left at the surface of the finished concrete.

**8-3.9.3 Tendons**

Stressing tendons and accessories shall be installed or placed as specified and as shown on contract and approved installation drawings. Installation details of stressing tendons and accessories not specified or shown shall be in accordance with ACI SP-66 or ACI 318M/318RM. Welding shall not be performed near or adjacent to stressing tendons. Stressing tendons shall not be installed until all welding has been completed on supports or any part which might be in contact with the tendons.

**(a) Prestressing Method and Equipment**

Descriptions of the proposed prestressing methods and equipment indicating the manufacturer of all prestressing equipment, including tensioning jacks, stress measurement gages, dynamometers and load cells or other devices for measuring stressing loads, shall be provided by the contractor. Descriptions shall include certified calibration records for each set of jacking equipment and testing curves for stress measurement gages which show that the gages have been calibrated for the jacks for which they are to be used.

**(b) Installation Drawings**

Detailed installation drawings for stressing tendons and accessories showing the type and size of stressing tendons and anchorages, erection methods, sequence of stressing and stressing calculations shall be provided by the Contractor.

**(c) Anchorages**

Anchorages must be set in a plane normal to the axis of the tendons such that uniform bearing on the concrete is assured. Positive connecting anchorages rather than gripping types shall be used for anchoring embedded ends of tendons. Anchorages and anchor fittings shall be permanently protected against corrosion. Parallel wire anchorage wedges or cores shall be recessed within the members.

**(d) Stressing Tendons and Ducts**

Protective coverings and wrappings shall be removed and each stressing tendon shall be closely inspected to see that nicks, scoring, pits or other damage does not exist and high strength steel bars shall be closely inspected to assure that they are not bent and that threaded ends are in satisfactory condition immediately prior to installation. Strand, wire and bar tendons shall be shop or field assembled as required and positively attached to anchorages. Type WA wire assemblies shall be

anchored only with wedge type anchorages. Stressing tendons and ducts shall be assembled to required shapes and dimensions and placed where indicated on drawings within specified tolerances and adequately supported. Ducts shall be securely fastened at close intervals and grout openings and vents must be securely anchored to ducts and to either the forms or reinforcing steel to prevent displacement during concrete placing. The ends of ducts shall be effectively protected to prevent entry of water, concrete, grout or debris. Wires of parallel-wire assemblies shall not be spliced. Steel bar tendons may be joined by couplers where shown or approved, provided they are capable of developing the guaranteed minimum ultimate strength of the bars. Strands to be spliced shall have the same lay or direction of twist and the ends shall be cut by shears or abrasive grinders. No more than one strand shall be spliced in any one member where single strand tensioning is employed. Strand splices shall be capable of developing the full ultimate strength of the strand. Slippage of the splice shall be checked and correction made for differential slippage. Where multiple strand tensioning is used, not more than 10 percent of the strands in any member shall be spliced.

**(e) Tensioning Tendons**

Tensioning of stressing tendons shall be as specified and shown. The stress induced in the tendons by any method of tensioning shall be determined independently by both (1) measurement of tendon elongation and (2) direct measurement of force using a pressure gauge or load cell. If the results of these two measurements do not check each other and the theoretical values within 5 percent, the operation shall be carefully checked and the source of error determined and corrected before proceeding further. Concrete cylinder tests shall indicate a breaking strength of at least 28 MPa for Pre-tensioning and 24 for Post-tensioning before transfer of stress to ensure that the concrete strength is adequate for the requirements of the anchorages or for transfer through bond as well as meet camber or deflection requirements. The final prestress load in each unit after seating shall be as shown. Safety measures shall be taken by the Contractor to prevent accidental injury caused by failure of a stressing tendon or tendon component. The exposed ends of stressing tendons and anchorages shall be protected from damage during stressing operations to prevent failure.

**(i) Post-Tensioning**

Tensioning shall not be performed until the concrete has reached the required strength at transfer of stress. Before final tensioning of tendons, all tendons shall be brought to a uniform initial tension of approximately 10 percent of the full load. The force corresponding to the initial tension shall be measured by a dynamometer or other approved method as a starting point in determining final elongation. A temporary overstress above the final prestress force as approved by the Engineer shall be used to overcome stress losses. The units shall be tensioned until the proper elongations and jacking pressures are attained and reconciled within the limits stated above. Straight tendons may be tensioned from one end. Curved or draped tendons shall be stressed by simultaneous jacking from both ends using a common pump with identical hoses and jacks, unless otherwise shown.

**(ii) Grouting Post-Tensioned Tendons**

Grouting between each tendon and its enclosing duct shall be performed within 5 days after completion of the tensioning operation. Grouting shall not be performed if air temperature below 7.2 degrees C is anticipated within 48 hours after grouting unless an approved method of temperature control is used. The grout shall be mixed in a mechanical mixer of a type that will produce uniformly and thoroughly mixed grout. First water shall be placed in the mixer followed by cement and admixture. Grout shall be continuously agitated until it is pumped. Grout that has begun to set shall be discarded. Just before grouting, the ducts shall be flushed with clean water and then blown clear by compressed air to removed excess water. With the grout vent open at one end of duct, grout shall be applied continuously under moderate pressure at the other end until all entrapped air is forced out as indicated by a uniform flow of grout from the discharge vent. The discharge vent shall then be closed and the pressure raised to 340 MPa minimum and held for at least 1 minute. The injection point shall then be closed by an approved means to prevent any loss of grout. For a period of at least 3 days after grouting the tendons, the prestressed members shall not have equipment or other loads

placed on them. A longer period may be required, depending upon the method of curing and magnitude of imposed stresses.

**(iii) Accuracy of Stress and Elongation Measurement**

**(i) Stress Measurement**

Hydraulic gauges, dynamometers, load cells or other devices for measuring stressing load shall have an accuracy of reading within two percent for stress measurement. Gauges are required to have been calibrated for the jacks for which they are used within a period not exceeding 12 months. Recalibration shall be performed at any time that a gaging system shows indication of erratic results in the opinion of the Engineer. Gauges shall indicate loads directly in kilonewton's or be accompanied by a chart which converts dial readings into kilonewtons.

**(ii) Elongation Measurement**

After the initial force has been applied to a tendon, reference points for measuring elongation due to additional tensioning forces shall be established. They shall be located according to the method of tensioning and type of equipment. The system used shall be capable of measuring the true elongation plus or minus 2 mm.

**(f) Prestressing Operations Records**

The Contractor shall compile and submit complete prestressing operations records to the Engineer. These records shall show the manufacturer, identification and description of materials and equipment including prestressing tendons and jacking and load measuring equipment; location of prestressing tendons; initial design tensioning loads, final design tensioning loads and actual tensioning loads for tendons; dates tensioning loads applied; and theoretical and actual elongations for tendons.

**(i) Inspection**

The Contractor's facilities shall be open for inspection by the Engineer at any time.

**(g) Materials Disposition Record**

Accurate materials disposition records identifying all materials incorporated into the work and showing the disposition of specific lots of approved tested materials shall be compiled by the Contractor.

**8-3.9.4 Anchorages for Post tensioning**

Anchorages for post tensioning tendons will not interfere with the placement of the member such that adequate compaction of the concrete in the anchorage zone is impeded.

**8-3.9.5 Steel Reinforcement**

Steel bars and welded wire fabric shall be placed in accordance with Clause 8-3.3.2 – Fabrication and Placement of Reinforcement.

**8-3.9.6 Concrete Placement**

Concrete placement shall be in accordance with Clause 8-3.4.2 – Placing, except that once placement is started in a member it shall be carried on in a continuous operation until the member is completed. Members shall be cast in a horizontal position and casting in tiers will not be permitted. Adequate vibration shall be provided with internal and form vibrators so the cast members shall be free of rock pockets or surface blemishes resulting from inadequate vibration. Cold joints shall not be permitted in prestressed concrete members. If delays occur that result in hardening of the concrete so it will not receive a vibrator and again become plastic, the concrete shall be removed and the forms shall be washed out and refilled, otherwise partially cast members will be rejected.

**8-3.9.7 Curing and Protection**

Concrete for the manufacturing of the precast-prestressed concrete members shall be cured and protected in accordance with Clause 8-3.6 – Curing and Protection or by other methods specified here.

**(a) Curing with Steam at Atmospheric Pressure**

Steam curing shall be under a suitable enclosure to retain the live steam to minimize moisture and heat losses. The enclosure shall allow free circulation of the steam around the sides and top of the beams. Steam jets shall be so positioned so they do not discharge directly on the concrete, forms, or test cylinders. The cycle of steam application shall conform to the following:

**(i) Curing After Placing and Vibrating**

After placing and vibrating, the concrete shall be allowed to attain its initial set before the steam is applied. During the period between placement of the concrete and application of steam, provisions shall be made to prevent surface drying by means of a coating of membrane curing compound, moist covers, or equally effective methods. Application of the steam shall be delayed not less than 2 hours and not more than 10 hours after the time of concrete placement.

**(ii) Temperature Increase**

The ambient temperature within the casting enclosure shall be increased at a rate not to exceed 22 degrees C per hour. Temperature increase shall be as uniform as possible.

**(iii) Temperature Range**

The temperature shall be increased until the ambient temperature in the casting enclosure is between 60 and 71 degrees C. Once this temperature range is reached, it shall be maintained until the concrete has reached the compressive strength necessary for stressing or destressing the tendons.

**(iv) Temperature Decrease**

In discontinuing the steam curing, the ambient air temperature shall decrease at a rate not to exceed 22 degrees C per hour. Temperature decrease shall be as uniform as possible.

**(v) Recording Thermometers**

Recording thermometers showing the time-temperature relationship through the curing period from placing concrete to transfer of prestress shall be provided. At least one recording thermometer per casting enclosure shall be used. The desired curing time-temperature relationship shall be placed on the recording chart of the recording thermometer to aid the personnel controlling the temperature during curing. Recording charts shall be made available upon request and shall be clearly visible during the curing process.

**(b) Curing with Radiant Heat and Moisture****(i) Radiant Heat**

Radiant heat may be applied to beds by means of pipe circulating steam, hot oil, or hot water or by electric blankets or heating elements on forms. Pipes, blankets, or elements shall not be in contact with concrete, form surface, or test cylinders.

**(ii) Moisture Loss**

During the cycle of radiant heat curing, effective means shall be provided to prevent rapid loss of moisture in any part of the member. Moisture may be applied by a covering of moist burlap or cotton matting. Moisture may be retained by covering the member with a plastic sheet in combination with an insulating cover or by applying a liquid seal coat or membrane curing compound.

(iii) Temperature Limits

Temperature limits and use of recording thermometer shall be as specified for curing with steam at atmospheric pressure.

(iv) Termination of Curing

Termination of curing shall be as specified in Clause 8-3.6 – Curing and Protection unless the concrete has been cured by one of the two methods stated above. Termination of curing for concrete cured by either the steam at atmospheric pressure method or the radiant heat with moisture shall be determined based on the compressive strength of the concrete necessary for stressing or destressing the tendons.

### 8-3.9.8 Repairs

All honeycombed areas, chipped corners, air pockets over 6 mm in diameter, and other minor defects shall be repaired. Form offsets of fins over 3 mm shall be ground smooth. All unsound concrete shall be removed from defective areas prior to repairing. All surfaces permanently exposed to view shall be repaired by a blend of portland cement and white cement properly proportioned so that the final color when cured will be the same as adjacent concrete.

### 8-3.9.9 Finishing

(a) Unformed surfaces

Unformed surfaces shall receive a steel trowel finish.

(b) Formed Surfaces

Formed surfaces shall match the texture and color of the sample panels, Sub-Clause 8-1.7.2(d) - Precast Panel.

### 8-3.9.10 Erection

Erection shall comply with the following.

(a) Storage Provisions

All provisions for storage and handling given in Clause 8-1.8 - Delivery, Storage, and Handling of Precast-Prestressed Members shall be observed at the erection site.

(b) Seating of Precast Prestressed Concrete Members

The precast prestressed concrete members shall be set in place in a manner which assures full bearing. If the bearing called for in the contract drawing is not obtained, then the members shall be removed and the situation corrected.

(c) Roof and Floor

Roof and floor single or double T-beams shall be erected in an increasing or decreasing magnitude of camber to minimize differential between beams. The Contractor shall measure T-beam camber and number the beams prior to erection.

(d) Welding

Welding during erection shall be done in accordance with Section 13, Miscellaneous Metalwork. When welding or burning with a welding electrode, the ground shall be attached directly to the base metal. Under no circumstances shall the member be used as a conductor for the ground.



(e) Erection Plan

The erection plan shall be in sufficient detail so that adequacy of equipment, techniques, and accessories can be determined and comments offered. Acceptance of the Contractor's erection plan shall not relieve the Contractor of his responsibility for erecting precast prestressed members into position as required by the drawings and specifications.

8-3.9.11 Construction Records

Complete construction records shall be kept of the manufacturing, handling, and erection of the precast-prestressed concrete members. Records shall be kept for, but not limited to, the following items:

- a. Specifications of material used in the manufacture of the members.
- b. Time-temperature history of the concrete members from casting to the transfer of the prestress force.
- c. Records of the tendon stressing operation including initial prestress force, measured elongation, how it was measured, and how the tendons were stressed and destressed.
- d. Records of inspection of the members before and after the prestress force is transferred to the members.
- e. Records of the inspection of the members each time they are moved.
- f. Records of any defects in the member and any corrective measures taken.

8-3.10 Tests and Inspections

8-3.10.1 General

The Contractor shall perform the following inspection and tests as described, and, based upon the results of these inspections and tests, he shall take the action required and submit reports as required. When, in the opinion of the Engineer, the concreting operation is out of control, concrete placement shall cease. The laboratory performing the tests shall be on-site and shall conform with the requirements given in ASTM C 1077. The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The Engineer will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077. The individual who performs the inspection shall have demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Transportation Construction Inspector (CTCI).

8-3.10.2 Testing and Inspection Requirements for Concrete

(a) Fine Aggregate

**(i) Grading**

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. The results shall be recorded on a sheet on which are also shown the specification limits applicable to the project.

**(ii) Fineness Modulus Control Chart**

Results for fineness modulus shall be grouped in sets of three consecutive tests, and the average and range of each group shall be plotted on a control chart. The upper and lower control limits for average

shall be drawn 0.10 units above and below the target fineness modulus, and the upper control limit for range shall be 0.20 units above the target fineness modulus.

**(iii) Corrective Action for Fine Aggregate Grading**

When the amount passing any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure for any sieve, the fact shall immediately be reported. Whenever a point on the fineness modulus control chart, either for average or range, is beyond one of the control limits, the frequency of testing shall be doubled. If two consecutive points are beyond the control limits, the process shall be considered out of control and concreting shall be stopped. Notify the Engineer, and take immediate steps to rectify the situation. After two consecutive points have fallen within the control limits, testing at the normal frequency may be resumed.

**(iv) Moisture Content Testing**

When in the opinion of the Engineer the electric moisture meter is not operating satisfactorily, there shall be at least four tests for moisture content in accordance with ASTM C 566 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When an electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content shall be used to adjust the added water in the control of the batch plant.

**(v) Moisture Content Corrective Action**

Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device).

**(b) Coarse Aggregate**

**(i) Grading**

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When facilities are available to test samples five times as large as those required in ASTM C 136, no averaging shall be done.

**(ii) Corrective Action for Grading**

When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported. Where two consecutive averages of five tests (or two consecutive tests where large samples are used) are outside specification limits, the operation shall be considered out of control, and that fact shall be reported, concreting shall be stopped, and immediate steps shall be taken to correct the grading.

**(iii) Coarse Aggregate Moisture Content**

A test for moisture content of each size group of coarse aggregate shall be made at least once a shift. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified previously for fine aggregate.

**(iv) Coarse Aggregate Moisture Corrective Action**

Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted to compensate for this.

**(v) Particle Shape Testing**

When directed, a problem exists in connection with aggregate particle shape, tests shall be made in accordance with ASTM D 4791. Testing frequency shall be not less than one per day, when directed.

**(vi) Particle Shape Corrective Action**

When testing for particle shape is required, two consecutive failures in the same sieve size shall be immediately reported, who shall determine what corrective action is needed.

**(vii) Material Finer than the 75-m (No. 200) Sieve**

When in the opinion of the Engineer, a problem exists in connection with the cleanliness of aggregate, tests shall be made in accordance with ASTM C 117. Testing frequency shall be as directed.

**(viii) Corrective Action for Material Finer than the 75-m (No. 200) Sieve**

When material finer than the 75-m (No. 200) sieve exceeds 1.0 percent of the weight of the aggregate finer than 37.5 mm or 0.5 percent of the weight of the aggregate coarser than 37.5 mm, the Engineer shall be notified and steps, such as washing or other corrective action, shall be initiated immediately.

**(c) Quality of Aggregates**

**(i) Frequency of Quality Tests**

Prior to submitting samples for mixture proportioning studies and 30 days prior to the start of concrete placement, the Contractor shall perform the tests for aggregate quality in the following list. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality in accordance with the following frequency schedule. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

Property	Fine Aggregate	Frequency Coarse Aggregate	Tests
Specific Gravity	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Absorption	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Durability (Procedure A)	Factor using Every 12 months	Every 12 months	COE CRD-C 144 ASTM C 666
Clay Lumps and Friable Particles	Every 3 months	Every 3 months	ASTM C 142
Material Finer than the 75-m (No. 200) Sieve	Every 3 months	Every 3 months	ASTM C 117
Organic Impurities	Every 3 months	Not applicable	ASTM C 40
L.A. Abrasion	Not applicable	Every 6 months	ASTM C 131 ASTM C 535
Soft and Friable (Scratch Hardness)	Not applicable	Every 6 months	COE CRD-C 130
Petrographic Examination	Every 6 months	Every 6 months	ASTM C 295
Chart, less than 2.40 specific gravity	Every 6 months	Every 6 months	ASTM C 123
Coal and Lignite, less	Every 6 months	Every 6 months	ASTM C 123

Property	Fine Aggregate	Frequency Coarse Aggregate	Tests
than 2.00 specific gravity			

**(ii) Corrective Action for Aggregate Quality**

If the result of a quality test fails to meet the requirements for quality during submittal of samples for mixture-proportioning studies or immediately prior to start of concrete placement, production procedures or materials shall be changed and additional tests shall be performed until the material meets the quality requirements prior to proceeding with either mixture-proportioning studies or starting concrete placement. After concrete placement commences, whenever the result of a test for quality fails the requirements, the test shall be rerun immediately. If the second test fails the quality requirement, the fact shall be reported and immediate steps taken to rectify the situation.

**(d) Scales**

**(i) Weighing Accuracy**

The accuracy of the scales shall be checked by test weights at least once a month for conformance with the applicable requirements of Clause 8-3.1 - Equipment. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors.

**(ii) Batching and Recording Accuracy**

Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. The Contractor shall confirm that the calibration devices described in Clause 8-3.1 - Equipment for checking the accuracy of dispensed admixtures, are operating properly.

**(iii) Scales Corrective Action**

When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

**(e) Batch-Plant Control**

The measurement of all constituent materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter for each class of concrete batched during plant operation.

**(f) Concrete****(i) Air Content**

At least two tests for air content shall be made on randomly selected batches of each concrete mixture produced during each 8 hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported. Tests shall be made in accordance with ASTM C 231. The average of each set of two tests for each mixture shall be plotted on control charts on which the average percent and upper and lower limits are set in accordance with Clause 8-2.14 – Concrete Mix Proportioning for each NMSA. The range between two consecutive tests for each mixture shall be plotted on a control chart on which the upper control limit is 3.0 percent. Samples for air content shall normally be taken at the mixer, however the Contractor is responsible for delivering the concrete to the forms at the proper air content. Samples shall be taken at the placement site as often as required, depending on the Contractors delivery method, to determine any air loss.

**(ii) Air Content Corrective Action**

Whenever points on the control chart approach the upper or lower control limits, an adjustment should be made in the amount of air-entraining admixture batched. If a single test result is outside the specification limit, immediate adjustment is mandatory. As soon as practical after each adjustment, another test shall be made to verify the correction of the adjustment. Whenever a point falls above the upper control for range, the dispenser shall be calibrated to ensure that it is operating correctly and with good reproducibility. Whenever two consecutive points either for average or range are outside the control limits, the Engineer shall be notified.

**(iii) Slump Testing**

At least two slump tests shall be made in accordance with ASTM C 143/C 143M on each concrete mixture produced during each 8-hour period or less of concrete production each day. Additional tests shall be made when excessive variation in workability is reported. The result of each test for each mixture shall be plotted on a control chart on which the upper and lower limits are set as specified in Mixture Proportioning. The range shall be plotted on a control chart on which the upper control limit is 50 mm. Samples for slump shall be taken at the mixer, however the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, samples shall be taken at the placement site as often as required by the Engineer.



**(iv) Slump Corrective Action**

Whenever points on the control chart approach the upper or lower control limits, an adjustment shall be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount specified in the mixture proportions provided based on the free water available with the aggregates and that amount of water batched. If the adjustments to the batch weights of water and aggregates do not satisfactorily produce the required slump, the Engineer may adjust the mixture proportions if the fine-aggregate moisture content is stable and within the required limits. When a single slump is outside the control limits, such adjustment is mandatory. As soon as practical after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range above the upper control limits, the slump shall be considered to be out of control, the concreting operation halted, and the additional testing for aggregate moisture content required shall be undertaken, and action taken immediately to correct the problem.

**(v) Compression Test Cylinders**

At least one set of test cylinders shall be made each shift on each different concrete mixture placed during the shift. Additional sets of test cylinders shall be made, as directed, when the mixture proportions are changed or when low strengths have been detected. A random sampling plan shall be developed by the Contractor and approved by the Engineer prior to start of construction. The plan shall assure that sampling is done in a completely random and unbiased, not just haphazard, manner. A set of test cylinders for structural concrete containing Type I or Type II portland cement only shall consist of six cylinders, two to be tested at 24 hours, two at 7 days, and two at 28 days. A set of test cylinders for all other concrete shall consist of six cylinders, two to be tested at 24 hours, one at 7 days, one at 28 days, and two at 90 days. In addition, for all concrete except that containing Type I or Type II portland cement only, every 2 months four additional cylinders shall be made and two tested at 6 months of age and two tested at 12 months of age. The 24-hour test cylinders shall be molded, cured, and tested in accordance with ASTM C 684, Method A. All other test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. All compressive strength tests shall be reported immediately. Quality control charts shall be kept for individual strength tests, moving average for strength and moving average for range for each mixture. The charts shall be similar to those found in ACI 214R.

**(g) Inspection Before Placing**

Foundation or construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify that they are ready to receive concrete. The results of each inspection shall be reported in writing.

**(h) Concrete Placement****(i) Placing Inspection**

The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement.

**(ii) Placing Corrective Action**

The placing foreman shall not permit placing to begin until he has verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

**(I) Vibrators****(i) Vibrator Testing and Use**

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing.

**(ii) Vibrator Corrective Action**

Any vibrator not meeting the requirements of Clause 8-3.3 - Preparation for Placing shall be immediately removed from service and repaired or replaced.

**(j) Curing**

**(i) Moist Curing Inspections**

At least twice each shift, and twice per day on nonwork days an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

**(ii) Moist Curing Corrective Action**

When a daily inspection report lists an area of inadequate moistness, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by one (1) day.

**(iii) Membrane Curing Inspection**

No curing compound shall be applied until the Contractor's authorized representative has verified that the compound is properly mixed and ready for spraying. At the end of each operation, he shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered and compute the rate of coverage in square meters/L. He shall note whether or not coverage is uniform.

**(iv) Membrane Curing Corrective Action**

When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

**(v) Sheet Curing Inspection**

At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

**(vi) Sheet Curing Corrective Action**

When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by one (1) day.

**(k) Cold Weather Protection and Sealed Insulation Curing**

At least once each shift and once per day on non-work days an inspection shall be made of all areas subject to cold weather protection. The protection system shall be inspected for holes, tears, unsealed joints, or other incongruities which could result in damage to the concrete. Special attention shall be taken at edges, corners, and thin sections. Any deficiencies shall be noted, corrected, and reported.

**(l) Cold Weather Protection Corrective Action**

When a daily inspection report lists any holes, tears, unsealed joints, or other incongruities, the deficiency shall be corrected immediately and the period of protection extended for one (1) day.



**(m) Mixer Uniformity****(i) Stationary Mixers**

Prior to the start of concrete placing and once every 3 months when concrete is being placed, or once for every 57,000 cubic meters of concrete placed, whichever results in the longest time, interval uniformity of concrete mixing shall be determined in accordance with Clause 8-3.1-Equipment. The initial and every fourth set of tests shall be regular tests performed on three batches of concrete. Intermediate uniformity tests shall be abbreviated tests performed on a single batch of concrete. If the mixer fails the abbreviated test, a regular test shall be immediately performed. Whenever adjustments in a mixer or increased mixing time are required because of failure of a uniformity test, the mixer shall be reevaluated by a regular test after the adjustments have been completed. If the Contractor proposes to reduce a mixing time, a regular test shall be performed to evaluate the proposed time. Additional testing shall be performed when directed when there is visible evidence of possible improper mixer performance. Results of all uniformity tests shall be reported in writing.

**(ii) Truck Mixers**

Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory. Results of tests shall be reported in writing.

**(n) Mixer Uniformity Corrective Action**

When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

**8-3.10.3 Tests, Inspections, and Verifications for Reinforcement**

The Contractor shall have material tests required by applicable standards and specified performed by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests, inspections, and verifications shall be performed and certified at the Contractor's expense.

**(a) Reinforcement Steel Tests**

Mechanical testing of steel shall be in accordance with ASTM A 370 except as otherwise specified or required by the material specifications. Tension tests shall be performed on full cross-section specimens using a gauge length that spans the extremities of specimens with welds or sleeves included. Chemical analyses of steel heats shall show the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel.

**(b) Radiographic Examination of Welds**

Radiographic examination of welds shall be in accordance with ASTM E 94 and shall be performed and evaluated by an approved testing agency adequately equipped to perform such services. Radiographs of welds and evaluations of the radiographs submitted for approval shall become the property of the Procuring entity/Employer.

**8-3.10.4 Test for Field-Molded Sealants**

Samples of sealant and primer, when use of primer is recommended by the manufacturer, as required in Field Molded Sealants and Primer, shall be tested by and at the expense of the Contractor for compliance with subclause 8-2.10.1 - Field Molded Sealants and Primer. If the sample fails to meet specification requirements, new samples shall be provided and rested.

**8-3.10.5 Test for Non-Metallic Waterstops**

Samples of materials and splices as required in Clause 8-2.11 - Waterstops shall be visually inspected and tested by and at the expense of the Contractor for compliance with COE CRD-C 513 or COE CRD-C 572 as applicable. If a sample fails to meet the specification requirements, new samples shall be provided and rested.

### **8-3.10.6 Splicing Waterstops**

(a) Procedure and Performance Qualifications

Procedure and performance qualifications for splicing waterstops shall be demonstrated in the presence of the Engineer.

(b) Non-Metallic Waterstops

Procedure and performance qualifications for splicing non-metallic waterstops shall be demonstrated by the manufacturer at the factory and the Contractor at the job site by each making three spliced samples of each size and type of finished waterstop.

### **8-3.10.7 Reports**

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

## **PART 4 MEASUREMENT AND PAYMENT**

### **8-4.1 Concrete**

#### **8-4.1.1 Measurement**

- (a) Measurement, for payment, of concrete required to be placed directly upon or against surfaces of excavation will be made to the lines for which payment for excavation is made.
- (b) Measurement, for payment, of all other concrete will be neat lines of the structures as shown on the Drawings unless otherwise prescribed in this Specification.
- (c) In measuring concrete for payment, deductions will be made for the volume of all ducts, embedded pipes, surface conduits and drains, recesses for rails and gate guides in first stage concrete, embedded metalwork and other blockouts having a cross-sectional area larger than  $0.10 \text{ m}^2$  as measured at right angles to their longitudinal axis. Deductions will also be made for all openings, recesses and block outs with cross-sectional areas less than  $0.10 \text{ m}^2$  but which have an individual volume larger than  $0.5 \text{ m}^3$ .
- (d) Measurement, for payment, for concrete required for treatment of defects outside the excavation pay lines other than in excavation for underground works will be made for the actual volume of concrete directed to be placed in these locations.
- (e) Measurement, for payment, of backfill / dental concrete will be made of the actual volume of concrete placed as directed by the Engineer.

#### **8-4.1.2 Payment**

- (a) Payment for concrete in the various parts of the Works will be made at the applicable rates per cubic metre tendered in the priced Bill of Quantities. These rates shall include the cost of all labor, constructional plant, formwork and materials including cement required in the construction, except that payment for providing and placing or installing reinforcing bars and fabric, waterstops, PVC cap seal for joints and joint

- fillers will be made in accordance with Clauses 8-4.2, 8-4.6, 8-4.7 and 8-4.8 respectively.
- (b) Except as provided in Sub-Clause 8-4.1.1(e), payment will not be made for concrete required to be placed outside specified or approved excavation pay lines due to over-breakage, excess excavation or wasted concrete, or for any other reason.
  - (c) Direct payment will not be made for cement used in concrete, mortar, shot Crete, dry-pack or grout other than cement in pressure grouting. Payment for furnishing and handling cement for pressure grouting will be made as provided in Section 10, Foundation Grouting.
  - (d) The cost of producing or providing aggregates required under this Specification shall be included in the rates tendered in the priced Bill of Quantities for the various grades of concrete construction in which the aggregate is used.
  - (e) The Contractor will not be entitled to any additional payment for materials wasted from deposits, including crusher fines, excess material of any of the sizes into which the aggregates are required to be separated by the Contractor and materials which have been discarded by reason of being above the maximum sizes specified for use.
  - (f) The cost of contraction joints shall be included in the rate tendered in the priced Bill of Quantities for the concrete in which the joints are required except that payment for waterstops if required, will be made as provided in Clause 8-4.6-Waterstops.
  - (g) The cost of expansion joints shall be included in the rate tendered in the priced Bill of Quantities for the concrete in which the joints are required except that payment for waterstops, joint filler and bond breaking coat if required, will be made as provided in Clauses 8-4.6, 8-4.8 & 8-11.9 respectively.
  - (h) The cost of all labor and materials for forms and for any necessary treatment or coating of forms shall be included in the rates tendered in the priced Bill of Quantities for concrete for which the forms are used.
  - (i) All materials, labor and construction plant required for the repair of concrete shall be provided at the expense of the Contractor.
  - (j) No payment will be made for the backfill / dental concrete to fill the over excavation due to negligence and fault of Contractor.
  - (k) The cost of placing concrete in blockouts, and dry pack and grout under base plates of metalwork supplied and installed by the Contractor shall be deemed to be included in the rates tendered in the priced Bill of Quantities for various items of metalwork in accordance with Section 13, Miscellaneous Metalwork.
  - (l) No separate payment will be made for injection of cement grout or epoxy grout for filling the gap or cavity with in hardened concrete.

#### **8-4.1.3 Unit of Measure**

Unit of measure: Cubic Meter

### **8-4.2 Reinforcing bars and fabric**

#### **8-4.2.1 Measurement**

Measurement, for payment, of providing and placing reinforcing bars and fabric will be made only of the calculated mass of the bars placed in the concrete in accordance with the Drawings or as directed. The calculated mass for reinforcing bars and fabric shall be determined as follows:

- (a) Reinforcing bars – The calculated mass shall be based on the mass per meter calculated from nominal diameter of the reinforcing bar and the mass density of steel of 7,850 kg per cubic meter.

- (b) Reinforcing Fabric – The calculated mass shall be based on the mass per unit area of the fabric based on the theoretical area of the bars and spacing and the mass density of steel of 7,880 kg per cubic meter.
- (c) All joints or splices shown on the Drawings or directed will be measured for payment as laps. Mechanical coupling approved by the Engineer, will be measured for payment in terms of length of equivalent lap joint. Additional joints or splices will not be measured for payment.

#### **8-4.2.2 Payment**

- (a) Payment for providing and placing high tensile Grade 60 reinforcing bars will be made at the rate per tonne tendered thereof in the priced Bill of Quantities.
- (b) Payment for providing and placing reinforcing steel fabric mesh-Grade 40 will be made at the rate per tonne tendered thereof in priced Bill of Quantities.
- (c) These rates shall include the cost of preparing reinforcement detail drawings, scheduling reinforcement and of furnishing and attaching wire ties and metal, concrete of other supports, of cutting, bending, cleaning, securing and maintaining in position all reinforcing bars. Payment will not be made for joints or splices except as provided Sub-Clause 8-3.3.2(d) – Splicing of this Clause, nor for reinforcement used in miscellaneous precast concrete units.

#### **8-4.2.3 Unit of Measure**

Unit of measure: Tonne

### **8-4.3 Precast Prestressed Concrete Members**

#### **8-4.3.1 Measurement**

Measurement of precast prestressed concrete member Grade C-33 shall be made as per dimension shown on drawings.

#### **8-4.3.2 Payment**

Payment for providing and installing various Precast Prestressed Concrete members will be made at the rate per cubic meter tendered thereof in the priced Bill of Quantities. The rate includes all reinforcement strands etc required as per drawings and all associated works required for completion of the item.

#### **8-4.3.3 Unit of Measure**

Unit of measure: Cubic Meter

### **8-4.4 Mortar and Concrete for Foundation Preparation**

#### **8-4.4.1 Measurement**

Mortar and concrete used in foundation and abutment preparation will be measured for payment in place based upon the established limit lines and the payment lines indicated on the cross sections shown or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation including the cut-off trench and accomplishment of foundation preparation (except scarifying) and the lines, grades and slopes of the accepted embankment. Mortar and concrete used in filling spaces beneath rock overhangs and around protrusions as specified in Clause 7-3.1.2 -Rock, will be measured for payment as the actual volumes of such mortar and concrete as determined by field surveys made before and

after placement of the mortar and concrete.

#### **8-4.4.2 Payment**

Payment will be made for costs associated with manufacturing, furnishing, delivering, placing, finishing, and curing of mortar and concrete for foundation and abutment preparation,

#### **8-4.4.3 Unit of Measure**

Unit of measure: Cubic Meter.

### **8-4.5 Waterstops**

#### **8-4.5.1 Measurement**

Measurement, for payment, of providing and placing PVC water stops will be made only of the lengths placed in accordance with the Drawings or as directed. No allowance will be made for laps at joints. Waterstops installed by the Contractor in construction joints in locations other than those shown on the Drawings or directed will not be measured for payment.

#### **8-4.5.2 Payment**

Payment for providing and placing, PVC water stops will be made at the applicable rate per linear meter tendered thereof in the priced Bill of Quantities.

#### **8-4.5.3 Unit of Measure**

Unit of measure: Linear Meter

### **8-4.6 Bond Breaking Coat**

#### **8-4.6.1 Measurement**

Measurement for payment of providing & placing bond breaking bituminous coat will be made as for surface area in plan.

#### **8-4.6.2 Payment**

Payment for providing & placing bond breaking bituminous coat will be made at the rate per square meter tendered thereof in the priced Bill of quantities.

#### **8-4.6.3 Unit of Measure**

Unit of measure: Square Meter

### **8-4.7 Epoxy Mortar**

The cost of providing and placing epoxy mortar in blackout and under base plates of metalwork supplied and installed by the Contractor shall be deemed to be included in the rates tendered in the priced Bill of Quantities for various items of metalwork in accordance with Section 13, Miscellaneous Metalwork.

**SECTION 9 - STONEMWORK****9-1.1 Stones**

- (1) Stone for all purposes shall be the best of its kind, sound and durable, free from flaws and from soft, weathered or decomposed parts. The stone and the quarry from which it is obtained shall be subject to the approval of the Project Manager, samples shall be submitted by the Contractor of the stone he proposes to use in the Works and the Project Manager's approval shall be obtained before such stone is used or any order is placed. The stone used shall be clean and must be washed if deemed necessary in the opinion of the Project Manager.
- (2) Stones for face work shall be as far as possible quarry split and not bull nosed or hammer dressed. A moderate amount of dressing to trim off large projections will however be permitted. Exposed faces of stones for masonry shall be free from tool marks except such as are inherent in the nature of any dressing that may be specified. In rock-faced work the roughness on the surface shall not project more than thirty eight millimeters (38mm) for stone less than one third of a square meter ( $1/3m^2$ ) face area and not more than sixty two millimeters (62mm) for large stones.

**9-1.2 Masonry**

- (1) Masonry shall be built to the lines and levels shown on the Drawings.
- (2) For face work the stones shall show a face of not less than two hundred and sixty square centimeters ( $260cm^2$ ) and not more than nine hundred and seventy square centimeters ( $970cm^2$ ) in area and none shall be less than one hundred and thirty millimeters (130mm) in depth; they shall be laid to give a uniformly random appearance and shall be selected in laying so as to present an even distribution of large and small stones on the face.
- (3) For the arises, stones shall be roughly squared, quarry split and of a size to give out bands varying from three hundred fifty six millimeters to four hundred sixty millimeters (356mm to 460mm) in length and in bands from one hundred fifty to two hundred fifty millimeters (150mm to 250mm). The alignment of arises shall be set true to the required lines.
- (4) The stones shall be set in mortar with their natural bedding plane (if any) as near normal as possible to the face or normal to the line of thrust in the case of load bearing structures. Particular care must be given to obtaining a sound bond both longitudinally and transversely and there shall be at least one bond or length not less than two-thirds of the wall thickness, in each square yard of wall face.
- (5) The mortar, unless otherwise specified, shall be machine mixed cement and sand in the proportion of one part to three (1:3) parts generally as described in the specification. Mortar shall completely fill all interstices between the stones.
- (6) The face joints in rubble masonry may vary in thickness from ten millimeters (10mm) to nineteen millimeters (19mm). They shall be finished as a neat weathered joint with mortar while the work proceeds where the masonry is specified to be "unpointed". Where pointing is specified, the joints in each day's work shall be raked out to a depth of not less than twenty five millimeters (25mm) before the mortar has set. Subsequently the joint shall be filled with mortar and finished in accordance with Clause 406. The face of the masonry is to be kept wet while the pointing is proceeding. Provision shall be

made to clean all exposed faces both as work proceeds and on completion so that they are left in a neat, tidy and clean condition.

- (7) Building of masonry will not be allowed in heavy rain without the written consent of the Project Manager. Building shall only proceed when suitable precautions to the satisfaction of the Project Manager shall be taken against the action of rain on newly placed mortar. If for any reason of urgency the consent of the Project Manager should be desired to a departure from these provisions, the Contractor shall submit to the Project Manager for approval their proposals for protecting the materials and work from the weather.

### **9-1.3 Types of Masonry**

The arrangement of the stones on the exposed face or faces of the masonry shall be as described below according to which type is called for on the Drawings.

- a. Random rubble uncoursed masonry shall be built with stones of irregular shapes taken generally as they come from the quarry, preparation being limited to the removal of inconvenient corners and excrescences appearance and no attempt shall be made to form courses.
- b. Random rubble masonry brought to courses shall be generally as the preceding type except that it shall be leveled up to courses between three hundred and four hundred ten millimeters (300mm to 410mm) in depth and coinciding with the quoins stones.
- c. Squared rubble coursed masonry shall be built in courses between hundred and two hundred twenty five millimeters (100 to 225mm) in depth of stones squared to rectangular shapes and selected so that all stones in one course are of approximately the same height.

### **9-1.4 Bedding of Masonry Stones**

Unless otherwise directed by the Project Manager, all masonry stones, when incorporated in the Works shall be laid on its natural bed, except in the case of arches where the natural bed shall be radial.

### **9-1.5 Special Stonework**

Special stonework shall consist of approved stones dressed to the shapes and dimensions and with the faces tooled, all as shown on the Drawings. All stones shall be laid true to line and center with mortar joints as shown on the Drawings.

### **9-1.6 Pointing of Joints in Masonry**

Unless otherwise shown on the Drawings, pointing to masonry joints shall be flush and shall be formed by raking the joint clean and then filling it with pointing consistency mortar which shall be given a flush face with a steel trowel.

### **9-1.7 Stone Masonry Armoring to Weirs**

- (1) Stone masonry armoring shall be provided where specified on the drawings to give a hard wearing surface to weirs and other structures subject to aggressive abrasion.
- (2) The stone used for the stone armoring of weirs shall be from metamorphic limestone rock and from a source and of a type approved by the Project Manager. The stone shall be extremely hard and durable, of the best of its kind and free from flaws, soft, weathered or decomposed parts. Samples of the stone proposed for use in the works shall be provided to the Project Manager and written approval shall be obtained before such stone is used or any order placed.

- (3) The stone shall be shaped to the dimensions shown on the Drawings and the surfaces dressed to the quality of finish as detailed on the Drawings and Specification. The stones shall be shaped and dressed in such a manner as the natural quarry bed or cleavage plane is always parallel to the face of the weir surface and the stresses borne by the stone are normal to the bedding or cleavage plane.
- (4) Stone arriving from the quarry will usually have had irregular angles taken off using a scrabbling hammer, when the stone is described as being quarry pitched, hammer faced, or hammer blocked. This face is then roughly dressed by Waller's hammer to produce a hammer dressed or scrabbled face finish.
- (5) A chisel dressed face (also called two-line dressed face) is produced by a second sparrow pitch or chisel dressing of a rough tooled face. No portion of the dressed face shall be more than four millimeters (4mm) from a straight edge placed on it. Chisel dressed face is analogous to medium pointed finish.
- (6) The sizes and tolerances of the individual stones and face finishes are as given on the Drawings and as specified. The stones shall generally have an upper exposed face of two hundred twenty five by two hundred twenty five millimeters (225mmx225mm), but with an area not less than four hundred sixty five square centimeters (465 cm<sup>2</sup>). The bottom face of the stone shall be parallel to the top in order to achieve a good bond with the bedding concrete. The bottom face shall generally be one hundred seventy eight by one hundred seventy eight millimeters (178mmx178mm) but with an area not less than three hundred and seven square centimeters (307cm<sup>2</sup>). The overall depth of the stone shall be not less than one hundred fifty millimeters (150mm) and not greater than two hundred millimeters (200mm).
- (7) The surface on which the armoring is to be placed shall be clean and sound. Where the existing surface of the weir has already been subject to abrasion by the river bed material, it is likely that no mechanical cleaning or roughening is required. The surface should be closely inspected to ensure that it is sound, with no loose or scaling material, that it is not too smooth (concrete surfaces shall have an exposed aggregate finish) and that it is free from dust, plaster, oil, paint, grease, algae or weed growth or any other deleterious substances.
- (8) Where the armoring is to be applied to new concrete, and no mechanical key by way of reinforcement is provided, the surface shall be mechanically roughened by scrabbling or needle gun or manually with hammers to remove laitance and produce a rough exposed aggregate finish. The surface shall then be thoroughly cleaned with air and/or water jets to ensure that it is free from dust, oil, grease or any other deleterious substance.
- (9) The surface on which concrete is to be placed shall be thoroughly dampened with water and any excess removed before fresh Class A concrete is placed. Unless otherwise directed by the Project Manager the surface shall be primed by thoroughly scrubbing with slurry coat comprising 1 volume clean fresh water to 3 volumes fresh cement.
- (10) The Class A concrete shall comply with the specification and characteristic strength of concrete Class A, except that the maximum size of aggregate shall be thirteen millimeters (13mm) and the nominal mix proportion, of 1:1.5:3 is intended as a guide only. The Contractor shall carry out trials to determine the optimum mix and water/cement ratio which gives required characteristics for bedding and anchoring the masonry armoring with absolutely no voids between the stones



- (11) The individual stones shall be set in the fresh Class A concrete within three hours of discharge from the mixer, or such other time as determined from trials on site and directed by the Project Manager. The thickness of the Class A concrete under the stone armoring shall be as determined by trials and as directed by the Project Manager on Site but shall not be more than one hundred fifty millimeters (150mm) or less than seventy five millimeters (75mm).
- (12) The stone armoring shall be laid in an interlocking bond pattern as shown on the Drawings. Under no circumstances shall the joint between any stones in any two adjacent rows be aligned together in the direction of the water flow.
- (13) The stone armoring shall be laid, tamped and bedded in concrete to produce an exactly flat surface, level or sloping to the lines and levels shown on the Drawings.
- (14) The weir crest shall be exactly level as shown on the Drawings with only variations up to five millimeters (5mm) from a six hundred millimeters (600mm) straight edge placed anywhere along the length of weir crest. The tolerance on other faces of the weir, such as the upstream or downstream slopes and stilling basin, shall not exceed five millimeter (5mm) from a six hundred millimeters (600mm) long straight edge or twelve millimeters (12mm) from a one thousand two hundred millimeters (1200mm) long straight edge. Any discontinuity between adjacent stones shall not exceed two millimeters (2mm) on any surface.
- (15) Subject to the above, the Contractor shall adopt the following procedure for installing stone masonry armoring:
  - The Class A concrete shall be applied in an even layer, on such depth and over such an area as will permit the masons to properly place and compact the stone into the wet concrete. The Contractor shall undertake such trials as are necessary in order to determine the optimum method of placing the stone in the wet concrete, the depth of the concrete layer and the extent of the working area for the concrete in advance of the stone laying operation. The concrete shall be freshly laid and under no circumstances shall be reworked to increase workability.
  - The stones shall be hammered into the fresh concrete to the required level when the voids between the stone being laid and previous stones shall be completely filled with concrete and the concrete fines and grout is extruded through the joint between the stones at the top surface. On no account shall the joint between the stones be filled with concrete, mortar or grout from the top. Any final pointing or finishing of the joints between the stones shall only be carried out with the express permission of the Project Manager.
- (16) The Contractor shall obtain the written approval of the Project Manager to the method of placing the stone following completion of the trials and prior to commencing the main works. Under no circumstances shall any deviation from the agreed placement method be considered without the written approval of the Project Manager.

### **9-1.8 Hand Placed Rubble Filling**

Hand placed rubble fillings shall consist of stones individually selected and placed by hand firmly in place in bearing contact with each other or with the sides of the space to be filled; the voids shall be carefully filled with small rocks and spalls wedged

together to form a compact mass. The sides of stones shall be roughly trimmed if necessary the exposed face the stones shall be placed with their flattened sides uppermost and in the plane of the face.

### 9-1.9 Tipped Rock/Pitching

- (1) Rock protection on embankment slopes and around structures shall be to the lines and levels shown on the contract Drawings. The terms "tipped rock" and "pitching" refer to the manner in which the rock is placed.
- (2) The different classes of rock are specified on the Drawings according to nominal size and the maximum and minimum size of the individual particles. Within the size limits of each class, the rock fragments shall be well graded with not more than forty per cent (40%) of the rocks being smaller than the stated nominal size. The shape of the rock shall be roughly uniform with no dimension less than sixty per cent (60%) of the largest dimension. The individual rock pieces shall be dense, durable and abrasion resistant.
- (3) The Contractor shall submit bulk samples of not less than two cubic meters ( $2\text{m}^3$ ) of each class of rock for approval by the Project Manager prior to placing. These samples shall be retained for comparison with material being placed in order to ensure a reasonable degree of uniformity within each class.
- (4) The base on which rock protection is to be placed shall be compacted and trimmed to the lines and levels shown on the drawings. Where two or more classes of rock are specified, the lower layers shall be completed to the Project Manager's approval before the placing of subsequent layers.
- (5) Tipped Rock shall be tipped directly in place and roughly trimmed to the required profile. The thickness, lines and levels of each class of tipped rock is shown on the Drawings.
- (6) Pitching will be used where a finished horizontal or inclined surface is required. It shall consist of hand placed stones, with spalls wedged into the interstices to produce an even surface, without projection above the neat lines shown on the Drawings. Care shall be taken to ensure that the stones are well bedded and the percentage of spalls shall not exceed forty per cent (40%) of the total rock volume. Pitching on slopes shall be built upwards from the toe, unless otherwise directed by the Project Manager. A coping consisting of large flat stones shall be laid along the top of stone pitching on slopes to produce a firm edge.

### 9-1.10 Gabions

- (1) Gabions shall be of the types and sizes shown on the Drawings. The cages shall be constructed from mild steel wire complying with BS 1052, "Specification for mild steel wire for general engineering purposes", galvanized in accordance with BS 443, "Specification for testing zinc coatings on steel wire and for quality requirements". The wire shall be four millimeters (4mm) diameter formed into a fabric having a mesh of seventy five by hundred millimeters (75mm x 100mm).
- (2) Stone filling for gabions shall consist of hard durable rock, free from weathered or decomposed parts. The minimum dimensions of each stone shall not be less than half its maximum dimension. For mattresses the stone shall be two hundred twenty five to one hundred fifty millimeters (225mm to 150mm), for baskets the stone shall be three hundred to two hundred twenty five millimeters (300mm to 225mm), The stone shall be obtained from a source approved by the Project Manager. No stone shall be smaller than the size of the

- gabion mesh. In carrying out the filling, selected pieces of stone of elongated shape shall be placed with their flatter and elongated faces in contact with the mesh wherever possible.
- (3) The empty gabions shall be placed to line and level as shown on the Drawings or as directed by the Project Manager and then stretched so that the gabions regain their shape on being filled. Diaphragms shall be provided at not more than one meter (1m) intervals for baskets and not more than one and quarter meter (1.25m) intervals for mattresses. A gabion shall not be completely filled until the adjacent basket or mattress has been half filled, unless otherwise directed, in order not to cause displacements from bulging during filling.
  - (4) For baskets at least two horizontal connection wires shall be tied between front and back of the gabion in each nine hundred millimeters (900mm) compartment, at a height of three hundred millimeters (300mm) and six hundred millimeters (600mm) from the bottom as the stone fill reaches these levels. Additional tie wires shall be provided if necessary and in no case shall the gabion basket bulge by more than twelve millimeters (12mm). Where a continuous line of gabions is required, adjacent gabions shall be securely tied together at the top and bottom of the gabions with tying wire.
  - (5) The gabions shall be filled to a level just sufficient to require the lid to be forced into place with a bar. The lid and all joints between baskets and between diaphragms and baskets shall each be tied down with a continuous running wire.
  - (6) Where gabions are to be shaped, the shape shall be formed by folding the mesh internally and tying it with a continuous running wire.
  - (7) All tying wire shall be galvanized and of same gauge as specified for the cages above.

### 9-1.11 Graded Filters

- (1) The filter shall consist of well graded natural or manufactured aggregate having the following gradation. In the following ratios, FM represents the filter material and BM the base material.

For graded filters of sub-rounded particles:

$$R_M = \frac{50\% \text{ size FM}}{50\% \text{ size BM}} = 12 \text{ to } 58$$

and

$$R_{15} = \frac{15\% \text{ size FM}}{15\% \text{ size BM}} = 12 \text{ to } 40$$

For graded filters of angular particles:

$$R_{60} = \frac{50\% \text{ size FM}}{50\% \text{ size BM}} = 9 \text{ to } 30$$

and

$$R_{15} = \frac{15\% \text{ size FM}}{15\% \text{ size BM}} = 6 \text{ to } 18$$

15% size BM

- (2) The filter material should pass a three inch screen for minimizing particle segregation and bridging during placement. Also the filter must not have more than five per cent (5%) of material finer than that passing a No 200 sieve to prevent movement of fines within the filter.
- (3) The filter shall be placed in layers and tamped into place in such a manner that mixing between layers or between the filter material and the formation to be protected, shall not occur.
- (4) Care shall be taken to ensure that segregation of sizes does not occur. The minimum thickness of each filter layer shall be 250mm unless otherwise shown on the Drawings.

## **9.2 Construction Requirements**

### **9.2.1 Mixing of Mortar**

Methods and equipment used for mixing mortar shall be such that each ingredient entering into the mortar shall be subject to the approval of the Engineer. If a mixer is used, it shall be of approved design and the mixing time after all the ingredients are in the mixer, except the full amount of water, shall be not less than two minutes.

Mortar shall be mixed only in sufficient quantities for immediate use. All mortar not used within thirty (30) minutes after addition of the water to the mix shall be wasted. Retempering of mortar will not be allowed. Mixing troughs and pans shall be thoroughly cleaned and washed at the end of each day's work.

### **9.2.2 Curing**

All stonework shall be cured for at least seven (7) days after laying. The curing method shall be to the satisfaction of the Engineer.

## **9.3 Measurement and Payment**

### **9.3.1 Measurement**

Measurement of stonework shall be made to the lines of the structures as shown on the Drawings or as modified by the Engineer for the appropriate items in which such stonework is incorporated.

The quantities to be measured shall be the number of cubic meters of stonework laid and accepted.

### **9.3.2 Payment**

The quantities measured in cubic meters (CM) shall be paid for at the contract unit price listed below and shown in the Bill of Quantities, which prices and payment shall be full compensation for furnishing all materials, labor, equipment and incidentals for performing all the work involved.

**SECTION 10 – MISCELLANEOUS METALWORK****PART 1 GENERAL****10-1.1 References**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)**

AISC 303 (2000) Code of Standard Practice for Steel Buildings and Bridges

**AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**

ANSI A10.3 (1995) Operations -- Safety Requirements for Powder Actuated Fastening Systems

ANSI B18.2.1 (1996; Errata 2003) Square and Hex Bolts and Screws Inch Series

ANSI B18.6.2 (1972; R 1993) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws

ANSI B18.6.3 (1972; R 1997) Machine Screws and Machine Screw Nuts

**AMERICAN WELDING SOCIETY (AWS)**

AWS D1.1/D1.1M (2002) Structural Welding Code - Steel

**ASME INTERNATIONAL (ASME)**

ASME B18.2.2 (1987; R 1999) Square and Hex Nuts

ASME B18.21.2M (1999) Lock Washers (Metric Series)

ASME B18.22M (1981; R 2000) Metric Plain Washers

**ASTM INTERNATIONAL (ASTM)**

ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2003) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 307 (2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 36/A 36M (2003a) Carbon Structural Steel

ASTM A 500	(2003) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M, Z275	(2003) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

**THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)**

SSPC SP 3 (1982; R 2000) Power Tool Cleaning

SSPC SP 6 (2000) Commercial Blast Cleaning

**U.S. GENERAL SERVICES ADMINISTRATION (GSA)**

FS TT-P-664 (Rev D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant

**U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)**

29 CFR 1910.27 Fixed Ladders

**10-1.2 Submittals**

The following shall be submitted for Engineer's review and approval in accordance with Clause 1-1.4 - Submittal Procedures:

**SD-02 Shop Drawings**

- Handrails, installation drawings
- Ladders, installation drawings
- Embedded angles and plates, installation drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

**SD-03 Product Data**

- Handrails
- Ladders

**SD-04 Samples**

- Control-joint covers

Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

**10-1.3 Qualification of Welders**

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

**10-1.4 Delivery, Storage, and Protection**

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

**PART 2 PRODUCTS****10-2.1 Materials****10-2.1.1 Structural Carbon Steel**

ASTM A 36/A 36M.

**10-2.1.2 Structural Tubing**

ASTM A 500.

**10-2.1.3 Steel Pipe**

ASTM A 53, Type E or S, Grade B.

**10-2.1.4 Fittings for Steel Pipe**

Standard malleable iron fittings ASTM A 47M.

**10-2.1.5 Anchor Bolts**

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

- (a) Lag Screws and Bolts

ANSI B18.2.1, type and grade best suited for the purpose.

- (b) Toggle Bolts

ANSI B18.2.1.

- (c) Bolts, Nuts, Studs and Rivets

ASME B18.2.2 and ASTM A 687 or ASTM A 307.

- (d) Powder Driven Fasteners

Follow safety provisions of ANSI A10.3.

- (e) Screws

ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3.

- (f) Washers

Provide plain washers to conform to ASME B18.22M. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.2M.

**10-2.2 Fabrication Finishes****10-2.2.1 Galvanizing**

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123/A 123M, ASTM A 153/A 153M or ASTM A 653/A 653M, Z275, as applicable.

**10-2.2.2 Galvanize**

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

**10-2.2.3 Repair of Zinc-Coated Surfaces**

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by application of sticky or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which sticky or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

**10-2.2.4 Shop Cleaning and Painting****(a) Surface Preparation**

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

**(b) Pretreatment, Priming and Painting**

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 0.03 mm. Tint additional prime coat with a small amount of tinting pigment.

**10-2.2.5 Non-Ferrous Metal Surfaces**

Protect by plating, anodic, or organic coatings.

**10-2.3 Manhole Cover and Frame**

Provide a heavy-duty type made of ductile cast-iron with bolted lid, machined bearing surfaces. Provide frame with a 760 mm diameter clear opening. Maximum weight of frame and cover together to be 240 kg.

**10-2.4 Steel Handrails / Guard Rails for Roads**

Supply and install Steel Handrails / Guard Rails for Road as shown in Drawings.

**10-2.4.1 Steel Handrails, Including Carbon Steel Inserts**

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A 53 or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Provide steel railings of nominal size shown in Drawings. Railings to be hot-dip galvanized and shop painted.

(a) Fabrication: Joint posts, rail, and corners by one of the following methods:

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 10 mm hexagonal-recessed-head setscrews.



- (2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 150 mm long.
  - (3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.
- (b) Provide removable sections as indicated.

### **10-2.5 Ladders**

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 65 by 10 mm steel flats for stringers and 20 mm diameter steel rods for rungs. Rungs to be not less than 400 mm wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 175 mm. Provide heavy clip angles riveted or bolted to the stringer and drilled as indicated. Provide intermediate clip angles not over 1200 mm on centers.

## **PART 3 EXECUTION**

### **10-3.1 Installation**

Install items at locations indicated, according to manufacturer's instructions. Items listed below require additional procedures.

### **10-3.2 Anchorage, Fastenings, and Connections**

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

### **10-3.3 Built-in Work**

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

### **10-3.4 Welding**

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

### **10-3.5 Finishes**

#### **10-3.5.1 Dissimilar Materials**

Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

#### **10-3.5.2 Field Preparation**

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

#### **10-3.5.3 Environmental Conditions**

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than -15 degrees C above the dew point of the surrounding air, or when surface temperature is below 7 degrees C or over 35 degrees C, unless approved by the Contracting Officer.

### **10-3.6 Steel Handrails / Guard Rails for Roads**

**10-3.6.1 Steel Handrail**

Install handrails as shown in Drawings.

**10-3.6.2 Guard Rails for Roads**

Install Guard Rails as shown in Drawings

**10-3.7 Ladders**

Secure to the adjacent construction with the clip angles attached to the stringer where approved by the Engineer. Install intermediate clip angles not over 1200 mm on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. In no case shall ends of ladders rest upon finished roof or floor.

**10-4.1 Metalwork Fabrication and installation****10-4.1.1 Measurement**

Metalwork fabrication and machine work for which payment is not otherwise specifically provided in these specifications, will be measured for payment based upon computed weights per fabricated piece, assembly or cast piece for the various metals as classified on the approved detail drawings except as indicated below. Computed weights shall be indicated on the detail drawings submitted for approval. Approval of the detail drawings will constitute acceptance of the computed weights shown thereon. When measurement of complicated shapes can be determined more readily by scale weights per fabricated piece, cast piece or assembly the use of certified scale weights will be approved as the basis for measurement.

**(a) Computed Weights**

Weights for payment shall be the net calculated weights based on the dimensions indicated on the detail drawings. The weight of rolled shapes and plates shall be computed on the basis of their nominal weights and dimensions. In calculating the net weights all copes, cuts and open holes except rivet and bolt holes shall be deducted. No additional weight shall be calculated for overweight allowance, protective coatings, allowance for milling, grip length of rivets and bolts and butt and groove welds. The weight of castings including fillets shall be computed on the basis of the dimensions shown on the detail drawings with deductions for all openings and cuts in the finished casting. Computed weights for fillet welds, rivets, bolts and cut washers shall be included in accordance with the following:

**ALLOWANCES FOR WEIGHT OF EQUAL-LEG FILLET WELDS**

<b>Leg of weld in Millimeters</b>	<b>Kilograms per meter Length of weld</b>
3	0.045
5	0.089
6	0.160
8	0.250
10	0.360
11	0.490
13	0.630
16	0.980
19	1.400
22	1.900
25	2.500

Note: For unequal-leg fillet welds the weight corresponding to the smaller leg in the above listing shall be multiplied by the ratio of the longer leg to the smaller leg.

**ALLOWANCES FOR WEIGHT OF RIVET HEADS**

<b>Diameter in Millimeters</b>	<b>Kilograms per 100 heads</b>
13	1.8
16	3.2

19	5.4
22	8.2
25	12.0
29	16.0
32	22.0
35	27.0
38	37.0

#### ALLOWANCES FOR WEIGHT OF BOLTS - REGULAR SIZE

Diameter in Millimeters	Kilograms per 100 units
13	6.12
16	12.20
19	20.00
22	31.30
25	46.70
29	68.50
32	92.10

#### ALLOWANCES FOR WEIGHT OF BOLTS - HEAVY SIZE

Diameter in Millimeters	Kilograms in 100 units
13	9.1
16	16.3
19	27.7
22	41.7
25	61.2
29	86.2
32	113.0
38	195.0
44	311.0
50	454.0
57	635.0
64	855.0
70	1100.0
75	1460.0

Note: Allowances for bolts are based on weight data given in AISC manual. Allowances consist of weight of square head, bolt shank (in and projecting beyond nut) and hexagonal nut and shall apply to all type bolts without modification. Projections beyond nuts are assumed equal to 1/2 the bolt diameter up to M50 size bolts and 25 mm for bolt sizes M50 and above. Where the number and size of another type of bolt would result in a significant difference in a pay item the allowances given above should be supplemented to include the additional type of bolt.

#### ALLOWANCES FOR WEIGHT OF CUT WASHERS

Bolt Diameter in Millimeters	Kilograms of 100 units
13	2.02
16	4.04
19	5.94

22	7.21
25	9.71
29	11.70
32	15.20
35	20.10
38	22.00
44	28.80
50	35.90
57	48.50
64	57.60
70	68.90
75	84.40

Note: Each unit comprise cut washer and bolt shank in depth of washer.

The following weights, per cubic millimeter, will be used in computing weights of metalwork:

Iron Castings .....	7.20 mg
Steel (All Compositions) .....	7.83 mg
Copper, Bronze, Brass; Nickel-Copper Alloy .....	8.61 mg
Lead .....	11.30 mg
Aluminum .....	2.77 mg
All Other Metals .....	7.83 mg

#### (b) Scale Weights

Shop scale weight measurements shall be made in the presence of the Contracting Officer unless otherwise specifically authorized. The weight of erection bolts, nuts and washer's boxes, crates and other containers used for packing and the materials used for supporting members during transportation shall not be included in the scale weights. It shall be the responsibility of the Contractor to prepare the shipping lists required in Clause 13-1.2 - Submittals in a format to allow the correct allocation of the scale weights of individual metal parts and members to the applicable payment classifications. Failure to comply with this requirement to the satisfaction of the Contracting Officer will necessitate measurement of computed weights. The weight of shop applied permanent protective coatings shall not be deducted from scale weights.

#### 10-4.1.2 Payment

Payment will be made for costs associated with metalwork fabrication and machine work not specifically provided for elsewhere, which includes costs for materials, fabricating work, shop and field painting, galvanizing or other metallic coatings and the installation of metal items shown or required by these specifications unless otherwise specified. No separate payment will be made for bolts, nuts, pins, washers, studs and strap hangers and the cost of such items shall be included in the unit prices of items on which they are used. No separate payment will be made for the inspection of welds.

#### 10-4.1.3 Unit of Measure

Unit of measure: Kilogram.

#### 10-4.2 Ladders

##### 10-4.2.1 Measurement

Measurement for payment will be made on number of Ladders of given lengths installed and will cover all associated cost for the same.

##### 10-4.2.2 Payment

Payment will be made for the number of Ladders of given length installed & at the respective rate tendered in Bill of quantities and will cover all associated cost for the same.

##### 10-4.2.3 Unit of Measure

Unit of measure: Each

**10-4.3 Hand Rails****10-4.3.1 Measurement**

Measurement for payment will be made as linear metre length of acceptably furnished and installed different types of hand rails as shown in the drawings and shall cover all associated cost for completing the items of work as shown in the drawings.

**10-4.3.2 Payment**

Payment will be made for the length of different types of hand rails as measured above at the respective rates tendered thereof in the priced Bill of Quantities and shall cover all associated cost for completing the different items of work.

**10-4.3.3 Unit of Measure**

Unit of measure: Linear Meter.

**GENERAL SPECIFICATIONS**

*(TECHNICAL SPECIFICATIONS FOR WORKMANSHIP MRS-2021 KPK)*