

**Tender Fee: Rs. 5,000/-  
(Non-Refundable)**

## **TENDER FORM**

### **Tender # CW/15/24-25**

#### **Rehabilitation of existing Metaled Road from Maskan Gate to Pharmacy Intersection at Karachi University**

**Date of Issue : January 10, 2025**  
**Last Date of Submission : January 29, 2025 (3:00 pm)**  
**Date of Opening : January 29, 2025 (3:30 pm)**

**Company Name:** \_\_\_\_\_

**NTN:** \_\_\_\_\_

**SRB / GST Registration Number:** \_\_\_\_\_

**Pay Order / Demand Draft # \_\_\_\_\_, Drawn on Bank \_\_\_\_\_**

**Amount of Rs. \_\_\_\_\_, Dated: \_\_\_\_\_**

**REHABILITATION OF EXISTING METALLED  
ROAD FROM MASKAN GATE TO  
PHARMACY INTERSECTION AT KARACHI  
UNIVERSITY**

**CONDITIONS OF  
CONTRACT (DEC.-2024)**

1st Floor, IEP Building, 177/2, Liaquat  
Barracks Main Shahrah-e-Faisal, Karachi-  
75530, Pakistan Tel: +92 213 278 0684-6  
[www.aiengineers.com](http://www.aiengineers.com)

# **VOLUME 1**

## **Conditions of Contract**

Notice Inviting Tender  
Instructions to Bidders  
Bidding Data  
Forms & Appendices to Bid

## TABLE OF CONTENTS

Description	Page No.
<b>INVITATION FOR BIDS</b>	<b>5</b>
<b>Form</b>	<b>6</b>
<b>INSTRUCTIONS TO BIDDERS</b>	<b>7</b>
<b>A. General</b>	
IB.1 Scope of Bid	<b>8</b>
IB.2 Source of Funds	<b>8</b>
IB.3 Eligible Bidders	<b>8</b>
IB.4 One Bid Per Bidder	<b>9</b>
IB.5 Cost of Bidding	<b>9</b>
IB.6 Site Visit	<b>9</b>
<b>B. Bidding Documents</b>	
IB.7 Contents of Bidding Documents	<b>10</b>
IB.8 Clarification of Bidding Documents	<b>10</b>
IB.9 Amendment of Bidding Documents	<b>10</b>
<b>C. Preparation of Bids</b>	
IB.10. Language of Bid	<b>11</b>
IB.11 Documents Accompanying the Bid	<b>11</b>
IB.12 Bid Prices	<b>11</b>
IB.13 Currencies of Bid and Payment	<b>12</b>
IB.14 Bid Validity	<b>12</b>
IB.15 Bid Security	<b>13</b>
IB.16 Alternate Proposals by Bidder	<b>13</b>
IB.17 Pre-Bid Meeting	<b>14</b>
IB.18 Format and Signing of Bid	<b>14</b>
<b>D. Submission of Bids</b>	
IB.19 Sealing and Marking of Bids	<b>16</b>
IB.20 Deadline for Submission of Bids	<b>17</b>
IB.21 Late Bids	<b>17</b>
IB.22 Modification, Substitution and Withdrawal of Bids	<b>17</b>

<b>E</b>	<b>Bid Opening and Evaluation</b>	
	IB.23 Bid Opening	<b>18</b>
	IB.24 Process to be Confidential	<b>18</b>
	IB.25 Clarification of Bids	<b>19</b>
	IB.26 Examination of Bids and Determination of Responsiveness	<b>19</b>
	IB.27 Correction of Errors	<b>20</b>
	IB.28 Evaluation and Comparison of Bids	<b>21</b>
<b>F</b>	<b>Award of Contract</b>	
	IB.29 Award	<b>22</b>
	IB.30 Procuring Agency's Right to Accept any Bid and to Reject any or all Bids	<b>23</b>
	IB.31 Notification of Award	<b>23</b>
	IB.32 Performance Security	<b>24</b>
	IB.33 Signing of Contract Agreement	<b>24</b>
	IB.34 General Performance of the Bidders	<b>25</b>
	IB.35 Integrity Pact	<b>25</b>
	IB.36 Instructions Not Part of Contract	<b>25</b>
	IB.37 Arbitration	<b>25</b>
	<b>BIDDING DATA</b>	<b>26</b>
	<b>FORMS OF BID AND APPENDICES TO BID</b>	<b>30</b>
	<b>FORM OF BID</b>	<b>31</b>
	Appendix-A to Bid : Special Stipulations	<b>33</b>
	Appendix-B to Bid : Foreign Currency Requirements	<b>35</b>
	Appendix-C to Bid : Price Adjustment (Under Clause 70)	<b>36</b>
	Appendix-D to Bid : Bill of Quantities	<b>37</b>
	Appendix-E to Bid : Proposed Construction Schedule	<b>38</b>
	Appendix-F to Bid : Method of Performing the Work	<b>39</b>
	Appendix-G to Bid : List of Major Equipment – Related Items	<b>40</b>
	Appendix-H to Bid : Construction Camp and Housing Facilities	<b>41</b>
	Appendix-I to Bid : List of Subcontractors	<b>42</b>
	Appendix-J to Bid : Estimated Progress Payments	<b>43</b>
	Appendix-K to Bid : Organization Chart of the Supervisory Staff and Labor	<b>44</b>
	Appendix-L to Bid : Integrity Pact	<b>45</b>
	<b>BID SECURITY</b>	<b>47</b>
<b>FORMS</b>	<b>PERFORMANCE SECURITY</b>	<b>49</b>
	<b>CONTRACT AGREEMENT</b>	<b>51</b>
	<b>MOBILIZATION ADVANCE GUARANTEE/BOND</b>	<b>53</b>

INDENTURE <b>FOR</b> SECURED ADVANCES	55
<b>PART-I: GENERAL CONDITIONS OF CONTRACT</b>	<b>60</b>
<b>PART-II: PARTICULAR CONDITIONS OF CONTRACT</b>	<b>61</b>

# INVITATION FOR BIDS

## NOTICE INVITING TENDER

The Institute of Business Administration (IBA), Karachi - South Asia's premier business school has arranged funds from its own resources towards the cost of Rehabilitation of existing Metaled Road from Maskan Gate to Pharmacy Intersection at Karachi University and is intended that the funds will be utilized to make eligible payments under the Contract for the aforesaid works.

Tender Title (Ref. No.)	Procedure	Bid Security
Rehabilitation of existing Metaled Road from Maskan Gate to Pharmacy Intersection at Karachi University <b>(CW/15/24-25)</b>	Single Stage One Envelope	2% of bid security
<ul style="list-style-type: none"> <li>• Fee: Rs.5,000/- each</li> <li>• Issuance start date: January 10, 2025 at 9 AM</li> <li>• Issuance end date &amp; time: January 29, 2025 at 3 PM</li> <li>• Submission date &amp; time: January 10 to January 29, 2025 from 9 AM to 3 PM</li> <li>• Opening date &amp; time: January 29, 2025 at 3:30 PM</li> <li>• <b>Site Visit:</b> January 21, 2025 at 11 AM at IBA Main Campus</li> <li>• <b>Completion Time: 04 Months</b></li> </ul>		

Sealed bids are invited on the basis of **Single Stage One Envelope** bidding procedure from Prequalified firms registered with Pakistan Engineering Council having valid active NTN and SRB registration. The prequalified firms are requested to collect the bidding documents.

The Prequalified firms shall submit the following documents along with financial bids must be sealed properly with company stamp and signature. However, all the information submitted and resources allocated by the prequalified bidders during the prequalification stage would remain as it is.

### Envelope contain

- a) Tender submission letter from Owner or his authorized representative.
- b) EOBI contribution certificate / Income Tax deduction Certificate of the Key Staff to be deputed on the Project.
- c) Proposed Work Methodology in line with the scope of project duly signed and stamped.
- d) Proposed Work Schedule & Procurement Plan of the Project duly signed and stamped.
- e) Condition of Contract Part-1 & Part-11 each page duly signed and stamped.
- f) Specification each page duly signed and stamped by the bidder.
- g) Tender drawings duly signed and stamped by the bidder.
- h) Traffic De-route Plan during construction period.
- a) Priced BOQ each item duly signed and stamped by the bidder.
- b) Bid Security equivalent to 2 % of the bid amount in PKR in the form Pay Order / Bank guarantee issued by a schedule Bank registered in Pakistan in favour of the Employer i.e IBA failing to which bid shall be rejected.

Tender Document containing detailed terms and conditions are available at Office of **Head of Procurement, Fauji Foundation Building, IBA Main Campus, University Enclave, Karachi** on any working day (Monday to Friday). The tender document can also be downloaded from IBA and SPPRA EPADS system. The Tender fee challan is to be generated from the IBA website <https://www.iba.edu.pk/tenders/> which may be deposited in any branch of Meezan Bank Ltd. Bidders are required to submit their bids (duly signed and stamped) on the uploaded Tender Document (along with a copy of Earnest Money and all supporting documents) through SPPRA EPADS system ([www.eprocure.gov.pk](http://www.eprocure.gov.pk)). The original bid security along with the Original Bid (duly signed and stamped) must be delivered to IBA, Karachi on below mentioned address before bid opening and will be opened on same date & venue in the presence of the bidders' representatives who may wish to attend. Bid Security in the form of Pay Order or Demand Draft has to be submitted in favour of "IBA Karachi".

### **N.B.**

(1) IBA Karachi reserves the right to reject any bid or cancel the bidding process subject to relevant provision of SPP Rules 2010.



(2) Only uploaded bid along with supporting documents will be accepted. In case there is a contradiction between bidder's EPADS submitted bid and manually submitted bid, bid submitted on EPADS will be considered valid for evaluation purpose.

**REGISTRAR**

IBA, Main Campus, Univeristy Enclave, Karachi 75270  
111-422-422 Fax (92-21) 99261508  
Contact Person Sr. Executive Purchase on 38104700 ext: 2150  
Email [nmalik@iba.edu.pk](mailto:nmalik@iba.edu.pk)  
Website <https://www.iba.edu.pk/tenders/>  
SPPRA EPADS <https://portalsindh.eprocure.gov.pk/#/>

It is hereby certified that the terms and conditions have been read, agreed upon and signed.

M/s \_\_\_\_\_

Contact Person: \_\_\_\_\_

Address \_\_\_\_\_

Tel # \_\_\_\_\_ Fax # \_\_\_\_\_

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

E-mail: \_\_\_\_\_

# INSTRUCTION TO BIDDERS

## INSTRUCTIONS TO BIDDERS

### A. GENERAL

#### IB.1 Scope of Bid

- 1.1 The Procuring Agency as defined in the Bidding Data hereinafter called “the Procuring Agency” 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.

#### IB.2 Source of Funds

- 2.1 The Procuring Agency has arranged fund from the source (s) indicated in the Bidding Data in PKR towards the cost of the project specified in the Bidding Data and it is intended that it will be applied to eligible payments under the Contract for which these Bidding Documents are issued.

#### IB.3 Eligible Bidders

Pre- Qualified bidders

#### 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 agency 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 Agency 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 Agency, 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 (SPP Rule-21)**

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. General Conditions of Contract, Part-I (GCC).
4. Particular Conditions of Contract, Part-II (PCC).
5. Specifications – Special Provisions.
6. Specifications - Technical Provisions.
7. Form of Bid & Appendices to Bid.
8. Bill of Quantities (Appendix-D to Bid).
9. Form of Bid Security.
10. Form of Contract Agreement.
11. Forms of Performance Security and Mobilization Advance Guarantee/Bond.
12. Drawings.
13. Addendum if any

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 (SPP Rule-23(1))**

8.1 Any interested bidder requiring any clarification(s) in respect of the bidding documents may notify the procuring agency in writing at the procuring agency's address indicated in the Invitation for Bids/NIT. Procuring agency will respond to any request for clarification provided they are received at least five calendar days prior to the date of opening of bid. Provided that any clarification in response to query by any bidder; shall be communicated to all parties who have obtained bidding documents.

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

9.1 At any time prior to the deadline for submission of bids, the Procuring Agency may, for any reason, whether at his own initiative or in response to a clarification requested by a interested 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. Interested bidders shall acknowledge receipt of each addendum writing to the Procuring Agency.

- 9.3 To afford bidders reasonable time in which to take an addendum into account in preparing their bids, the procuring agency 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 Agency 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**

- 11.1 Each bidder shall:

- (a) Submit a written power of attorney authorizing the signatory of the bid to act for and on behalf of the bidder;
- (b) Update the information indicated and listed in the Bidding Data.
- (c) furnish a technical proposal taking into account the various Appendices to Bid specially the following:
 

Appendix-E to Bid	Proposed Construction Schedule
	Appendix-F to Bid
	Method of Performing the Work
	Appendix-G to Bid
	List of Major Equipment
Appendix-K to Bid	Organization Chart for Supervisory Staff

## **11.2**

## **DELETED**

- 11.3 Bidders shall also submit proposals of work methods and schedule, in sufficient detail to demonstrate the adequacy of the Bidders' proposals to meet the technical specifications and the completion time referred to in Sub-Clause 1.2 hereof.

### **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 IB 1.1 hereof, based on the unit rates or prices submitted by the bidder or percentage quoted above or below on the rates of Composite Schedule of Rates (CSR), as the case may be.

- 12.2 The bidders shall fill in rates and prices for all items of the works described in the Bill of Quantities. Items against which no rate or price is entered by a bidder will not be paid for by the procuring agency when executed and shall be deemed to be covered by rates and prices for other items in the Bill of Quantities. In case of Composite Schedule of Rates, if the bidder fails to



mention the percentage above or below, it shall be deemed to be at par with the rates of Composite Schedule of Rates.

- 12.3 The bid price submitted by the contractor shall include all rates and prices including the taxes. All duties, taxes and other levies payable by the contractor under the contract, or for any other cause during the currency of the execution of the work or otherwise specified in the contract as on the date seven days prior to the deadline for submission of bids.

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.

#### 12.4

**DELETED**

### **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 Agency'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

**DELETED**

### **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 agency 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.15 in all respects.

**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.
- 15.2 The bid security shall be at the option of the bidder, in the form of deposit at call, Pay order or a bank guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan in favor of the procuring agency, which should commensurate with the bid validity period. The bank guarantee for bid security shall be acceptable in the manner as provided at Annexure BS-1.
- 15.3 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Procuring Agency as non-responsive.
- 15.4 Bid security shall be released to the unsuccessful bidders once the contract has been signed with the successful bidder or the validity period has expired.
- 15.5 The bid security of the successful bidder shall be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.
- 15.6 The Bid Security may be forfeited:
- (a) if the bidder withdraws his bid 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 Each bidder shall submit only one bid either by himself, or as a member of a joint venture, until and unless they have been requested or permitted for alternative bid, then he has to purchase separate bidding documents and alternate bid shall be treated as separate bid.
- 16.2 Alternate proposals are allowed only for procurement of works where technical complexity is involved and more than one designs or technical solutions are being offered. Two stage two envelope bidding procedure will be appropriate

when alternate proposal is required.

- 16.3 Alternate bid(s) shall contain (a) relevant design calculations; (b) technical specifications; (c) proposed construction methodology; and (d) any other relevant details / conditions, provided that the total sum entered on the Form of Bid shall be that which represents complete compliance with the bidding documents.

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

- 17.1 Procuring agency 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, shall be communicated to all bidders. All bidders or their authorized representatives shall be invited to attend such a pre-bid meeting at their own expense.
- 17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Procuring Agency 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 bidders. 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 Agency 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 Alteration is not 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 without alterations and shall provide an original copy along with photocopies as per the requirement of the procuring agency specified in the bidding data. The original as well as copies of the document shall be clearly marked as "ORIGINAL" and „COPY", as the case may be. If there is any discrepancy between original and copy (ies) then 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 Agency, 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) ONE ORIGINAL and ONE COPY of the Bid shall be separately sealed and put in separate envelopes and marked as such.
  - (b) The envelopes containing the ORIGINAL and COPIES shall be put in one sealed envelope and addressed as given in Sub- Clause 19.2 hereof.
- 19.2 The inner and outer envelopes shall:
- (a) be addressed to the procuring agency 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 agency 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 agency at the address specified no later than the time and date stipulated in the Bidding Data.
- (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 Agency 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 agency 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 Agency 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 submit the bid in time.

**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 agency prior to the deadline 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

bid 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 Procuring agency will open the bids, including withdrawals, substitution and modifications made pursuant to Clause IB.22, in the presence of bidders' representatives who choose to attend, at the time, date and location stipulated in the Bidding Data. The bidders' representatives who are in attendance shall sign an attendance sheet.
- 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 No bid may be modified by a bidder after the deadline for submission of bids except in accordance with sub-clauses IB 22.1 and IB 27.2.
- 23.4 Withdrawal of a bid during the interval between the deadlines 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.

### **IB.24 Process to be Confidential (SPP Rule-53)**

- 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 in accordance with the requirements of Rule 45, which states that Procuring agencies shall announce the results of bid evaluation in the form of a report giving reasons for acceptance or rejection of bids. The report shall be hoisted on website of authority and that of procuring agency if its website exists and intimated to all bidders at least seven (7) days prior to the award of contract. 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 agency's 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 as per Rule 31; however mere fact of lodging a complaint shall not warrant suspension of the procurement process.

## **IB.25 Clarification of Bids (SPP Rule-43)**

- 25.1 To assist in the examination, evaluation and comparison of bids, the Procuring Agency 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 agency 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 agency will determine whether the bidder fulfills all codal requirements of eligibility criteria given in the tender notice such as registration with tax authorities, registration with PEC (where applicable), turnover statement, experience statement, and any other condition mentioned in the NIT and bidding document. If the bidder does not fulfill any of these conditions, it shall not be evaluated further.
- 26.2 Once found to be fulfilling the eligibility criteria, as mentioned in sub-clause 26.1, the bids of eligible bidders will be evaluated for technical responsiveness as per specification and criteria given in the bidding documents. Technical and financial evaluations may be carried out in accordance with single stage-single one envelope, single stage-two envelopes, two stage or two stage-two envelopes bidding procedures, depending on the selection procedure adopted by the procuring agency.
- 26.3 A bid will be considered technically responsive if it (i) has been properly signed; (ii) is accompanied by the required bid security; and (iii) 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 affects 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 agency's rights or the bidder's obligations under the contract; or (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.
- 26.4 If a bid has major deviations to the commercial requirements and technical specifications will be considered technically non responsive. As a general rule, major deviations are those that if accepted, would not fulfill the purposes for which the bid is requested, or would prevent a fair comparison or affect the ranking of the bids that are compliant with the bidding documents.

### **(A). Major (material) Deviations include: -**

- (i) has been not properly signed.

- (ii) is not accompanied by the bid security of required amount and manner.
- (iii) stipulating price adjustment when fixed price bids were called for;
- (iv) failing to respond to specifications.

- (v) failing to comply with Milestones/Critical dates provided in Bidding Documents.
- (vi) sub-contracting contrary to the Conditions of Contract specified in Bidding Documents.
- (vii) refusing to bear important responsibilities and liabilities allocated in the Bidding Documents, such as performance guarantees and insurance coverage.
- (viii) taking exception to critical provisions such as applicable law, taxes and duties and dispute resolution procedures.
- (ix) a material deviation or reservation is one:
  - (a) which affects in any substantial way the scope, quality or performance of the works.
  - (b) Adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

### **(B) Minor Deviations**

Bids that offer deviations acceptable to the Procuring Agency and which can be assigned a monetary value may be considered substantially responsive at least as to the issue of fairness. This value would however be added as an adjustment for evaluation purposes only during the detailed evaluation process.

- 26.5 If a bid is not substantially responsive, it will be rejected by the procuring agency, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

### **IB.27 Correction of Errors before Financial Evaluation.**

- 27.1 Bids determined to be substantially responsive will be checked by the procuring agency for any arithmetic errors. Errors will be corrected by the Procuring Agency 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 Agency 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 agency 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 Financial Evaluation and Comparison of Bids

- 28.1 The procuring agency 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 agency 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.
- 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 Agency's estimate of the cost of work to be performed under the Contract, the procuring agency 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 agency 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 Agency against financial loss in the event of default of the successful bidder under the Contract.
- 28.5 Bidders may be excluded if involved in **"Corrupt and Fraudulent Practices"** means either one or any combination of the practices given below SPP Rule 2 (q);
- (i) **"Coercive Practice"** means any impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence the actions of a party to achieve a wrongful gain or to cause a wrongful loss to another party;
  - (ii) **"Collusive Practice"** means any arrangement between two or more parties to the procurement process or contract execution, designed to achieve with or without the knowledge of the procuring agency to establish prices at artificial, noncompetitive levels for any wrongful gain;
  - (iii) **"Corrupt Practice"** means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence the acts of another party for wrongful gain;
  - (iv) **"Fraudulent Practice"** means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to

mislead, a party to obtain a financial or other benefit or to avoid an obligation;

- (v) **“Obstructive Practice”** means harming or threatening to harm, directly or

indirectly, persons or their property to influence their participation in a procurement process, or affect the execution of a contract or deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements before investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or acts intended to materially impede the exercise of inspection and audit rights provided for under the Rules

## **28.6 Evaluation Report (SPP Rule 45)**

After the completion of evaluation process, as described in clauses IB 27 and IB 28, the procuring agency shall announce the results of bid evaluation in the form of report (available on the website of the authority) giving reasons for acceptance and rejection of bid. The report shall be hoisted on website of the authority and that of procuring agencies if its website exists and intimated to all bidders at least seven (7) days prior to the award of contract.

## **F. AWARD OF CONTRACT**

### **IB.29 Award (SPP Rule-49)**

- 29.1 Subject to Clauses IB.30 and IB.34, the procuring agency 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 agency, 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 for the said project.

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

### **IB.30 Procuring Agency's Right to accept any Bid or Annul/Cancellation the Bidding Process (SPP Rule-25)**

Notwithstanding clause IB 29 and provision of the rule: (1) A procuring agency reserves may cancel the bidding process at any time prior to the acceptance of a bid or proposal; (2) The procuring agency shall incur no liability towards bidders solely by virtue of its invoking sub-rule (1); (3) Intimation of the cancellation of bidding process shall be given promptly to all bidders and bid security shall be returned along with such intimation; (4)

The procuring agency shall, upon request by any of the bidders, communicate to such bidder, grounds for cancellation of the bidding process, but is not required to justify such grounds.



**IB.31 Notification/ Publication of the Award of Contract (SPP Rule 25)**

- 31.1 Prior to expiration of the period of bid validity prescribed by the Procuring Agency, the procuring agency 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 Agency 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 anyother bidder shall be permitted, however, Procuring Agency 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 agency and the bidder till signing of the formal Contract Agreement.
- 31.4 Upon furnishing by the successful bidder of a Performance Security, the procuring agency will promptly notify the other bidders that their Bids havebeen unsuccessful and return their bid securities accordingly.
- 31.5 Within seven days of the award of contract, procuring agency shall publish on the website of the Authority and on its own website, if such a website exists, the results of the bidding process, identify the bid through procurement identifying numbers, and the following information:
- (1) Evaluation Report;
  - (2) Form of Contract and letter of Award;
  - (3) Bill of Quantities or Schedule of Requirement.

**31.6 Debriefing (SPP Rule 51).**

- (a) A bidder may ask the procuring agency for reasons for non-acceptance of hisbid and may request for a debriefing meeting and procuring agency shall givehim the reasons for such non acceptance, either in writing or by holding a debriefing meeting with such a bidder.
- (b) The requesting bidder shall bear all the costs of attending such a debriefing.

**IB.32 Performance Security (SPP Rule 39)**

- 32.1 The successful bidder shall furnish to the Procuring Agency a Performance Security in the form and the amount stipulated in the Bidding Data and the Conditions of Contract 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.

- 32.3 Validity of performance security shall extend at least ninety days beyond the date of completion of contract, or as mentioned in the bidding data to cover defects liability period or maintenance period subject to final acceptance by the procuring agency.

### **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 Agency 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 Agency and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the successful bidder from the Procuring Agency.
- 33.3 A procurement contract shall come into force when the procuring agency requires signs contract, the date on which the signatures of both the procuring agency and the successful bidder are affixed to the written contract. Such affixing of signatures shall take place within the time prescribed in the bidding documents.  
Provided that the procuring agency may reduce the maximum time limit for signing of contract, as and when required, and shall be mentioned in the bidding documents.
- 33.4 Stamp Duty.**  
The formal Agreement between the Procuring Agency and the successful bidder shall be duly stamped at rate of as mentioned in bidding data of bid price (updated from time to time) stated in Letter of Acceptance

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

The Procuring Agency reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts/works. The Procuring Agency may in case of consistent poor performance of any Bidder as reported by the Procuring Agency of the previously awarded contracts, inter alia, reject his bid and/or refer the case to the Pakistan Engineering Council (PEC). Upon such reference, PEC 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 debaring him from participation in future bidding for similar works.

### **IB.35 Integrity Pact (SPP Rule 89)**

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 Arbitration (SPP Rule 34)**

Any dispute that is not amicably resolved shall be finally settled, unless otherwise specified in the Contract, under the Arbitration Act 1940 updated from time to time and would be held anywhere in the Province of Sindh at the discretion of procuring agency.

# BIDDING DATA

## **BIDDING DATA**

1.1	<b>Name and address of the Employer:</b>	Institute of Business Administration (IBA), Main Campus University Road Karachi 75270
1.1	<b>Name of the Project:</b>	Rehabilitation of Existing Metaled Road from Abulhasan Ispahani Gate to Pharmacy Intersection At Karachi University
2.1	<b>Name of the Borrower/Source of Financing /Funding Agency:</b>	IBA
2.1	<b>Amount and type of financing:</b>	From IBA resources
.		
8.1	<b>Time limit for clarification:</b>	05 days
10.1	<b>Bid language:</b>	English

### **11.1 (b) Qualification criteria to be updated:**

1. Name of the Firm, Address and valid contact numbers.
2. Valid Pakistan Engineering Council Certificate
3. Valid NTN Number
4. Valid S.S.T Number
5. An affidavit duly signed and stamped that company is not currently black listed / litigation by any Government, Semi Government, Autonomous or by private organization
6. EOBI contribution certificate / Income Tax deduction Certificate of the Key Staff to be deputed on the Project.

***Note: Any false information provided will result in disqualification of the contractor.***

**11.1(b) Complete Bid:**

The bidder to submit a complete bid in sufficient detail to demonstrate the adequacy of the bid in meeting requirements for timely completion of the Works.

- 14.1 **Period of Bid Validity:** 90 days from the date of opening of the bids.
- 15.1 **Amount of Bid Security:**  
Minimum 2% of the total bid price, in the form of a Pay Order/Demand Draft or Bank Guarantee payable to the Institute of Business Administration, Karachi issued by a Scheduled Bank of Pakistan.
- 17.1 **Venue, time, and date of the pre-Bid meeting:** Project Office, First Floor Store and Parking Building, IBA Main Campus at Karachi University, Karachi  
Date; \_\_\_\_\_, Time: \_\_\_\_\_
- 18.4 **Number of copies of the Bid to be completed and returned:** Hard copy of EPADS submitted bid
- 19.2(a) **Employer's address for the purpose of Bid submission**  
Sr. Manager Procurement  
Fauji Foundation Building, Ground Floor, IBA Main Campus at Karachi University, Karachi
- 19.2(b) **Name and Number of the Contract:** Rehabilitation of Existing Metaled Road from Abulhasan Ispahani Gate to Pharmacy Intersection At Karachi University
- 20.1(a) **Deadline for submission of bids:** Date as announced in 'Invitation for Bid'.
- 23.1 **Venue, time, and date of Bid opening:** IBA Main Campus, Karachi University,  
University Road, Karachi.  
Date as announced in 'Invitation for Bid'.
- 32.1 **Standard form and amount of Performance Security acceptable to the Employer:**  
Performance Bond in the form of a Bank Guarantee/ Pay order from a Scheduled Bank for an amount equal to 5% of the Bid Price in favor of Employer.



**32.4 Stamp Duty:**

This Contract Agreement is required to be written on Stamp Paper of appropriate value, as per applicable law. To the best of our knowledge, the present “appropriate value” is 0.35% of the value of the Contract. It is the Bidder’s responsibility to ensure that the prevailing rate is incorporated into the bid price.

The Stamp Paper shall be purchased by the successful bidder at his own cost and provided to the Procuring Agency for preparation of the Contract Agreement.

# **FORM OF BID AND APPENDICES TO BID**

**FORM OF BID**

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

To: (Name of  
Contract/Works)\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Gentleman,

1. Having examined the Bidding Documents including Instructions to Bidders, Bidding Data, and Conditions of Contract. Specifications, Drawings and Bill of Quantities and Addenda Nos. \_\_\_\_\_ for the execution of the above-named Works, we, the undersigned, 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.
2. We understand that all the Appendices attached hereto form part of this Bid.
3. As security for due performance of the undertakings and obligations of this Bid, we submit herewith a Bid Security in the amount of Rupees \_\_\_\_\_ (Rs. \_\_\_\_\_) drawn in your favor or made payable to you and valid for a period of \_\_\_\_\_ days beginning from the date Bids are opened.
4. We undertake, if our Bid is accepted, to commence the Works and to complete the whole of the Works comprised in the Contract within the time stated in Appendix- A to Bid.
5. We agree to abide by this Bid for the period of \_\_\_\_\_ days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at anytime before the expiration of that period.
6. 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.
7. We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other bidder for the Works.

8. 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) (Seal)

Address: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Witness:

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

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

Occupation \_\_\_\_\_

**Appendix-A to Bid  
SPECIAL STIPULATIONS**

S. No.	Description	Clause	Conditions of the Contract
1.	IBA Engineer's Authority to issue Variations in an emergency	2.1	2% of the Contract Price stated in the Letter of Acceptance.
2.	Amount of Performance Security	10.1	5% of Contract Price stated in the Letter of Acceptance.
3.	Time for Furnishing Programme	14.1	Within 15 days from the date of receipt of Letter of Acceptance.
4.	Minimum amount of Third Party Insurance	23.2	Rs. 500,000 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 the Contract Agreement.
6.	Time for Completion	43.1, 48.2	120 days period from the date of receipt of Engineer's Notice to Commence.

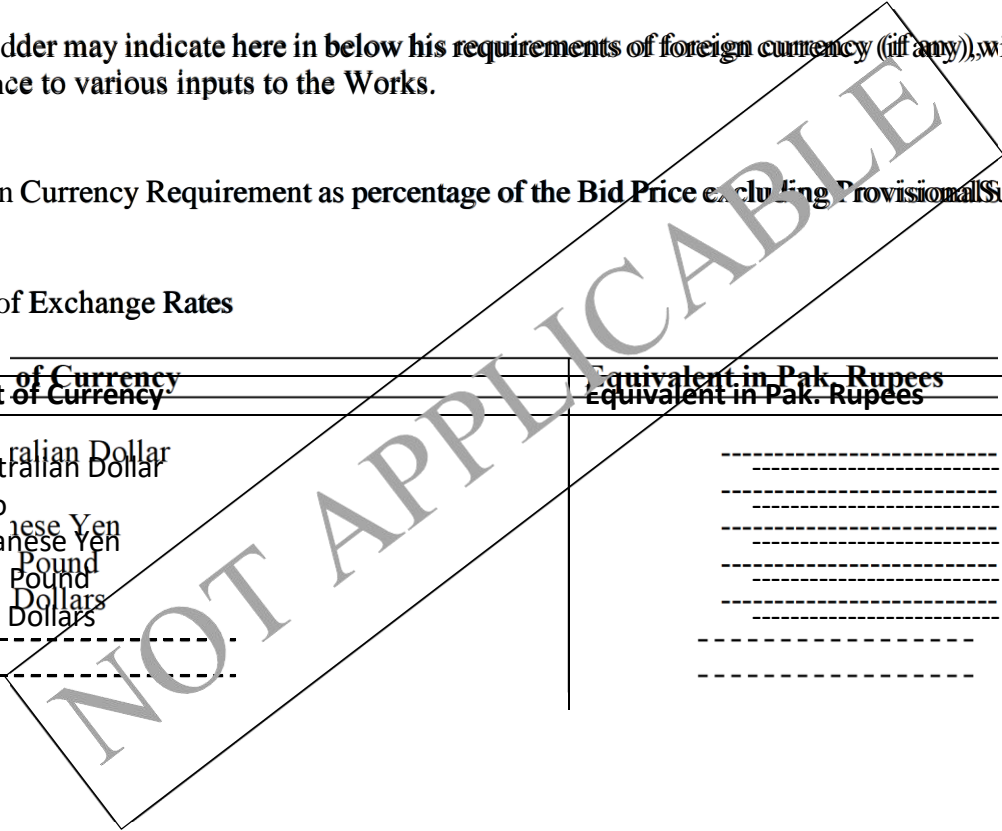
7.	Amount of Liquidated Damages	47.1	0.05% Liquidated damages for per <b>day</b> of delay (not exceeding 10% of contract value) of the whole of the works shall be enforced of the works (or the accepted bid price, whichever is higher) divided by one-fourth of the number of days specified as completion time.
8.	Defects Liability Period	49.1	12 Months 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 Contract Price stated in the Letter of Acceptance.
11.	Minimum amount of Interim Payment Certificates (Running Bills)	60.2	5% of the Contract Amount
12.	Time of Payment from delivery of Engineer's Interim Payment Certificate to the Procuring Agency.	60.10	30 days after verification of invoice.
13.	Financial assistance to the Contractor	60.11 60.12	Secured advance on materials as per Clause 60.11, and Mobilization Advance as per Clause 60.12 of the Conditions of Contract.

**Appendix-B to Bid FOREIGN**

**CURRENCY REQUIREMENTS**

1. The Bidder may indicate here in below his requirements of foreign currency (if any), with reference to various inputs to the Works.
2. Foreign Currency Requirement as percentage of the Bid Price excluding Provisionals Sums %.
3. Table of Exchange Rates

Unit of Currency	Equivalent in Pak. Rupees
Australian Dollar	-----
Euro	-----
Japanese Yen	-----
U.K. Pound	-----
U.S. Dollars	-----
-----	-----
-----	-----



## 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:

Cost Element	Description	Weightages	Applicable index
1	2	3	4
(i)	Fixed Portion FIXED PORTION	0.84 0.84	
(ii)	Local Labor	*****	
(ii)	Cement – in bags	0.06	Government of Pakistan Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin (GP)
(v)	Reinforcing Steel	0.10	“
(v)	High Speed Diesel (HSD)	*****	“
(vi)	Bricks	*****	“
(vii)	Bitumen	*****	“
(viii)		*****	
	Total	1.000	

## Notes:

- Indices for “(ii)” to “(vii)” are taken from the Government of Pakistan Federal Bureau of Statistics, Monthly Statistical Bulletin. 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.
- Any fluctuation in the indices or prices of materials other than those given above shall not be subject to adjustment of the Contract Price.



**Appendix-D to Bid**

**BILL OF QUANTITIES**

----- Please refer to Volume-II attached with this bid-----

**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 in the bar chart (CPM, PERT or any other to be 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 Agency's completion targets in days noted below and counted from the date of receipt of Engineer's Notice to Commence (Attach sheets as required for the specified form of Construction Schedule):

<b><u>Description</u></b>	<b><u>Time for Completion</u></b>
a) Whole Works	120 days

Note: The Construction Schedule will be submitted by the contractor either as a bar chart or CPM, specifying various activities, their sequence and the number of days required for completion of each activity.

**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 in Pakistan, 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.]

**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.]

**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 arrange d on Lease						

**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.).

**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>
<b>1</b>	<b>2</b>

**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, expressed in thousands of Pakistani Rupees:

<b>Quarter/ Year/ Period</b>	<b>Amounts (1,000 Rs.)</b>
<b>1</b>	<b>2</b>
1st Quarter	
<b>Bid Price</b>	

**Appendix-K to Bid**

**ORGANIZATION CHART FOR THE SUPERVISORY STAFF AND  
LABOUR**

**(Attached separate sheet as necessary)**



**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: \_\_\_\_\_

..... [name of Supplier] 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 Sindh (GoS) or any administrative subdivision or agency thereof or any other entity owned or controlled by GoS through any corrupt business practice.

Without limiting the generality of the foregoing, [name of Supplier] 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 GoS, except that which has been expressly declared pursuant hereto.

[name of Supplier] 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 GoS and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[name of Supplier] 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 GoS under any law, contract or other instrument, be voidable at the option of GoS.

Notwithstanding any rights and remedies exercised by GoS in this regard, [name of Supplier] agrees to indemnify GoS for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoS 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 GoS.

Name of Buyer: .....

Signature: .....

[Seal]

Name of Seller/Supplier: .....

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 Agency') 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 Agency; and

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

PROVIDED ALSO THAT the Procuring Agency 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 Agency 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 Agency]

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 Agency) 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 Agency, 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 Agency'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 fulfill 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 Agency, with or without notice to the Guarantor, which notice is, hereby, waived and shall also well and truly perform and fulfill 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 Agency without delay upon the Procuring Agency's first written demand without cavil or arguments and without requiring the Procuring Agency to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Procuring Agency'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 Agency's designated Bank & Account Number.

PROVIDED ALSO THAT the Procuring Agency 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 Agency 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) Signature \_

Witness:  
1. \_\_\_\_\_

\_\_\_\_\_

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

Name \_\_\_\_\_ Title \_

\_\_\_\_\_

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

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

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

## FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the day  
of \_\_\_\_\_(month) 20\_\_\_\_\_  
\_\_\_\_\_ between

\_\_\_\_\_ (hereafter called the "Procuring Agency") of the one part and  
\_\_\_\_\_ (hereafter called the "Contractor") of the  
other part.

WHEREAS the Procuring Agency 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 witnesseth 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 L);
  - (i) The Drawings;
  - (j) The Specifications.
  - (k) \_\_\_\_\_(any other)
3. In consideration of the payments to be made by the Procuring Agency to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Procuring Agency 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 Agency 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 Agency

\_\_\_\_\_  
(Seal)

\_\_\_\_\_  
(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:

Witness:

\_\_\_\_\_

\_\_\_\_\_

(Name, Title and Address)

(Name, Title and Address)

**Notes: 1. This contract agreement is required to be written on Stamp Paper of appropriate value, as per applicable law. To the best of our knowledge, the present “appropriate value” is 0.35% of the value of the Contract. It is the Bidder’s responsibility to ensure that the prevailing rate is incorporated into the bid price.**

**2. The Stamp Paper will be purchased by the successful bidder at his own cost and provided to the Procuring Agency for preparation of the Contract Agreement.**



**MOBILIZATION ADVANCE GUARANTEE/BOND**

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

WHEREAS \_\_\_\_\_ (hereinafter called the 'Procuring Agency') has entered into a Contract for \_\_\_\_\_ (Particulars of Contract) with \_\_\_\_\_ (hereinafter called the "Contractor").

AND WHEREAS, the Procuring Agency 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 Agency 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 or Insurance Company acceptable to the Procuring Agency) (hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the Procuring Agency 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 Agency for payment not exceeding the aforementioned amount.

Notice in writing of any default, of which the Procuring Agency shall be the sole and final judge, on the part of the Contractor, shall be given by the Procuring Agency 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)

### INDENTURE FOR SECURED ADVANCES

(For use in cases in which is contract is for finished work and the contractor has entered into an agreement for the execution of a certain specified quantity of work in a given time).

This INDENTURE made the ..... day of .....  
..... 20..... BETWEEN (hereinafter called "the Contractor" which expression shall where the context so admits or implied be deemed to include his heirs, executors, administrators and assigns) of the one part and THE GOVERNOR OF SINDH (hereinafter called "the Government" of the other part).

WHEREAS by an agreement, dated (hereinafter called the said agreement, the contractor has agreed to perform the under-mentioned works (hereinafter referred to as the said work):-

(Here enter (the description of the works).1

AND WHEREAS the contractor has applied to the ..... for an advance to him of Rupees .....

(Rs. .... ) on the security of materials absolutely belonging to him and brought by him to the site of the said works the subject of the said agreement for use in the construction of such of the said works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labor and other charge) AND WHEREAS the Government has agreed to advance to the Contractor the sum of Rupees, (Rs. .... ) on the security of materials the quantities and other particulars of which are detailed in Part II of Running Account Bill (B). the said works signed by the contractor

Fin R.Form.17.A

On ..... and on such covenants and conditions as are hereinafter contained and the Government has reserved to itself the option of marking any further advance or advances on the security of other materials brought by the Contractor to the site of the said works.

NOW THIS INDENTURE WTTNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees.....

(Rs. .... ) on or before the execution of these presents paid to the Contractor by the Government (the receipt whereof the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as aforesaid (all of which advances are hereinafter collectively referred to as the said amount) the Contractor doth hereby assign unto the Government the said materials by way of security for the said amount

And doth hereby covenant and agree with the Government and declare ay follow :-

- (1) That the said sum of Rupees..... RS. .... ) so advanced by the Government to the Contractor as aforesaid and allor any further sum or sums which may be advanced as aforesaid shall be employed by the contractor in or towards expending the execution of the said works and for no other purpose whatsoever.

(2) That the materials detailed in the said Running Account Bill (B) which have been offered to and accepted by (he Government as security for the said amount are absolutely by the Contractors own property free from encumbrances of any kind and the Contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the contractor hereby agrees, at all times, to indemnify and save harmless the Government against all claims whatsoever to any materials in respect of which an advance has been made to him as aforesaid.

(2) That the said materials detailed in the said Running Account Bill (B) and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Divisional Officer (hereinafter called the Divisional Officer) and in the terms of the said agreement.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangement for the proper watch, safe custody and protection against all risks of the said material and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and at his own risk and on his own responsibility and shall at all times be open to inspection by (he Divisional Officer or any officer authorized by him. In the event of the said materials of any part (hereof being stolen, destroyed or damaged or becoming deteriorated in a greater degree than is due to reasonable use and wear thereof Contractor will forthwith replace the same with other materials of like quality or repair and make good the same as required by the Divisional Officer and the materials so brought to replace the said materials so repaired and made good shall also be considered as security for the said amount.

(5) That the said materials shall not on any account be removed from the site of the said works except with the written permission of the Divisional Officer or an officer authorized by him in that behalf

(6) That the said amount shall be payable in full when or before the Contractor receives payment, from the Government of the price payable to him for the said works under the terms and provisions of the said agreement PROVIDED THAT if any intermediate payments are made to the contractor on account of work done then on the occasion of each such payment the Government will be at liberty to make a recovery from the Contractors Bill for such payment by deducting there from in the value of the said materials (then actually used in the construction and in respect of which recovery has not been made previously the value for this purpose being determined in respect of each description of material at (he rate at which the amount of the advances made under these presents were calculated.

(6) That if the Contractor shall at any time make any default in the performance or observation in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the Government shall immediately on the happening of such default be repayable by the Contractor to the Government together with interest thereon at twelve percent per annum from the date or respective dates of such advance or advances to the date of repayment and

with all costs, charges, damages and expenses incurred by the Government in or for the recovery thereof or the enforcement of this security or otherwise by reason of (he default of the Contractor and any moneys so becoming due and payable shall constitute a debt due from the Contractor to the Government and the Contractor hereby covenants and agrees with the Government to repay and the same respectively to it accordingly.

That the Contractor hereby charges all the said materials with the repayment to the Government of the said sum of Rupees ..... (Rs. .... ) and any further sum or sums which may be advanced as aforesaid and all costs charges damages and expenses payable under these present PROVIDED ALWAYS and it is hereby agreed and declared that not, withstanding anything in the said agreement and without prejudice to the powers contained therein if and whether the covenant for payment and repayment hereinbefore contained shall become enforceable and the money owing shall not be paid to accordingly. Once there with the Government may at any time thereafter adopt all or any of following courses as it may deem best ;-

- (a) Seize and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor he is to pay the same to the Government on demand.
  - (b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable to the Government under these presents and pay over the surplus (if any) to the Contractor.
  - (c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.
- (9) That except as is expressly provided by the presents interest on the said advance shall not be payable.
- (10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been hereinbefore expressly provided for the same shall be referred to the Superintending Engineer/Executive District Officer/Officer one grade higher to officer signed the agreement Circle whose ..... decision shall be final and the provisions of the Arbitration Act 1940 for the time being in force so far as they are applicable shall apply to any such reference.

enforcement of this security or otherwise by reason of (he default of the Contractor and anymoneys so becoming due and payable shall constitute a debt due from the Contractor to theGovernment and the Contractor hereby covenants and agrees with the Government to repayand the same respectively to it accordingly.

Singed, sealed and delivered by\*

Singed, sealed and delivered by\*

In the presence of

In the presence of

SEAL

SEAL

1st witness

2nd witness

# CONDITIONS OF CONTRACT

The conditions of contract comprise two parts and are based on Pakistan Engineering Council's "Standard Form of Bidding Documents":

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

## **PART I: GENERAL CONDITIONS OF CONTRACT**

The General Condition of Contract as a part of Civil Engineering Contracts is a document prepared by the International Federation of Consulting Engineers (Federation Internationaldes Ingenieurs-Conseil, or FIDIC) whose address is as follows:

FIDIC Secretariat  
P.O. Box 86  
1000 Lausanne 12Switzerland  
e-mail: [fidic.pub@fidic.org](mailto:fidic.pub@fidic.org) – [FIDIC.org/bookshop](http://FIDIC.org/bookshop)

The aforesaid document is also known as The FIDIC Conditions of Contract (1987). It is a copyright material and therefore cannot be made available here as a part of TenderDocuments. Interested bidders are advised to obtain a copy of the document from the address given above.

In the following Part II: Particular Conditions of Contract, any reference to GeneralConditions of Contract or the FIDIC (1987) Condition of Contract **assumes that the bidder submitting this bid has read and is fully conversant with it.**



## TABLE OF CONTENTS

### PART II - PARTICULAR CONDITIONS OF CONTRACT

Clause	Title	Page
1.1	Definitions	63
2.1	Engineer's Duties and Authority	63
2.2	Engineer's Representative	65
2.7	Engineer Not Liable	65
2.8	Replacement of the Engineer	65
5.1	Language(s) and Law	65
5.2	Priority of Contract Documents	65
6.6	Shop Drawings	66
6.7	As-Built Drawings	66
10.1	Performance Security	66
10.4	Performance Security Binding on Variations and Changes	67
14.1	Programme to be Submitted	67
14.3	Cash Flow Estimate to be Submitted	67
14.5	Detailed Programme and Monthly Progress Report	67
15.2	Language Ability of Contractor's Representative	68
15.3	Contractor's Representative	68
16.3	Language Ability of Superintending Staff of Contractor	68
16.4	Employment of Local Personnel	68
19.3	Safety Precautions	68
19.4	Lighting Works at Night	69
20.4	Procuring Agency's Risks	69
21.1	Insurance of Works and Contractor's Equipment	70
21.4	Exclusions	70
25.5	Insurance Company	70
31.3	Co-operation with Other Contractors	70
34.2	Rates of Wages and Conditions of Labor	70
34.3	Employment of Persons in the Service of Others	70
34.4	Housing for Labor	71
34.5	Health and Safety	71
34.6	Epidemics	71
34.7	Supply of Water	71
34.8	Alcoholic Liquor or Drugs	71
34.9	Arms and Ammunition	71
34.10	Festivals and Religious Customs	72
34.11	Disorderly Conduct	72
34.12	Compliance by Subcontractors	72
35.2	Records of Safety and Health	72
35.3	Reporting of Accidents	72
36.6	Use of Pakistani Materials and Services	72
41.1	Commencement of Works	72

48.2	Taking Over of Sections or Parts	73
51.2	Instructions for Variations	73
<b>Clause</b>	<b>Title</b>	<b>Page</b>
52.1	Valuation of Variations	73
53.4	Failure to Comply	73
54.3	Customs Clearance	73
54.5	Conditions of Hire of Contractor's Equipment	73
57.1	Method of Measurement	73
59.4	Payments to Nominated Sub-contractors	73
59.5	Certification of payments & Nominated Subcontractors	74
60.1	Monthly Statements	74
60.10	Time for Payment	74
60.11	Secured Advance on Materials	75
60.11	Financial Assistance to Contractor	76
63.1	Default of Contractor	76
65.2	Special Risks	76
67.3	Arbitration	76
68.1	Notice to Contractor	77
68.2	Notice to Procuring Agency and Engineer	77
70.1	Increase or Decrease of Cost	77
73.1	Payment of Income Tax	77
73.2	Customs Duty & Taxes	77
74.1	Integrity Pact	77
75.1	Termination of Contract for Procuring Agency's Convenience	78
76.1	Liability of Contractor	78
77.1	Joint and Several Liability	78
78.1	Details to be Confidential	78
79.1	Safety Requirements	79

## PART II - PARTICULAR CONDITIONS OF CONTRACT

### 1.1 Definitions

- (a) (i) The “Procuring Agency” is synonymous with “Procuring Agency is the **Institute of Business Administration, Main Campus, University Road, Karachi.**
- (a) (iv) The Engineer is **Institute of Business Administration, Karachi**, or any other competent person appointed by the Procuring Agency, 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.

The following paragraphs are added:

- (a)(vi) “Bidder or Tenderer” means any person or persons, company, corporation, firm or joint venture submitting a Bid or Tender.
- (a)(vii) “Project Manager” means a person or firm appointed by the Procuring Agency to manage the construction project on his behalf and provide detailed supervision during the construction phase of the project.

(b)(v) 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)(ix) “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 therefrom as may be made and remedying of any defects therein in accordance with the provisions of the Contract.
- (g)(iv) Add the words “and e-mail, CD or DVD”

### 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 Agency 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 “NotForeseeable 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 Agency 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 Agency.)

## 2.2 Engineer's Representative

The following paragraph is added:

The Procuring Agency or the Project Manager appointed by him 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 or Project Manager 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 Agency intends to replace the Engineer, the Procuring Agency 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 Agency shall not replace the Engineer with a person against whom the Contractor raises reasonable objection by notice to the Procuring Agency, 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; and
- (10) The Specifications

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 Procuring Agency, Engineer and Project Manager for review 3 copies of all shop and erection drawings along with CD applicable to this Contract as per provision of relevant Sub-Clause of the Contract.

Review and approval by the Engineer and/or the Project Manager 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 contractor will also provide to the Procuring Agency a softcopy (CD, etc.) of the drawings. The price of such Drawings and CD 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 Agency 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 5% 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-Clause10.4 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 along with soft copy within 15 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, or
- ii) a CPM identifying the critical path/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 and the Project Manager detailed programme for the following:
  - (1) Execution of Works;
  - (2) Labour Employment;
  - (3) Local Material Procurement;
  - (4) Material Imports, if any; and
  - (5) Other details as required by the Engineer or the Project Manager.
  
- (b) During the period of the Contract, the Contractor shall submit to the Engineer or the Project Manager not later than the 8<sup>th</sup> day of the following month, two 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 and/or the Project Manager 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 and/or the Project Manager 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. Fortnightly meetings will be held on site to review progress and coordination issues. Representatives of Architect, Consultants, Project Manager, Client, Contractor and Sub-contractor (if any) are to attend the meetings on regular basis.

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 staff and labour from sources within Pakistan.

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 appoint a full time safety inspector and shall take 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. However, no work will be carried out at night without prior approval of the Procuring Agency.

#### **20.4 Procuring Agency's Risks**

The Procuring Agency'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 Agency 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**

In Clause 21.1(b), read 25%, instead of 15%.

### **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 Agency.

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 Agency at and in the vicinity of the Site and also shall provide adequate precautionary facilities not to make himself a nuisance to local residents, other contractors and students and faculty of the Procuring Agency.

The following Sub-Clauses 34.2 to 34.12 are added:

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

The Contractor shall pay rates of wages and observe conditions of labour 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 labour so established, the Contractor shall pay rates of wages and observe conditions of labour which are not less favourable than the general level of wages and conditions observed by other Procuring Agency 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 labour from amongst the persons in the services of the Procuring Agency or the Engineer or the Project Manager; except with the prior written consent of the Procuring Agency, the Engineer or the Project Manager, as the case may be.

### **34.4 Housing for Labour**

Save insofar as the Contract otherwise provides, the Contractor shall provide, if not provided for otherwise elsewhere in these documents, and maintain such housing accommodation and amenities as he may consider necessary for all his supervisory staff and labour, 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 Agency or if the Procuring Agency 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 labour 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 & Power**

The Contractor shall, arrange water and power required for execution and working labour and staff at site from his own resources and IBA shall make no additional payment in this regard.

### **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 labour.

**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 labour have due regard to all recognised 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 labour and for the preservation of peace and protection of persons and property in the neighbour hood 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.

#### **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 "or the Project Manager, 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**

This Sub-Clause is deleted in its entirety.

#### **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.

#### **57.1 Method of Measurement**

The following paragraph is added at the end:

Measurements for the purpose of billing shall be recorded on a Measurement Book(MB). No other documents shall be considered valid for payment.

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 Agency 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 Agency, the amount which the nominated Subcontractor was directly paid by the Procuring Agency.

### **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-Cause 60.11 (a)(6) hereof".

(in case Clause 60.11 is applicable)

### **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 Agency to the Contractor within 30working days after such Interim Payment Certificate has been jointly verified by Procuring Agency 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 Agency 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.

The following Sub-Clause 60.11 and 60.12 are added:

### **60.11 Secured Advance on Materials**

- (a) The Contractor shall be entitled to receive from the Procuring Agency Secured Advance against an INDENTURE BOND in P W Account Form No. 31 (Fin. R. Form No. 2 acceptable to the Procuring Agency 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:
- (i) The materials are in accordance with the Specifications for the Permanent Works;
  - (ii) Such materials have been delivered to the Site and are properly stored and protected against loss or damage or deterioration to the satisfaction and verification of the Engineer but at the risk and cost of the Contractor;
  - (iii) 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;
  - (iv) 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 therefore;
  - (v) Ownership of such materials shall be deemed to vest in the Procuring Agency and these materials shall not be removed from the Site or otherwise disposed of without written permission of the Procuring Agency;
  - (vi) 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 market price of stands other materials;
  - (vii) Secured Advance should not be allowed unless & until the previous advance, if any, fully recovered;
  - (viii) Detailed account of advances must be kept in part II of running account bill; and
  - (ix) Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 3 months from the date of issue of secured advance and definitely not for full quantities of materials for the entire work/contract
- (b) Recovery of Secured Advance:
- (i) Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis, but not later than period specified in the rules not more than three months (even if unutilized); other conditions.
  - (ii) As recoveries are made the outstanding accounts of the items concerned in Part II should be reduced by making deduction entries in the column; —deduct quantity utilized in work measured since previous bill, equivalent to the quantities of materials used by the contractor on items of work shown

as executed in part I of the bill.

### **60.12 Financial Assistance to Contractor (Mobilization Advance)**

Mobilization Advance up to 10 % of the Contract Price stated in the Letter of Acceptance shall be paid by the Procuring Agency to the Contractor on the works costing Rs.2.5 million or above on following conditions:

- (i) on 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 to the Procuring Agency;
- (ii) Contractor will pay interest on the mobilization advance at the rate of 10% per annum on the advance; and
- (iii) This Advance including the interest shall be recovered in 5 equal installments from the five (05) R.A bills and in case the number of bills is less than five (05) then 1/5th of the advance inclusive of the interest thereon shall be recovered from each bill and the balance together with interest be recovered from the final bill. It may be insured that there is sufficient amount in the final bill to enable recovery of the Mobilization Advance.

### **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 Agency against the Contractor under this Clause, the Procuring Agency 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 Karachi, 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 Agency 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 Agency and Engineer**

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

- a) The Procuring Agency:

Institute of Business Administration (IBA), Main Campus, University Road, Karachi 75270

- b) The Engineer:

Any competent person appointed by the Procuring Agency

**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:-

$$P_n = \frac{L_n}{L_0} + \frac{M_n}{M_0} + \dots + \frac{E_n}{E_0}$$

$\frac{L_0}{L_0} \quad \frac{M_0}{M_0} \quad \frac{E_0}{E_0}$

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 70.1 (a), and with Paragraphs 70.1 (b) and (c), where any variations and any work that are 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 weightages or coefficients representing the estimated proportion of each cost element (labour, 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;

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

$L_n, M_n, E_n, \text{ etc.}$  are the current cost indices or reference prices of the cost elements at the date specified in Sub-Clause 70.1(d).

$L_0, M_0, E_0, \text{ etc.}$  are the base cost indices or reference prices corresponding to the above cost elements and weightages 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 month is related. If at any time the current indices are not available, provisional indices shall be used, as determined by the Engineer, which shall be subject to subsequent correction if 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 in 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 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, 79.1 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**

The Procuring Agency is not in any way liable to pay any customs duty and taxes payable or paid by the contractor.

**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 Agency 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 Agency 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 Agency under Sub- Para (a) and (c) of this Sub-Clause.

**75.1 Termination of Contract for Procuring Agency's Convenience**

The Procuring Agency shall be entitled to terminate the Contract at any time for

the Procuring Agency'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 Agency 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 labour laws including the Workmen's Compensation Act and the Procuring Agency shall be fully indemnified for all claims, damages etc. arising out of any dispute between the Contractor, his Subcontractors or assigns and the labour 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 Agency 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 Agency.

#### **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 Agency 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.

#### **79.1 Safety Requirements**

The Institute of Business Administration (IBA) obliged to provide and maintain, so far as is practicable, an environment for its employees, students and public, that is safe and without risk to health. As a condition of this contract, the IBA requires that any Contractors or subcontractors that may be engaged will at all times identify and exercise all reasonable and necessary precautions for the health and safety of all persons. This includes Contractor employees, IBA employees and public who may be affected by the works or services.

The Contractor will forthwith comply with any and all directions by the Engineer relating to occupational health and safety. This includes the right to carry out site inspections by Engineer.

**a). Legislative Compliance:** The Contractor must comply with and ensure that its

employees, subcontractors and agents comply with local laws and by-laws, Codes of Practice, and the IBA's HS policy and procedures that are in any way applicable to this contract or the performance of the work / services under this contract.

**b). Incident Notification:** The Contractor must promptly notify the Engineer of any accident, injury, property or environmental damage that occurs during the carrying out of the contract works. All lost time incidents shall be immediately notified to Engineer. The Contractor must and within 3 working days of any such incident provide a report giving complete details of the incident, including results of investigations into its cause, and any recommendations or strategies for prevention in the future.

**c). Non Compliance:** If during the performance of works under the contract the Engineer informs the Contractor in writing that it is the opinion of the Engineer that the Contractor is:

- not conducting the work in compliance with the Contractor's Health and Safety Plan, health and safety management procedures, or
- conducting the work in such a way as to endanger the health and safety of Contractors employees or the IBA's employees or its Contractors' and subcontractors' employees, plant, equipment or materials,

the Contractor shall promptly remedy that breach of health and safety.

The Engineer may direct the Contractor to suspend the work until such time as the Contractor satisfies the Engineer that the work will be resumed in conformity with applicable health and safety provisions.

During periods of suspension referred to above, the Engineer shall not be required to make any payment whatsoever to the Contractor.

If the Contractor fails to rectify any breach of health and safety for which the work has been suspended, or if the Contractor's performance has involved recurring breaches of health and safety, the Engineer may as its option terminate the work forthwith, without further obligation to the Contractor. In this event, the Procuring Agency's liability shall be limited to payment for the work performed and costs incurred by the Contractor up to the time of termination or an earlier suspension of works.

**d). Disputes on Health and Safety Matters:** Where there is a dispute on health and safety matter between the Procuring Agency and the contractor, then after a reasonable period for negotiation (depending upon the nature and seriousness of the matter), the matter will be referred to the relevant government authority. Only written opinions from the relevant government authority will be accepted.

**e). Health and Safety Plan:** Prior to commencing the works under the contract the Contractor shall submit to the Engineer a Health and Safety Plan specific to the contract and works. The Health and Safety Plan shall consider and respond to the specific OHS hazards and issues relevant to the contract works and shall document the systems and methods to be implemented for the term of the contract. The Health and Safety Plan shall be reviewed by the Engineer and formal approval to commence the contract shall be provided subject to acceptance of the Health and Safety Plan.

**f). Risk Assessment:** The Contractor shall prepare and submit a risk assessment prior to commencing the works under the contract. The risk assessment may be in the form of a Job Safety Assessment (JSA) or Safe Working Method Statement (SWMS). The risk assessment shall record the risk assessment and risk control methods to be employed by the Contractor. The completed risk assessment shall be submitted to the Engineer for review and approval prior to commencement of works under the contract.

**g). Health & Safety Performance Reporting:** The Contractor must when requested by the Engineer provide evidence of ongoing performance of the Contractor's HSP management system. If requested by the Engineer, the information shall apply to all the contractor's operations not just those pertaining to the Engineer. Without limiting the requirements of this obligation, the Contractor shall provide the following information on a monthly basis in the form of a Contractor Health & Safety Performance Report:

- a. Number of lost time injuries
- b. Working days lost due to injury
- c. Current status of any injured personnel, damaged property or environmental damage or pollution
- d. Status of the implementation and outcomes of corrective actions undertaken as a result of HS inspections and risk assessments
- e. Status of HS management system audits undertaken

The HS Performance Report shall be submitted by the Contractor using the Contractor Monthly HS Performance Report Form. The Contractor shall when requested by the Engineer provide reports on HS inspections, audits or assessments undertaken during the course of the contract.

**h). Other Parties and Contractors sharing the contract location:** Where the health and safety of other parties or other contractors may be affected by this contract, the contractor is required to ensure adequate communication and coordination occurs on health and safety matters. Where there are matters of issue or concern they must be raised as soon as practicable with the Procuring Agency through the Engineer.

**j). Personal protective equipment:** Where adequate protection against the risk of accident or injury to health, including exposure to adverse conditions, cannot be ensured by other means, suitable personal protective equipment and protective clothing, having regard to the type of work and risks, shall be provided and maintained by the Contractor, without cost to the workers.



Institute of  
Business Administration  
Karachi

*Leadership and Ideas for Tomorrow*

**INSTITUTE OF BUSINESS ADMINISTRATION**  
**KARACHI**

**REHABILITATION OF EXISTING METALLED ROAD FROM MASKAN  
GATE TO PHARMACY INTERSECTION AT KARACHI UNIVERSITY**

**PO - 005126**

**BILL OF QUANTITIES**  
**DECEMBER 2024**





# **Summary**

**REHABILITATION OF EXISTING METALLED ROAD  
 FROM MASKAN GATE TO PHARMACY INTERSECTION  
 AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES  
SUMMARY**

S.NO.	DESCRIPTION	AMOUNT (PKR.)
<b>A</b>	<b>ROAD WORKS</b>	
	<b>Schedule Items</b>	
1	Constructuion of Road	83,714,779.62
2	Dismantling & reconstruction of boundary wall & Relocation of gate	2,298,169.74
	<b>Sum of (1) and (2)</b>	<b>86,012,949.35</b>
	Premium / Rebate on Schedule items ( ____ %)	Rs.
	<b>Sub Total of Schedule Items with Premium / Rebate</b>	<b>Rs.</b>
	<b>Non-Schedule Items</b>	
1	Constructuion of Road	
2	Dismantling & reconstruction of boundary wall & Relocation	
	<b>Sum of Non Schedule Items</b>	<b>Rs.</b>
	<b>Sub Total of (A): Road works , Dismantling &amp; Reconstruction of boundary wall &amp; Relocation of gate</b>	<b>Rs.</b>
<b>B.</b>	<b>CHECK POST, UGWT, SEPTIC TANK &amp; SOAK PIT</b>	
	<b>Schedule Items</b>	
1	Check Post	5,304,975.08
2	Check Post MEP	404,303.14
3	Under Ground Water Tank	782,416.58
4	Septic Tank & Soak Pit	850,799.58
	<b>Sum of (1) to (4)</b>	<b>7,342,494.38</b>
	Premium / Rebate on Schedule items ( ____ %)	Rs.
	<b>Sub total of Schedule Items with Premium / Rebade</b>	<b>Rs.</b>
	<b>Non-Schedule Items</b>	
1	Check Post	
2	Check Post MEP	
2	Under Ground Water Tank	
3	Septic Tank & Soak Pit	
	<b>Sum of Non Schedule Items</b>	<b>Rs.</b>
	<b>Sub Total of (B): Check Post , UGWT , Septic Tank and Soak Pit</b>	<b>Rs.</b>
	<b>Total of A &amp; B</b>	<b>Rs.</b>

**Amount in Words:**

\_\_\_\_\_

\_\_\_\_\_

**Road works ,**  
**Dismantling &**  
**Reconstruction of**  
**boundary wall &**  
**Relocation of gate(A)**

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**ROAD WORK**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(A) SCHEDULE ITEMS</b>						
1	Vol-III, Part-IV, Highway works, Items #1, Page-211	<b>Clearing and Grubbing</b> Clearing and grubbing the site by cutting, uprooting and removing all rubbish and shrubs including disposal to (outside limits) designated places	12,272	Sq.m	31.00	380,432.00
2	Vol-III, Part-IV, Highway works, Items #39(1), Page-220 (a)	<b>Jungle Clearance</b> Jungle clearance and removing within 100 ft.  Thin Jungle.	12,272	%Sq.m	4,258.86	522,647.30
3	Vol-III, Part-IV, Highway works, Items #39(5), Page-221 (a)	<b>Relocate Trees</b> Up-rooting stumps and removing within 100 ft.:  2.0 FT: TO 6.0 FT: GIRTH.	250	Each	3,168.59	792,147.50
4	Vol-III, Part-IV, Highway works, Items #39(11), Page-221	<b>Dismantling</b> Dismantling of existing asphalt concrete road including base, sub-base and disposal of dismantled materials to designated placed	200	Cu.m	974.59	194,918.00
5	Vol-III, Part-IV, Highway works Items #10, Page-212	<b>Excavation</b> Excavation in existing berm for widening the road, including Preparation of sub-grade after watering, rolling with Power Roller, dressing the excavated stuff etc.: complete	1,265	Sq.m	176.41	223,158.65
6	Vol-III, Part-IV, Highway works, Items #39(6), Page-221	<b>Scarification</b> Scarifying the existing road surface	1,050	Sq.m	68.14	71,547.00
7	Vol-III, Part-IV, Highway works Items #6(II)(a), Page-211 (II) (a)	<b>Embankment</b> Earth work for road embankment by bulldozer including ploughing, mixing, clod breaking dressing and compacting with optimum moisture content. Lead upto 100 ft: and lift upto 5 ft: in all types of soil except rock. <b>If earth work is done by other then departmental agency.</b> For 95-100% modified AASHO density	575	Cu.m	583.67	335,610.25
8	Vol-III, Part-IV, Highway works Items #9, Page-212	<b>Sub -Grade</b> Preparing sub grade including earth excavation or filling to an average depth of 9" dressing to camber and consolidation with power Roller	1,050	Sq.m	176.41	185,230.50
9	Vol-III, Part-IV, Highway works Items #11(d), Page-213	<b>Sub-Base Course</b> Preparing Sub-Base by supplying and spreading well graded pit or bed run gravel having a liquid limit not greater than 25 and plasticity index not greater than 6 in proper camber and grade including watering rolling and compacting in layers, thickness of each compacted layer not exceeding 6" compacted upto 98-100% density as per modified AASHO density (Rate i/c all cost of materials T&P and carriage upto 3 chanins)	1,160	Cu.m	3,429.99	3,978,788.40

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**ROAD WORK**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
10	Vol-III, Part-IV, Highway works Items # 13(b), Page- 214	<b>Base Course</b> Providing and laying Aggregate base course in proper grade and camber having CBR 80% as per specification i/c spreading and compacting by approved mechanical means (Motor grader, Vibratory roller and Smooth wheel roller etc.) watering to maintain the moisture content the compaction of each layer shall 100 percent to the max dry density (Rate i/c all cost of materials T&P and carriage upto 3 chains	3,162	Cu.m	4,893.72	15,473,942.64
11	Vol-III, Part-IV, Highway works Items # 31, Page- 218	<b>SURFACE TREATMENT</b> <b>Prime Coat or Tack Coat</b> Applying priming coat or tack coat with approved binder at the required rate including cleaning the road surface thoroughly, heating to the required temperature and spraying the binder with pressure as directed etc., complete	42,159	Sq.m	37.67	1,588,129.53
12	Vol-III, Part-IV, Highway works Items # 24.(A), Page- 217	<b>Asphalt Wearing Course</b> <b>1½" Thick Asphalt Concrete Wearing Course Plant Mix</b> Laying mechanically to proper line and grade plant mixed Asphalt Concrete specified formula according to job mixed formula approved by the Engineer incharge rolling and finishing to design Proper grade line level and comberetc (Machinery with POLs Cost of material carriage).	21,080	Sq.m	1,813.81	38,235,114.80
13	Vol-III, Part-IV, Ch.#8 Items # 39.(14), Page-221	<b>Kerb Stone</b> Providing & fixing Precast Edge Block 3750 PSI Industrial Made Size 6 inches thick x 12 inches long x 18 inches high including the cost of Cartage, excavation, form Work for haunching, 1450 PSI lean concrete, 2250 PSI concrete for haunching, 1:4 cement sand mortar	5,775	Rm	2,225.09	12,849,894.75
14	Vol-III, Part-I, Ch.#8 Items # 67, Page-50	<b>Paving Blocks on Footpath</b> Providing & fixing cement paving blocks flooring having size of 197 x 97 x 60 (mm) of city /quddra / cobble shape with natural colours , having strength b/w 5000 PSI to 8500 PSI i/c filling the joints with hill sand over a bed of 2" thick hill sand or stone dust and laying and compacting in specified manner/ pattern and design etc. complete	2,599	S.qm	2,124.88	5,522,575.60
15	Vol-III, Part-IV, Highway works Items # 39.(13), Page-221	<b>Tharmo Plastic Paint</b> Pavement marking in Reflective Tharmo Plastic Paint for Lines of 6" Width.	1,500	Rm	282.51	423,765.00
16	Vol-III, Part-IV, Highway works Items # 39.(12), Page-221	<b>Cat Eyes / Road Studs</b> Supplying and Fixing of reflectorize Road Studs Double Face, Flush surface type	20	Each	1,520.42	30,408.40
17	Vol-III, Part-III, Ch. #16, Items #1.(b), Page-209  (b)	<b>Manhole Cover</b> Manufacturing & Supplying of R.C.C manhole cover cast in 1:2:4 cement concrete ratio 3" inch deep at center reinforced with 1/2" dia tor steel bars with 4" c/c welded to a 3/16' thick 2 inch wide M.S Plate and two hooks of 3/8" inch dia tor bars including compacting, curing and transportation 24" inch dia	10	Each	3,730.24	37,302.40

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**ROAD WORK**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
18	Vol-III, Part-IV, Highway works Items # 18, Page- 222	<b>Traffic Signs</b>  Providing & Fixing traffic sign 3' dia G.I.Pipe post and sign of equilateral triangular shape each side 3' long i/c Painting, Marking as directed each.  (a)  (b) Providing & Fixing 3' dia G.I single post sign of circular shape 3' Dia i/c Painting, Marking as directed each  (c) (I) Providing & Fixing Rectangular shape 3'x2' comprizing 2 Nos: 3" Dia G.I pipe Post i/c Painting, writing as directed each.	3  3  5	Each  Each  Each	55,873.81  55,873.81  52,117.78	167,621.43  167,621.43  260,588.90
19	Vol-III, Part-I, Ch.#4 Items # 9, Page-26	Precast cement concrete solid or face block at edge of footpath (1 : 2 : 4 ) including cost of templates	57	Cu.m	17,076.22	978,404.07
20	Vol-III, Part-I, Ch.#4 Items # 9, Page-26	<b>Sleeves Marker</b>  Precast cement concrete solid or face block (1 : 2 : 4 ) including cost of templates	0.4531	Cu.m	17,076.22	7,736.71
21	Vol-III, Part-I, Ch.#4 Items # 5(f), Page-25	<b>Speed Breaker</b>  Cement concrete plain including placing compacting, finishing and curing, complete (including screening and washing at stone aggregate without shuttering Ratio. 1:2 :4	23.7819	Cu.m	15,724.36	373,955.14
22	Vol-III, Part-II, Ch.# II, Items #4(d), Page-111	<b>Sleeves</b>  Providing, Laying uPVC pipes of Class 'B' fixingintrenchi/cutting, fitting and jointing with solvent cement i/c testingwithwater to a head of 61 meter or 200 ft.  d) 150 mm (6" dia) b) 100 mm (4" dia)	174.0 174.0	R.m R.m	2,508.07 1,332.41	436,404.33 231,840.16
23	Vol-III, Part-I, Ch.#11Items #5(e), Page-63	<b>Paint on Kerb Stone</b>  Preparing surface and painting fillets, framings, skirtings, pipes, gutters and similar, linear work not exceeding 6" inches in with Priming coat. Each subsequent coat	5,775 5,775	Rm Rm	25.99 16.44	150,066.38 94,928.35
<b>TOTAL OF SCHEDULE ITEMS</b>					<b>Rs.</b>	<b>83,714,779.62</b>
Premium / Rebate on Schedule Items (___%)					<b>Rs.</b>	
<b>TOTAL OF SCHEDULE ITEMS WITH PREMIUM / REBATE</b>					<b>Rs.</b>	

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**ROAD WORK**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(B) NON-SCHEDULE ITEMS</b>						
		<b>Plantation</b>				
24	N.S	Plantation of Tree having height minimum 1.3m (4.5 feet) of following type including excavation , providing sweat earth with fertilizers. Excavation, Plantation and Back fill complete in all respect. The replacement / replantation of the dead plant is also included in the scope with in the currency of contract.				
	a.	Neem	255	Each		
	b.	Gulmohar	15	Each		
	c.	Amaltas	15	Each		
	d.	Aerocaria	15	Each		
	e.	Jacaranda	15	Each		
	f.	Terminalia	15	Each		
	g.	Acacia Nodosa/Javinica	15	Each		
	h.	Bakain	15	Each		
	j.	Arjun	15	Each		
	k.	Alstonia	5	Each		
	l.	Sukhchian	20	Each		
	m.	Ulta Ashok	20	Each		
	n.	Moringa	5	Each		
		<b>Binder</b>				
		<b>2" (50mm) Asphaltic Base Course Plant mix</b>				
25	N.S	Providing and laying Plant mixed Asphalt Concrete Binder Course compacted thickness 2 inches (50mm thick) as per approved job mix formula using crush aggregate from approved sources. Using asphalt of grade 80/100 during laying temperature not less than 140C compacted by steel wheel & PTR roller. The procedure of laying binder course material & methodology shall fully comply with AASHTO and as directed by Engineer Incharge. Minimum bitumen content should be 3.5% binder course shall be spreading using paver machine. Rolling & Finishing to design proper grade line level and camber etc.: (Machinery with POLs cost of material carriage)	21,080	Sq.m		
26		<b>Bollard</b>				
	N.S	Providing and Fixing Mild Steel Bolard of 6" dia pipe (filled with PVC) with C.C foundation including excavation and restoration of road as directed by the engineer complete in all respect with reflected 3M or equivalent sheets (Black and Yellow)	7	Each		
27		<b>Arm Barrier</b>				
	N.S	Providing and installation of arm barrier of mild steel pipe with weight bucket dia 150 mm(6") for carriage way of 24' approx. including steel stand and foundation with all required civil works (excavation , backfill, concreting ) as directed by the engineer complete in all respect	2	Each		
<b>TOTAL OF NON-SCHEDULE ITEMS</b>					<b>Rs.</b>	
<b>TOTAL OF (A + B)</b>					<b>Rs.</b>	-

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**BOUNDARY WALL & RELOCATE OF GATE**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(A) SCHEDULE ITEMS</b>						
1		<b><u>Dismantling</u></b>				
a.	Vol-III, Part-I, Ch.#2 Items # 14, Page-19	Dismantling cement block masonry	9.47	Cu.m	1,790.47	16,951.38
b.	Vol-III, Part-I, Ch.#2 Items # 20, Page-20	Dismantling cement concrete reinforced separating reinforced cement from concrete cleaning and straightening the same	7.15	Cu.m	8,112.56	58,031.29
2		<b><u>Earthwork</u></b>				
	Vol-III, Part-I, Ch.#1 Items # 18, Page-17	Earth work excavation in irrigation channels, drains etc., dressed to designed section grades and profiles excavated material disposed off and dressed within 50 ft. (15 meter) lead				
	b.	In ordinary soil	31.91	Cu.m	279.69	8,924.15
	c.	In hard soil or soft murum	31.91	Cu.m	358.09	11,425.61
3		<b><u>Plain Cement Concrete</u></b>				
	j.	Ratio 1:4:8	4.70	Cu.m	12,318.93	57,948.25
4		<b><u>REINFORCED CEMENT CONCRETE (SUB-STRUCTURE)</u></b>				
	Vol-III, Part-I, Ch.#4 Items # 6, Page-25	Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds, lifting, centering, shuttering and curing (including screening and washing of shingle.)				
	a.	R.C.C work in roof slab, beams, column, rafts, lintels and other structural members laid in situ or precast laid in position complete in all respects				
	i.	Ratio 1 : 2 : 4 90 Lbs of cement, 2 Cft sand and 4 Cft shingle 1/8" to 3/4" gauge				
		Foundation	10.40	Cu.m	25,341.69	263,510.90
		Plinth Beam	7.37	Cu.m	25,341.69	186,653.56
		Column (Short & Long)	7.37	Cu.m	25,341.69	186,653.56
5		<b><u>REINFORCEMENT</u></b>				
	Vol-III, Part-I, Ch.#4 Items # 8, Page-26	Fabrication of deformed steel reinforcement for cement concrete including cutting, bending, laying in position, making joints and fastenings including cost of binding wire (also includes removal of rust from bars.)				
	a.	Deformed bar				
	i.	Grade-60	60.00	Cwt	18,934.02	1,136,041.20
6		<b><u>BLOCK MASONRY WORK</u></b>				
	Vol-III, Part-I, Ch.#4 Items # 24, Page-27	Providing and laying 1 : 3 : 6 cement concrete solid block masonry wall 6" and below in thickness set in 1 : 6 cement mortar in ground floor Super Structure including raking out joints & curring etc., complete	19.50	Cu.m	18,180.87	354,469.52
7		<b><u>Colour Washing</u></b>				
	Vol-III, Part-I, Ch.#9 Items # 38.A, Page-54	1st coat over white washed surface				
		New Surface	384.00	Sq.m	45.73	17,560.32
<b>TOTAL OF SCHEDULE ITEMS</b>					<b>Rs.</b>	<b>2,298,169.74</b>
<b>Premium / Rebate on Schedule Items (___%)</b>					<b>Rs.</b>	
<b>TOTAL OF SCHEDULE ITEMS WITH PREMIUM / REBATE</b>					<b>Rs.</b>	



**REHABILITATION OF EXISTING METALLED ROAD  
 FROM MASKAN GATE TO PHARMACY INTERSECTION  
 AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**BOUNDARY WALL & RELOCATE OF GATE**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(B) NON-SCHEDULE ITEMS</b>						
8	N.S	<b>M.S GATE (Removing &amp; Re-fixing)</b> Removing and re-fixing M.S Gate (double leaf) from existing boundary wall and fixed at new boundary wall with repair and alignment, level etc. including required hardware and applying anti rustes paint, enamel paint with complete in all respect, as direct by the Engineer.	3.00	Job		
<b>TOTAL OF NON-SCHEDULE ITEMS</b>					Rs.	
<b>TOTAL OF (A + B)</b>					Rs.	-

**Check Post ,**  
**UGWT ,**  
**Septic Tank &**  
**Soak Pit(B)**

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- CIVIL WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(A) SCHEDULE ITEMS</b>						
1	Vol-III, Part-I, Ch.#1 Items #5, Page-15	<b>EXCAVATION FOR FOUNDATION</b> Earth work excavation in irrigation channels, drains etc, dressed to designed section grades and profiles excavated material disposed off and dressed within 50 ft. (15 metre) lead				
		a. Ordinary Soil	1024.00	Cft.	7.92	8,110.08
		b. Hard Soil	1024.00	Cft.	10.14	10,383.36
2	Vol-III, Part-I, Ch.#1 Items #21, Page-17	<b>BACK FILLING (USING EXCAVATED / SURPLUS EARTH PRESENT AT SITE)</b> Filling, watering and ramming earth in under floors with surplus earth from foundation etc. lead upto one chain and lift upto 5 feet.	1527.00	Cft.	6.50	9,925.50
3	Vol-III, Part-I, Ch.#4 Items #5(i), Page-24-25	<b>LEAN CONCRETE</b> Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering.				
		i. Ratio. 1: 4 :8	103.00	Cft.	348.83	35,929.49
4	Vol-III, Part-I, Ch.#4 Items #6, Page-25	<b>REINFORCED CEMENT CONCRETE</b> Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds lifting shuttering curing rendering and finishing the exposed surface (including screening and washing of shingle)  <b>NOTE : ALL STRUCTURAL CONCRETE UPTO PLINTH LEVEL SHALL BE WITH SULPHATE RESISTING CEMENT .</b> R.C. work in roof slab, beams columns rafts, lintels and other structural members laid in situ or precast laid in position complete in all respects.				
		a. Ratio 1:2: 4 Conc. 90 lbs OPC cement,2 cft Sand 4 Cft stone aggregate				
		a. Foundation	353.00	Cft.	717.59	253,309.27
		b. Column upto plinth	67.00	Cft.	717.59	48,078.53
		c. Plinth beams	162.00	Cft.	717.59	116,249.58
		d. Columns in super structure	152.00	Cft.	717.59	109,073.68
		e. Roof Beams	81.00	Cft.	717.59	58,124.79
		f. Slabs	673.00	Cft.	717.59	482,938.07
5	Vol-III, Part-I, Ch.#4 Items #8, Page-26	<b>STEEL REINFORCEMENT</b> Fabrication of deformed steel reinforcement for cement concrete including cutting,bending, laying in position, making joints and fastenings including cost of binding wire (also includes removal of rust from bars.)				
		a. Deformed bar				
		i. Grade-60	77.45	Cwt	18,934.02	1,466,365.31
6	Vol-III, Part-I, Ch.#4 Items #23, Page-27	<b>BLOCK MASONARY</b> Providing and laying 1 :3 : 6 Cement concrete <b>solid Block masonry</b> wall above 6" in thickness set in 1 : 6 cement mortar in G.F ground floor superstructure including raking out joints & curing etc, complete	1448.00	Cft.	493.79	715,007.92

**REHABILITATION OF EXISTING METALLED ROAD  
 FROM MASKAN GATE TO PHARMACY INTERSECTION  
 AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- CIVIL WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
7		<b>RENDERING (PLASTER )</b>				
		<b>Internal Plaster</b>				
a	Vol-III, Part-I, Ch.#9 Items #11(b), Page-52	Cement Plaster 1:4 upto 12' height  1/2" thick Plaster (for ceiling )	1208.00	Sft.	39.83	48,114.64
b	Vol-III, Part-I, Ch.#9 Items #13(b), Page-52	Cement Plaster 1:6 upto 12' height (Internal)  1/2" thick Plaster ( wall)	3209.00	Sft.	37.01	118,765.09
		<b>External Plaster</b>				
c	Vol-III, Part-I, Ch.#9 Items #11(c), Page-52	Cement Plaster 1:4 upto 12' height  3/4" thick Plaster (for wall)	3457.00	Sft.	53.82	186,055.74
8	<b>B</b>	<b>FLOORING</b>				
		<b>FLOORING BASE CONC. 1:3 :6</b>				
	Vol-III, Part-I, Ch.#4 Items #5(h), Page-24-25	Cement Concrete plain including placing, compacting, finishing and curing complete including screening and washing at stone aggregate with out shuttering.	399.00	Cft.	388.67	155,079.33
9		<b>FLOOR, DADO &amp; SKIRTING</b>				
		<b>Wall Tile</b>				
	Vol-III, Part-I, Ch.#8 Items #24, Page-45	Laying floor of approved with glazed tiles 1/4" thick dado of approved color & size jointing in white cement and laid over 1:2 cement sand mortar 3/4" thick including grouting with matching color and finishing	739.00	Sft.	389.36	287,737.04
		<b>Floor Tile &amp; Skirting</b>				
	Vol-III, Part-I, Ch.#8 Items #24, Page-45	Laying floor of approved with glazed tiles 1/4" thick floor of approved color & size jointing in white cement and laid over 1:2 cement sand mortar 3/4" thick including grouting with matching color and finishing	595.00	Sft.	389.36	231,669.20
10		<b>Door with Door Frame</b>				
	Vol-III, Part-I, Ch.#10 Items #8, Page-57	Providing and fixing in position, doors, windows and ventilators of 2"x2"x1/4" angle iron frames and 1- 3/4" thick commercial ply wood (3 ply) on both sides, including hold fasts, cleats, iron tower bolts, handles, hinges and one mortice lock.	127.00	Sft.	2,995.87	380,475.49
11		<b>MS SECURITY GRILLS</b>				
	Vol-III, Part-I, Ch.#17 Items #26, Page-76	Supplying & fixing in position iron/steel grill of 3/4" x 1/4" size flat iron of approved design including painting 3 coats etc. complete ( weight not to be less than 3.7 lbs /sft of finished grill ) item # 26 , pg 76	68.00	Sft.	1,124.10	76,438.80
12		<b>ALUMINUM WINDOWS /VENTILATORS</b>				
	Vol-III, Part-I, Ch.#18 Items #84, Page-83	Supplying & fixing in position Aluminum channels framing for sliding windows & ventilators of made with 5 mm thick tinted glass glazing (Belgium) & Aluminum fly screen l/c handles stoppers & locking arrangementetc. Complete. (a) Deluxe model	80.00	Sft.	2,386.73	190,938.40

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- CIVIL WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
13	Vol-III, Part-I, Ch.#9 Items #24(c), Page-53	<b>PAINT</b>				
		i. <b>CEILING DESTEMPER</b> Distempering three coats page	1208.00	Sft.	17.23	20,813.84
	Vol-III, Part-I, Ch.#9 Items #36(A), Page-54	ii. <b>INTERNAL WALL PAINTING</b> Preparing the surface and painting with matt finish l/c rubbing the surface with Bathy (silicon carbide rubbing brick) filling the voids with zink /chalk / plaster of paris mixture, applying first coat premix, making the surface smooth and then painting 3 coats with matt finish of approved make etc: complete .(new surface)	3209.00	Sft.	49.27	158,107.43
		iii. <b>EXTERNAL WALL PAINTING</b> Preparing the surface and painting with weather coat l/c rubbing the surface with rubbing brick / sand Paper, filling the voids with chalk/ plaster of Paris and then painting with weather coat of approved make.	3457.00	Sft.	39.38	136,136.66
	Vol-III, Part-I, Ch.#11 Items #5d), Page-63	iv. <b>PAINT OVER IRON SURFACE</b> Preparing surface and painting guard bars gates, iron bars grating, railings (including standard braces etc) and similar open work.				
		i. Priming Coat	68.00	Sft.	9.76	663.68
	ii. Each Subsequent Coat	68.00	Sft.	7.12	484.16	
<b>TOTAL OF SCHEDULE ITEMS</b>					Rs.	<b>5,304,975.08</b>
Premium / Rebate on Schedule Items (___%)					Rs.	
<b>TOTAL OF SCHEDULE ITEMS WITH PREMIUM / REBATE</b>					Rs.	
<b>(B) NON-SCHEDULE ITEMS</b>						
14	N.S	<b>P.C.C (2000 psi)</b> Providing & laying <b>P.C.C. concrete</b> , having minimum compressive cylindrical strength 28 days of <b>2000 psi</b> , graded coarse and fine aggregate conforming to ASTM specifications at over membrane & roof slab including leveling, compacting & curing, including form work if any, complete as per drawing and specification or as directed by the Engineer.				
		a Screed at roof	269	Cft.		
<b>TOTAL OF NON-SCHEDULE ITEMS</b>					Rs.	
<b>TOTAL OF (A + B)</b>					Rs.	-

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(A) SCHEDULE ITEMS</b>						
<b>SANITARY FITTING</b>						
1	Vol-III, Part-I, Ch.#1 Items #5, Page-204	Providing and fixing European type white glazed earthen ware wash down W.C. pan complete with & including the cost of white / black plastic seat ( Best quality ) and lid with C.P. brass hinges best quality and buffers 3 gallons white glazed earthen ware low level flushing cistem with siphon fitting 1½ " dia white porcelain enameled flush bend dia and making requisite number of holes in walls , plinth & floor for pipe connection & making good in cement concrete 1:2:4 ( Foreign quality ) . ( ICL or equivalent ) .	1	P.No	42,354.59	42,354.59
2	Vol-III, Part-I, Ch.#1 Items #3(b), Page-204	Providing and fixing Orusa type white glazed earthen ware W.C. pan with front flush inlet & complete with including the cost of flushing cistem with internal fitting and flush pipe with bend and making requisite number of holes in walls, plinth & floor for pipe connection & making good in cement concrete 1:2:4.	3	P.No	11,282.90	33,848.70
3	Vol-III, Part-I, Ch.#6 Items #19-A), Page-198	Supplying & fixing C.P muslim shower with double bib cock and ring pipe etc. complete	3	P.No	5,475.60	16,426.80
4	Vol-III, Part-I, Ch.#1 Items #8, Page-205	Providing and fixing 24x18" lavatory basin in white glazed carthen ware complete with & including the cost of W.I. or C.I. cantilever bracket 6 inches built into wall, painted white in two coats after a primary coat of red lead paint, a pair of ½" dia chrome plated pillar taps, 1-1/2" rubber plug & chrome plated brass chain 1-1/4" dia malleable iron or C.P. brass traps malleable iron or brass unions and making requisite number of holes in walls, plinth & floor for pipe connection & making good in cement concrete 1:2:4 (Standard Pattern) (Karam Ceramics).	3	P.No	9,495.14	28,485.42
5	Vol-III, Part-I, Ch.#1 Items #9, Page-205	Add extra for providing & fixing of earth ware pedestal white or coloured Glazed ( Standard pattern)	3	P.No	3,276.00	9,828.00
6	Vol-III, Part-I, Ch.#6Items #3(a), Page-215	Providing & Fixing C.P Shower brass shower rose with or 3/3" inlet (with detachable lid) 4" dia (Standard quality )	3	Each	1,333.80	4,001.40
7	Vol-III, Part-I, Ch.#2Items #O(a), Page-134	Chamber for the required diameter of circular sewer and 3'-6" (1067 mm) depth with walls of B.B in cement sand mortar 1:3 cement plastered 1:3, 1/2" thick, inside of walls and 1" (25 mm) thick over benching and channel i/c fixing C.I manhole coverwith frame of clear opening 1-1/2' x1- 1/2' (457x457 mm) of 1.75 cwt. (88.9 kg) embaded in plain C.C1:2:4 and fixing 1" (25 mm) dia M.Ssteps6"(150 mm) wide projecting 4" (102 mm) from the face of wall at 12" (305 mm) C/C duly painted etc. Complete as per standard specification and drawing a 4" to 12" dia 2'x2'x3'-6"	3	Each	55,584.18	166,752.54
8	Vol-III, Part-I, Ch.#16Items #1(a), Page-209	Manufacturing & Supplying of R.C.C manhole cover cast in 1:2:4 cement concrete ratio 3" inch deep at center reinforced with 1/2" dia tor steel bars with 4" c/c welded to a 3/16' thick 2 inch wide M.S Plate and two hooks of 3/8" inch dia tor bars including compacting, curing and transportation within 10 miles. (a) 21" inch dia	3	Each	3,238.79	9,716.37

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES  
CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
9	Vol-III, Part-I, Ch.#7Items #22(a), Page-42	Cast iron rain water down pipe fixed in position, excluding heads and shoes, but including painting and clamps, etc. (a) 4" (100mm) dia Cast Iron down pipe.	50	P.Rft	475.37	23,768.50
10	Vol-III, Part-I, Ch.#7Items #24, Page-42	Shoes bends or offsets for cast iron rain water down pipe including fixing and painting.	4	P.No	688.86	2,755.44
11	Vol-III, Part-I, Ch.#2Items #4(d), Page-111	Providing, Laying uPVC pipes of Class 'B' fixing in trench/cutting, fitting and jointing with solvent cement i/c testing with water to a head of 61 meter or 200 ft. d) 150 mm (6" dia)	15	R.ft	764.46	11,466.90
12	Vol-III, Part-I, Ch.#6Items #4(B), Page-197	Providing and fixing full way gun metal valves with wheels, threaded or flanged end with rubber washer  e 1-1/2" dia (Standard Pattern) f 2" dia (Standard Pattern)	1 1	Each Each	1,614.60 1,965.60	1,614.60 1,965.60
13	Vol-III, Part-I, Ch.#8Items #1(A), Page-201	Supplying & fixing Fiber glass tank of approved quality and design and wall thickness as specified including cost of nuts, bolts and fixing in plat form of cement concrete 1:3:6 and making connection for inlet, outlet and over flow pipes etc. complete. (A) 250 gallons tank with wall thickness 3.5mm. Material	1	Each	37,698.31	37,698.31
14	Vol-III, Part-I, Ch.#6Items #1(b), Page-197	<b>Supplying &amp; Fixing in Position C.P bib.</b> 1/2" dia C.p Bib Cock (standard pattern)	3	Each	1,134.90	3,404.70
15	Vol-III, Part-I, Ch.#1Items #19(C), Page-188	Providing and fixing steel sinks stainless local bt make complete with cast iron or wrought iron LINA ALVH brackets 6 inches built into wall, 1 1/2" rubber plug and chrome plated brass chain 1 1/2" C.P. brass waste wwith 1-1/2" P.V.C. waste pipe & making requisite number of holes in walls, plinth & floor for pipe connection & making good in cement concrete 1:2:4. c Steel Sink stainless size 33"x18" local make (standard pattern)	1	P.No	10,215.27	10,215.27
<b>TOTAL OF SCHEDULE ITEMS</b>					<b>Rs.</b>	<b>404,303.14</b>
<b>Premium / Rebate on Schedule Items (___%)</b>					<b>Rs.</b>	
<b>TOTAL OF SCHEDULE ITEMS WITH PREMIUM / REBATE</b>					<b>Rs.</b>	
<b>(B) NON-SCHEDULE ITEMS</b>						
16	<b>B</b> N.S	<b>SANITARY DRAINAGE</b> PPR cold and hot water pipes SDR 6(PN 20) conforming to DIN 8077 & DIN 8078 & fittings SDR 6 (PN20) conforming to DIN 16962.  a) 20 mm (outer dia 25mm) b) 25 mm (outer dia 32 mm) c) 32 mm (outer dia 40 mm)	60 15 40	R.ft R.ft R.ft		
17	N.S	Galvanized steel cold water pipe & fittings conforming to BS-1387 (medium quality) of the following diameter running on roof wrapped in fibre glass wool insulation as specified. (ring expose on roof)  a) 32 mm (1.25 inch) b) 50 mm (2 inch) c) 100 mm (4 inch )	100 15 15	R.ft R.ft R.ft		

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
18	N.S	uPVC pipe confoRMing to ASTM D-1785 schedule 40 & fittings confirMing to D-2466 Schedule 40 for soil, waste and vent pipe of following diameters: a) 40 mm b) 50 mm c) 80 mm d) 100 mm  uPVC floor traps of the following diameter as specified. a) 75 mm  uPVC floor drains of the following diameter as specified. a) 75 mm  UPVC floor cleanout of the following diameter with brass cover as specified. a) 100 mm b) 75 mm	5 25 25 30	R.ft R.ft R.ft R.ft		
19	N.S	<b>FIRE FIGHTING</b> Ref. Spec. 5150, 5220 & 5180  Portable fire extinguisher of following types with hanging arrangement as specified.(NEFCOor Equivalent)  a) Dry Chemical Powder Type (5 Kg) b) Carbon Dioxide type (5 Kg) c) Foam type (9 litre)	6 2 1	No. No. No.		
20	N.S	<b>PUMPING MACHINERY</b> Ref. Spec. 5240 & 5220 Potable water booster pumps of following flow and head level suitable at UGWT and OHWT, gate valves, check valves and all other accessories required for installation and operation  Flow = 10 US GPM Head =40 feet	1	No.		
<b>TOTAL OF SANITARY</b>					<b>Rs.</b>	
		<b>ELECTRICAL WIRING &amp; FIXTURES</b>				
		<b>BASIC ELECTRICAL MATERIAL &amp; METHODS</b> <b>Particular Notes:</b> a) See pricing preambles / General Instructions. b) Separate back boxes shall be used for Emergency / UPS circuits for normal light / power wiring c) Wiring shall be done with appropriate color codes as per latest edition of IEEE wiring regulations <b>d) Wiring Accessories shall be based on Clipsal C-Vivace series (white)</b>  Providing and fixing of following point wiring with single core PVC insulated 450/750 volt grade copper conductors, including green/yellow CPC (cream color for clean / isolated earth) in appropriate size class B PVC conduit rigid / flexible, clipped to the surface, or concealed in structure or in already-laid trunking, including cutting, chasing, making good and all accessories, 10A gang switch, fan dimmer, 2 way switch, bell push, ceiling rose, sheet steel back-box with earth terminal, fan hook, connectors etc.,1.0mmsq 3-core flexible PVC/PVC cord upto fixture, etc., for; a) DB / UPS-DB / LCP to switch / relay / dimmer (including wiring between switching units on same circuit) with 2x2.5mmsq conductors and 2.5mmsq CPC b) Light / exhaust / fan point to switch with 2x1.5mmsq conductors and 1.5mmsq CPC	3 26	Nos. Nos.		



**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
	2	Providing and fixing of switch socket-outlet point wiring with single core PVC insulated 450/750 volt grade copper conductors, including green/yellow CPC (cream color for clean / isolated earth) in appropriate size class B PVC conduit rigid / flexible, clipped to the surface, or concealed in structure or in already-laid trunking, including cutting, chasing, making good, sheet steel back-box with earth terminal, connectors etc., and all accessories, as follows: a. From DB to 5A/13A Round Universal switch socket outlet point with 2x2.5mmsq conductors and 2.5mmsq CPC 4 Nos. b. Same as (a) above but, point to point with 2x2.5mmsq conductors and 2.5mmsq CPC 14 Nos. c. From DB to 13A flat pin (simplex / duplex) / switch socket outlet point with 2x4 mmsq conductors + 4 mmsq isolated earth. 6 Nos. d. Same as item (c) but, point to point with 2x2.5mmsq conductors and 2.5mmsq CPC 4 Nos. e. 5 / 13 /15A adjacent outlet with 2x2.5mmsq conductors + 2.5mmsq CPC (isolated earth with 13A sockets) 6 Nos. f. DB to 15A round pin switch socket outlet point with 2x4mmsq conductors + 4mmsq CPC 1 No.				
	3	Providing and fixing of 20 amp isolator wiring for AC / ventilation fans/ Water Heater, including wiring between isolator and indoor unit with single core PVC insulated 450/750 volt grade copper conductors, including green/yellow CPC, in appropriate size class B PVC conduit rigid / flexible, clipped to the surface, or concealed in structure or in already-laid trunking, including cutting, chasing, making good, sheet steel back-box with earth terminal for isolator and all mounting accessories, as follows: a. From DB to 20A SPN isoator point with 2x4.0mmsq conductors and 4.0mmsq as CPC 2 Nos.				
	4	Providing and fixing of wiring for UPS / Data Center Rack power, with PVC insulated 450/750 volt grade copper conductors, including green/yellow CPC, in appropriate size class B PVC conduit rigid / flexible, clipped to the surface, or concealed in structure or in already-laid trunking, including cutting, chasing, making good, sheet steel back-box with earth terminal for isolator and all mounting accessories, as follows: a. From DB / CDB to UPS in/out isoator / industrial socket outlet point with 5Cx6.0mmsq conductors [avg len = xx rft] 2 Nos.				Ref. Section "Wiring"
		<b>Total Cost of Electrical Material and Methods:</b>			<b>Rs.</b>	
		<b>WIRING &amp; RACEWAY</b>				
		<u>Particular Notes:</u> a) See pricing preambles / General Instructions. <b>Note: Cost of ceiling suspended conduits, pipes, cable tray etc. even if not explicitly stated shall be inclusive of threaded rods, nuts washer, steel base plate etc</b> <b>WIRING (LV)</b> Supply, laying, connecting up and testing of non armoured / armoured cable 600/1000 V grade, in already laid raceway, including all fixing, jointing & termination accessories, designation labels at both ends etc., in the following sizes (Actual length of cable shall be measured at site by the contractor before placing the order with the manufacturer, however approximate length of cable are shown herewith)				
	1	a. 4C x 16mmsq Cu/PVC/PVC [From Existing MDB to MDB-IBA-G ]	65	Rft		

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
	2	Supply, laying, connecting up and testing of PVC insulated 450/750V grade cable, in already laid raceway including all fixing, jointing & termination accessories, designation labels at both ends etc., in the following sizes: (Actual length of cable shall be measured at site by the contractor before placing the order with the manufacturer, however approximate length of cable are shown herewith)				
		a. 3C x 6mmsq Cu/PVC/PVC (For UPS)	20	Rft		
		b. 1C x 16mmsq PVC (Earthing Cable)	65	Rft		
		c. 1C x 6mmsq PVC (Earthing Cable)	20	Rft		
		d. 1C x 4mmsq PVC (Equipment Earthing)	30	Rft		
	3	<b>RACEWAY</b> Supply, laying and installation of following PVC / GI / MS pipe to be recessed in walls / floors or clipped to surface, as required at site and as shown on the drawing including accessories steel pull wires, complete in all respects;				
		a. 60mmx60mm PVC channel (Adamjee Dura Duct or equivalent)	80	Rft		
		b. 38mm dia (class B)	30	Rft		
		c. 32mm dia (class B)	45	Rft		
		d. 25mm dia (class B)	10	Rft		
	4	Providing and fixing underfloor RCC / block masonry Man hole / Hand Hole, including medium duty uPVC (or appropriate rust proof) cover with collar and all installation accessories etc complete in all respects [with 2" thick 1:3:6 CC base and 1:4 wall plaster-1/2"]				
		a. 300x300x450mm block masonry hand hole with 5" horizontal block on cc base and 5" vertical blocks for walls	3	Nos.		
		<b>Total Cost of Wiring and Raceways:</b>			<b>Rs.</b>	
		<b>WIRING ACCESSORIES</b>				
		<u>Particular Notes:</u>				
		a) See pricing preambles / General Instructions.				
		b) Cost of industrial sockets shall be of complete set (male + female)				
		<b>c) Wiring Accessories shall be based on Clipsal C-Vivace series (white)</b>				
	1	Providing and fixing following rating 250/500 volt switch socket outlet and all mounting accessories				
		a. 3 pin, 5 Amp, 250 volt universal switch socket outlet	20	Nos.		
		b. 3 pin, 13 Amp, flat pin, 250 volt switch socket outlet	16	Nos.		
		c. 3 pin, 15 Amp, 250 volt switch socket outlet	2	Nos.		
		d. 32 Amp, SPN+E industrial socket outlet (surface, flanged type) male - female set	2	Nos.		
	2	Providing and fixing following rating SP&N 250 / TP&N 500 volts weather proof load break switches / isolator, including whether proof sheet steel enclosure and all mounting accessories				
		a. 20A, 250V, double pole isolator switch with neon indication (AC, air curtain, water heater, etc.)	1	No.		
	3	Providing and fixing following type 250 volts ceiling suspended, false ceiling mounted fan / exhaust fan, including all mounting accessories				
		a. 56" dia ceiling suspended fan with 12" long rod	3	Nos.		
		b. 18" dia wall bracket fan	3	Nos.		
		c. 8" plastic exhaust fan	3	Nos.		
	4	Providing and fixing following type pull boxes in 16swg sheet steel with cover and knockouts for cable entry, including all mounting accessories etc. complete in all respects				
		a. 12"x12" floor-mount sheet steel (Epoxy powder painted GI) pull box	3	Nos.		
		b. 12"x12" ceiling mount PVC pull box	3	Nos.		

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
	6	Providing and fixing 16SWG (powder painted) sheet steel furniture boxes (technology box) with cover and provision for outlets (A, B, C types etc.)/ floor boxes, <b>without</b> socket outlets but including all mounting accessories etc. complete in all respects.  a. Furniture outlet box consisting of 1x 13A, 3 Pin Duplex switch socket outlet 1x 5A, 3 Pin switch socket outlet 1x dual port RJ45 outlet	3	Nos.		
		<b>Total Cost of Wiring Accessories</b>			<b>Rs.</b>	
		<b>LIGHT FIXTURES</b>				
		Particular Notes: a) See pricing preambles / General Instructions. b) Fluorescent fixtures should be compatible with and fit exactly into the false ceiling c) <b>All lamps shall be warm white (4000K) unless otherwise stated or instructed by Architect / Consultant</b> d) Ballast shall be of electronic type as indicated e) All light fixtures including emergency and exit lights shall be LED type f) <b>All light fixtures shall be rated at minimum 35000 operating hours</b> Providing and Fixing of following light fixtures as per fixture schedule or equivalent light fixture as approved by consultant installed on surface or on false ceiling or pendant mounted, with all accessories such as lamps, lamp holders, ballast, starters, capacitors, LED drivers as applicable, etc. and all relevant installation material as approved by the Engineer, complete in all respects				
	1	a. Fixture type "A": Surface / Recessed type LED Downlight fixture including 12W LED lamp (warm white) b. Fixture type "C": Surface mounting Flood Light fixture including 100W LED Lamp	28	Nos.		
			4	Nos.		
		<b>Total Cost of Light Fixtures:</b>			<b>Rs.</b>	
		<b>STRUCTURED CABLING SYSTEM</b>				
		Particular Notes: a) See pricing preambles / General Instructions. b) All components, materials and equipment shall meet or exceed the relevant Category requirements of EIA/TIA Standard 568A/B c) Contractor shall coordinate and follow recommendations of Voice / Data equipment supplier <b>DATA CABLING SYSTEM</b> Providing and fixing of following type of wiring with 4 pair CAT6 UTP cable in appropriate size class B PVC conduit rigid / flexible, clipped to the surface, or concealed in structure or in already-laid trunking, including cutting, chasing, making good, including termination at both ends, sheet steel back-box etc. and all accessories etc. complete in all respects as follows:				
	1	a. Cat6 LSOH UTP cable (plenum rated) from Data Patch Panel to Cat6 RJ45 outlet (23 AWG)	27	Nos.		
	2	Supply and installation of (imported, Velocity, Contch, Toten, Taiwan etc.) 19" 9U Data Rack (600mmx800mm) with mesh front door including 1 Fan tray, 2 fixed and 1 sliding tray and all mounting accessories etc. (50% of the cabinet space shall be kept empty to install active networking hardware).	3	Nos.		

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
	3	Supply, installation and connecting up of following type Cat6 multiport (RJ45) jack patch panels including sleeve type labelling and all mounting accessories etc. complete in all respects				
		a. 24 Port Patch Panel, including rear cable mangement	3	Nos.		
		b. Front Cable Management	3	Nos.		
	4	Providing and fixing following type shuttered communication outlet including sleeve type labelling, identification tags and all accessories etc. complete in all respects.				
		a. Single Port, Cat6 RJ45 outlet	11	Nos.		
		b. Dual Port, Cat6 RJ45 outlet	13	Nos.		
	5	Supply, installation and connecting up of Cat6 patch cords with RJ45/RJ45 plugs as follows;				
		a. 1.0 m long	11	Nos.		
		b. 2.0 m long	13	Nos.		
	6	Supply, installation and connecting up of Rack mount 3 way power extension strip.	3	Nos.		
	7	Testing and Commissioning, including labelling of Data / Voice network and providing owner/consultant witnessed fluke test report (two copies, bounded) etc. complete in all respects.	1	Job		
		<b>VOICE CABLING SYSTEM</b>				
	8	Providing and fixing of following type of wiring in already laid raceway including termination at both ends, sheet steel back-box, and all accessories etc. complete in all respects as follows;				
		a. 5 pair Cat5e cable from PTCL Cabinet to DeMarc block / TJB [Length mentioned is approximate only. Exact length to be confirmed as per site]	35	Rft		
		b. 5 pair Cat5e cable from PABX - TJB	20	Rft		
	9	Providing and fixing of following type of TJB / Main Cross Connect / MDF / IDF including wheather resistant sheet steel / PVC back-box, and all accessories etc. complete in all respects as follows;				
		a. TJB 50 pair (110 type IDC wiring blocks) wall mounted (PVC enclosure)	1	No.		
		b. 05 pair building entrance protector (gas tube based) installed in TJB Guard (Mandatory requirement)	1	No.		
	10	Providing and connecting up of factory made patch cords (non-plenum) as follows;				
		a. 2 pair Cat5e 110-110 type plugs, 0.6m	2	Nos.		
		b. 4 pair Cat5e 110-RJ45 type	2	Nos.		
		<b>FIBER OPTIC / INFRASTRUCTURE NETWORK</b>				
	11	Providing, laying and connecting up of following type of fiber optic cable in already laid raceway including termination at both ends, and all accessories etc. complete in all respects as follows;				
		a. 6 strand 9/125um OS-1 semi armoured single mode fiber optic cable	130	Rft		
	14	Supply, installation and connecting up of following type multiport fiber optic patch panels including labelling and all mounting accessories etc. complete in all respects				
		a. 12 Port FO Patch Panel, including mangement tray	3	Nos.		
	15	Providing, fixing and connecting up of following type fiber optic connectors with pigtails, including splicing labelling and all mounting accessories etc. complete in all respects				
		a. Singlemode 1 mtr. SC Pigtail	3	Nos.		

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
	16	Supply and connecting up of following type of fiber optic patch cords				
	a.	Simplex SC - LC (or as applicable) 1 mtr. Fiber Patch Cord	3	Nos.		
	17	Testing and Commissioning, including labelling of entire fiber optic network and providing owner/consultant witnessed OTDR test report (two copies, bounded) etc. complete in all respects.	1	Job		
		<b>Total Cost of Structure Cabling:</b>			<b>Rs.</b>	
		<b>EARTHING SYSTEM</b>				
		Particular Notes: a) See pricing preambles / General Instructions. b) All earth pits shall be individually tested for value <=1 Ohm.				
	1	Providing, fixing and commissioning of earth test point at various locations, including isolators, nuts bolts washers and all mounting accessories with green colored heat shrink sleeves , as follows;				
	a.	Providing and fixing of tinned copper earth bar 12" long, 1" wide and ½" thick in Electric closet for system / genset earthing etc.	3	Nos.		
	b.	Providing and fixing of tinned copper earth bar 8" long, 1" wide and ½" thick in Server and UPS Rooms for rack earthing .	3	Nos.		
	2	Equipotential bonding of all DB's racks, UPS, etc with 1C x 4 sqmm Cu/PVC cable connected to nearest earth test point including lugs, washers bolts etc. complete in all respects. Cable already covered in other section. Only services to be considered	1	Job		
		<b>Total Cost of Earthing System:</b>			<b>Rs.</b>	
		<b>UPS / STABILIZED POWER SYSTEM</b>				
		Particular Notes: a) See pricing preambles / General Instructions.				
	1	Supply, installation and commissioning of following type / size of Uninterruptible Power Supply (UPS) system, with minimum backup time of 15 minutes with maintenance free lead acid batteries, including all mounting accessories etc. complete in all respects				
	a.	5kVA 1~in/1~out floor mount UPS (Eaton, APC or Equilent)	1	No.		
		<b>Total Cost of Miscellaneous items</b>			<b>Rs.</b>	
		<b>SWITCHGEAR</b>				
		Particular Notes: a) See pricing preambles / General Instructions. b) Short-circuit ratings to IEC 947-2, Icu/Ics at 400V c) All components (ELCBs, Contactors etc.) are to be provided with backup protection d) DBs of incoming size 100A or less may be provided with cascading e) Vendor shall be responsible for getting the DB's verified by consultant / 3rd party prior to dispatch to site. Cost of factory inspection including air travel, lodging, per diem charges shall be borne by the contractor				

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**CHECK POST- MEP WORKS**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
1		Supply, installing, testing & commissioning of following distribution boards ( made of 16 SWG sheet steel ) with hinged doors and locks, including bus bars of tin plated copper conductor for phases, neutral and ground, of short circuit rating as mentioned below and all TP MCCBs shall also have minimum ultimate interrupting capacities (Icu) as mentioned in the drawings or more ( All circuit breakers will be having co-ordination and selectivity properties for this system ) , with proper brass glands for incoming cables. All DBs are Flush / surface Mounted type and of suitable dimensions to fit-in the location / space shown on drawings. The contractor shall take the dimensions of the site, prepare the shop drawing of DB / Panel and approval from the Consultant before manufacturing) and with following configuration (Maximum current density of each Phase, Neutral and Earth bus bar shall not be more than 1.5 Amp per sq. mm & arrangement / connections of bus bar will be as required. All of the MCBs & MCCBs will be having thermal as well as magnetic short circuit releases).				
		a. MDB-IBA-G (Wall Mounted)	1	No.		
		b. DB-IBA-G-01 (Wall Mounted)	1	No.		
		c. DB-IBA-G-01 (Wall Mounted)	1	No.		
		<b>Total Cost of Switchgear:</b>			<b>Rs.</b>	
		<b>C.C.T.V. SYSTEM (IP)</b>				
		<u>Particular Notes:</u>				
		a) See pricing preambles / General Instructions.				
		b) Video retention to be min 45 day at 25fps, HDD capacity to be configured accordingly				
		Wiring for CCTV System from camera to recording equipment in Server / Security room with following / manufacturers recommended cable in appropriate size PVC conduit including all accessories etc. complete in all respects.				
1		a. From IP camera to appropriate floor patch panel in IT Rack (MDF / IDF) with Cat 6 UTP LSZH cable (23 AWG)	16	Nos.		Ceiling already covered in "Structured Cabling" section
2		Refixing and connecting up of following CCTV Cameras Including mounting and all accessories, complete in all respects.				
		a. 4 MP (smoked dome type) IP Camera [cameras to be project series and not commercial series]	16	Nos.		
3		Refixing and connecting up of NVR (raid capable) 16CH with recording of atleast 30 days for the above mentioned cameras also having frame rate and other specifications as mentioned on the drawing or instructed by the consultant, including system configuration and licenses for 3 concurrent sessions. (2x8TB HDD or higher as per recording requirement)	1	No.		
4		Providing and fixing of 24 port POE switch, including system configuration etc. complete in all respects	1	No.		
5		Providing, fixing and connecting up of 32" LCD Monitor in Security Room	1	No.		
6		Testing and Commissioning of CCTV system including training of owner's personnel in the operation and maintenance of the equipment (All operation and maintenance manuals shall be submitted in triplicate).	1	Job		
		<b>Total Cost of IP C.C.T.V. System:</b>			<b>Rs.</b>	
<b>TOTAL OF ELECTRICAL</b>					<b>Rs.</b>	
<b>TOTAL OF NON-SCHEDULE ITEMS</b>					<b>Rs.</b>	
<b>TOTAL OF (A + B)</b>					<b>Rs.</b>	-

**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**UNDER GROUND WATER TANK**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(A) SCHEDULE ITEMS</b>						
1	Vol-III, Part-I, Ch.#1 Items #5, Page-15	<b>EXCAVATION FOR FOUNDATION</b> Earth work excavation in irrigation channels, drains etc, dressed to designed section grades and profiles excavated material disposed off and dressed within 50 ft. (15 metre) lead				
		a. Ordinary Soil	630.00	Cft.	7.92	4,989.60
		b. Hard Soil	630.00	Cft.	10.14	6,388.20
2	Vol-III, Part-I, Ch.#4 Items #5, Page-24-25	<b>LEAN CONCRETE</b> Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering.				
		i. Ratio. 1:3 :6	31.00	Cft.	388.67	12,048.77
		ii. Ratio. 1: 1 1/2 :3	15.00	Cft.	502.17	7,532.55
3	Vol-III, Part-I, Ch.#4 Items #6, Page-25	<b>REINFORCED CEMENT CONCRETE</b> Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds lifting shuttering curing rendering and finishing the exposed surface (including screining and washing of shingle)				
		a Bottom Slab(28 Mpa)	105.00	Cft.	717.59	75,346.95
		b Wall(28 Mpa)	255.00	Cft.	717.59	182,985.45
		c Top Slab(28 Mpa)	80	Cft.	717.59	57,407.20
4	Vol-III, Part-I, Ch.#9 Items #11(c), Page-52	<b>PLASTER</b> Cement plaster 1:4 upto 12' height. (c) 3/4" thick	340	Sft	53.82	18,298.80
5	Vol-III, Part-I, Ch.#11 Items #9, Page-63	<b>Bitumen coating</b> Bitumen coating to plastered or cement concrete surface.	1000	Sft	21.83	21,830.00
6	Vol-III, Part-I, Ch.#4 Items #8, Page-26	<b>STEEL REINFORCEMENT</b> Fabrication of deformed steel reinforcement for cement concrete including cutting,bending, laying in position, making joints and fastenings including cost of binding wire (also includes removal of rust from bars.)				
		a. Deformed bar				
		i. Grade-60	19.68	Cwt	18934.02	372,621.51
7	Vol-III, Part-I, Ch.#4 Items #7(i), Page-25	<b>Water Proffing</b> P/Applying Hi Bond (Sealer ) water proofing polymer Modified comontitions slurries (WPMCS) to be used as water proofing, anticorrosion, weater resistance or curring membranc for fresh concrete having thickness upto 2mm in two coats upto 20' height testured or trowel finish grey or coloured i/c preparing the surface for application aas directed by Engineer Inchare.	405.00	Sft	56.71	22,967.55
<b>TOTAL OF SCHEDULE ITEMS</b>					<b>Rs.</b>	<b>782,416.58</b>
<b>Premium / Rebate on Schedule Items ( ___%)</b>					<b>Rs.</b>	
<b>TOTAL OF SCHEDULE ITEMS WITH PREMIUM / REBATE</b>					<b>Rs.</b>	

**REHABILITATION OF EXISTING METALLED ROAD  
 FROM MASKAN GATE TO PHARMACY INTERSECTION  
 AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**

**UNDER GROUND WATER TANK**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(B) NON-SCHEDULE ITEMS</b>						
8	N.S	<b>M.S RUNGS</b> Providing fabricating and fixing of 20mm (3/4") dia G.I ladder/rungs in U.G water tank as shown in drawing painting with rust proof paint etc, complete in all respect as per specifications & relevant approved drawings, all works to the entire satisfaction and as directed by the Engineer	10	Nos.		
9	N.S	<b>Swellable Bar</b> Providing and fixing for construction joint in concrete, provide swellable bar approved as wall thickness, providing key in concrete and cost of the material and labor etc. complete in all respects as per standard specification, drawing and entire satisfaction of the Engineer.	40	Rft		
<b>TOTAL OF NON-SCHEDULE ITEMS</b>					Rs.	
<b>TOTAL OF (A + B)</b>					Rs.	-



**REHABILITATION OF EXISTING METALLED ROAD  
FROM MASKAN GATE TO PHARMACY INTERSECTION  
AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES  
SEPTIC TANK & SOAK PIT**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(A) SCHEDULE ITEMS</b>						
<b>1</b>	Vol-III, Part-I, Ch.#1 Items #5, Page-15	<b>EXCAVATION FOR FOUNDATION</b> Earth work excavation in irrigation channels, drains etc, dressed to designed section grades and profiles excavated material disposed off and dressed within 50 ft. (15 metre) lead				
		a. Ordinary Soil	1034.25	Cft.	7.92	8,191.26
		b. Hard Soil	1034.25	Cft.	10.14	10,487.30
<b>2</b>	Vol-III, Part-I, Ch.#4 Items #2, Page-24	<b>Stone Filling</b> Dry rammed brick or stone ballast 1 1/2" to 2" gauge	440	Cft.	104.97	46,186.80
<b>3</b>	Vol-III, Part-I, Ch.#4 Items #5, Page-24-25	<b>Lean Concret</b> Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering.				
		i. Ratio. 1:3 :6	42.00	Cft.	388.67	16,324.14
		ii. Ratio. 1: 1 1/2 :3	15.00	Cft.	502.17	7,532.55
<b>4</b>	Vol-III, Part-I, Ch.#4 Items #6, Page-25	<b>REINFORCED CEMENT CONCRETE</b> Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds lifting shuttering curing rendering and finishing the exposed surface (including screening and washing of shingle)				
		a Bottom Slab	105.00	Cft.	717.59	75,346.95
		b Wall	255.00	Cft.	717.59	182,985.45
		c Top Slab	94.67	Cft.	717.59	67,931.85
<b>5</b>	Vol-III, Part-I, Ch.#9 Items #11(c), Page-52	<b>PLASTER</b> Cement plaster 1:4 upto 12' height. (c) 3/4" thick	340	Sft	53.82	18,298.80
<b>6</b>	Vol-III, Part-I, Ch.#11 Items #9, Page-63	<b>Bitumen coating</b> Bitumen coating to plastered or cement concrete surface.	1000	Sft	21.83	21,830.00
<b>7</b>	Vol-III, Part-I, Ch.#4 Items #8, Page-26	<b>STEEL REINFORCEMENT</b> Fabrication of deformed steel reinforcement for cement concrete including cutting,bending, laying in position, making joints and fastenings including cost of binding wire (also includes removal of rust from bars.)				
		a. Deformed bar				
		i. Grade-60	19.69	Cwt	18934.02	372,716.93
<b>8</b>	Vol-III, Part-I, Ch.#4 Items #7(i), Page-25	<b>Water Proffing</b> P/Applying Hi Bond (Sealer ) water proofing polymer Modified comontitions slurries (WPMCS) to be used as water proofing, anticorrosion, weater resistance or curring membranc for fresh concrete having thickness upto 2mm in two coats upto 20' height testured or trowel finish grey or coloured i/c preparing the surface for application aas directed by Engineer Inchare.	405.00	Sft	56.71	22,967.55
<b>TOTAL OF SCHEDULE ITEMS</b>					<b>Rs.</b>	<b>850,799.58</b>
Premium / Rebate on Schedule Items ( ___%)					<b>Rs.</b>	
<b>TOTAL OF SCHEDULE ITEMS WITH PREMIUM / REBATE</b>					<b>Rs.</b>	

**REHABILITATION OF EXISTING METALLED ROAD  
 FROM MASKAN GATE TO PHARMACY INTERSECTION  
 AT KARACHI UNIVERSITY**

**BILL OF QUANTITIES**  
**SEPTIC TANK & SOAK PIT**

S.No.	CSR-24 Govt. of Sindh	Description	Qty.	Unit	Rate (PKR.)	Amount (PKR.)
<b>(B) NON-SCHEDULE ITEMS</b>						
9	N.S	<b>M.S RUNGS</b> Providing fabricating and fixing of 20mm (3/4") dia G.I ladder/rungs in U.G water tank as shown in drawing painting with rust proof paint etc, complete in all respect as per specifications & relevant approved drawings, all works to the entire satisfaction and as directed by the Engineer.	10	Nos.		
10	N.S	<b>Swellable Bar</b> Providing and fixing for construction joint in concrete, provide swellable bar approved as wall thickness, providing key in concrete and cost of the material and labor etc. complete in all respects as per standard specification, drawing and entire satisfaction of the Engineer.	40	Rft		
11	N.S	<b>BLOCK MASONARY</b> Providing and laying 1 : 3 : 6 Cement concrete <b>solid Block masorany</b> wall above 6" in thickness set with open joints	770.00	Cft.		
<b>TOTAL OF NON-SCHEDULE ITEMS</b>					Rs.	
<b>TOTAL OF (A + B)</b>					Rs.	-

<b>Gross Total Amount for this Project</b>	
<b>Add 15 % SRB ON Gross Total Amount</b>	
<b>Grand Total Amount Including SRB</b>	

**Grand Total Amount in Words:**

**Rupees:** \_\_\_\_\_

\_\_\_\_\_

**ROAD WORK  
 MEASUREMENTS SHEET**

Sr.#	Description	No.	Measurements			Qty.	Qty. I/c 5% Add	Unit
			L	W	H/D			
	<b>EARTH WORK</b>							
<b>1</b>	<b>Clearing &amp; Gurbing</b>							
	Section-A	1	990	8.50		8,415.00		
	Section-B	1	385	8.50		3,272.50		
						-		
					<b>Total</b>	<b>11,687.50</b>	<b>12,272.00</b>	<b>SM</b>
<b>2</b>	<b>Jungle Clearance</b>							
	Section-A	1	990	8.50		8,415.00		
	Section-B	1	385	8.50		3,272.50		
						-		
					<b>Total</b>	<b>11,687.50</b>	<b>12,272.00</b>	<b>SM</b>
<b>3</b>	<b>Trees Relocate</b>							
	Section-A & B					250.00		
						-		
					<b>Total</b>	<b>250.00</b>	<b>250.00</b>	<b>Nos.</b>
<b>4</b>	<b>Dismantling of existing road</b>							
	Section-A	1						
	Section-B	1						
					<b>Total</b>	<b>-</b>	<b>200.00</b>	<b>CM</b>
<b>5</b>	<b>Excavation</b>							
						1,150.00		
						-		
					<b>Total</b>	<b>1,150.00</b>	<b>1,265.00</b>	<b>SM</b>
<b>6</b>	<b>Scarification</b>							
		1	1,000			1,000.00		
						-		
					<b>Total</b>	<b>1,000.00</b>	<b>1,050.00</b>	<b>SM</b>
<b>7</b>	<b>Embankment</b>							
						520.00		
						2.00		
					<b>Total</b>	<b>522.00</b>	<b>575.00</b>	<b>CM</b>
	<b>SUB BASE &amp; BASE COURSE</b>							
<b>8</b>	<b>Preparing sub grade</b>							
		1	1,000			1,000.00		
						-		
					<b>Total</b>	<b>1,000.00</b>	<b>1,050.00</b>	<b>SM</b>
<b>9</b>	<b>Sub Base Course</b>							
	Section-A	2	990	2.30	0.150	683.10		
	Section-B	1	385	7.30	0.150	421.58		
					<b>Total</b>	<b>1,104.68</b>	<b>1,160.00</b>	<b>CM</b>
<b>10</b>	<b>Base Course</b>							
	Section-A	2	990	7.30	0.150	2,168.10		
	Section-B	2	385	7.30	0.150	843.15		
					<b>Total</b>	<b>3,011.25</b>	<b>3,162.00</b>	<b>CM</b>

**ROAD WORK  
 MEASUREMENTS SHEET**

Sr.#	Description	No.	Measurements			Qty.	Qty. I/c 5% Add	Unit
			L	W	H/D			
	<b>SURFACE COURSE</b>							
<b>11</b>	<b>Prime Coat &amp; Tack Coat</b>							
	Section-A	2	990	14.60		28,908.00		
	Section-B	2	385	14.60		11,242.00		
						1.00		
					<b>Total</b>	<b>40,151.00</b>	<b>42,159.00</b>	<b>SM</b>
<b>12</b>	<b>Binder</b>							
	Section-A	2	990	7.30		14,454.00		
	Section-B	2	385	7.30		5,621.00		
						1.00		
					<b>Total</b>	<b>20,076.00</b>	<b>21,080.00</b>	<b>SM</b>
<b>13</b>	<b>Asphalt Wearing Course</b>							
	Section-A	2	990	7.30		14,454.00		
	Section-B	2	385	7.30		5,621.00		
						1.00		
					<b>Total</b>	<b>20,076.00</b>	<b>21,080.00</b>	<b>SM</b>
<b>14</b>	<b>Kerb Stone</b>							
	Section-A	4	990			3,960.00		
	Section-B	4	385			1,540.00		
						-		
					<b>Total</b>	<b>5,500.00</b>	<b>5,775.00</b>	<b>RM</b>
<b>15</b>	<b>Pavers</b>							
	Section-A	2	990	0.90		1,782.00		
	Section-B	2	385	0.90		693.00		
						-		
					<b>Total</b>	<b>2,475.00</b>	<b>2,599.00</b>	<b>SM</b>
<b>16</b>	<b>Thermo Plastic Paint</b>							
	Section-A	1	990			990.00		
	Section-B	1	385			385.00		
						53.00		
					<b>Total</b>	<b>1,428.00</b>	<b>1,500.00</b>	<b>RM</b>
<b>17</b>	<b>Block Masonry</b>							
		2	121.761	0.33	0.670	53.84		
						0.16		
					<b>Total</b>	<b>54.00</b>	<b>57.00</b>	<b>CM</b>
<b>18</b>	<b>Sleeve Marker</b>							
		8	0.594	0.594	0.153	0.431		
					<b>Total</b>	<b>0.431</b>	<b>0.453</b>	<b>CM</b>
<b>19</b>	<b>Spead Breaker</b>							
	Software Calculation					-	<b>23.782</b>	<b>CM</b>

**REHABILITATION OF EXISTING METALLED ROAD  
 FROM MASKAN GATE TO PHARMACY INTERSECTION  
 AT KARACHI UNIVERSITY**

**ROAD WORK  
 MEASUREMENTS SHEET**

Sr.#	Description	No.	Measurements			Qty.	Qty. I/c 5% Add	Unit
			L	W	H/D			
<b>20</b>	<b>uPVC Pipe</b>							
a.	6" Dia					117.000		
						48.000		
					<b>Total</b>	<b>165.000</b>	<b>174.00</b>	<b>RM</b>
b.	4" Dia					117.000		
						48.000		
					<b>Total</b>	<b>165.000</b>	<b>174.00</b>	<b>RM</b>
<b>21</b>	<b>Paint on Kerb Stone</b>							
	Section-A	4	990			3,960.00		
	Section-B	4	385			1,540.00		
						-		
					<b>Total</b>	<b>5,500.00</b>	<b>5,775.00</b>	<b>RM</b>



Institute of  
Business Administration  
Karachi

*Leadership and Ideas for Tomorrow*

## INSTITUTE OF BUSINESS ADMINISTRATION KARACHI

### REHABILITATION OF EXISTING METALLED ROAD FROM MASKAN GATE TO PHARMACY INTERSECTION AT KARACHI UNIVERSITY

## TECHNICAL SPECIFICATIONS

OCTOBER 2024



# GENERAL

## 1. Introduction

### 1.1 Preamble

General Specifications have been produced for National Highway Authority, keeping in consideration that following types of activities are being carried out in this organization:

- i) Construction of Motorways, new Highways, Bridges and allied works.
- ii) Rehabilitation and Improvement of existing road network.
- iii) Maintenance of existing roads and structures.

All the above three aspects of construction, rehabilitation and maintenance have been covered in these General Specifications. Subsequent chapters would give a list of such items of work with an indication of their probable use, in case of the above three categories of works.

### 1.2 Standards

These Specifications describe the requirements and procedures for execution of work items to achieve required workmanship and quality. The materials to be used shall conform to specifications and testing procedures as per American Association of State Highway and Transportation Officials (AASHTO), the American Society for Testing and Materials (ASTM) or British Standard (B.S.) as indicated in their latest editions. Samples of materials for laboratory tests and their subsequent approval shall be utilized according to these references.

### 1.3 Manpower

Contractor shall also provide skilled manpower in adequate number, who can perform execution with quality and workmanship control in accordance with the requirements of the work item.

### 1.4 Equipment

Number and kind of Equipment required for different items of work shall be planned by the contractor keeping in view the workmanship required by a particular item and the quantity of finished item required to be carried out in eight hours shift. The Engineer shall approve such planning or any changes shall be proposed for guidance of the Contractor. However this procedure shall not relieve the Contractor of his contractual obligations pertaining to performance and maintenance of project.

### 1.5 Alternative Equipment

While few of these specifications may provide that equipment of a particular size and type is to be used to perform portions of the work, it is to be understood that the deployment and use of new or improved equipment is to be encouraged.

The Contractor may request, in writing, permission from the Engineer to use equipment of a different size or type in place of the equipment specified or recommended in these chapters.



The Engineer, before considering or granting such request, may require the Contractor to furnish, at his expense, evidence to satisfy the Engineer that the equipment proposed for use by the Contractor is capable of producing work equal to or better in quality than, that which can be produced by the equipment specified.

If such permission is granted by the Engineer, it, shall be understood that such permission is granted for the purpose of testing the quality of work actually produced by such equipment and is subject to continuous attainment of results which, in the opinion of the Engineer, are equal to, or better than, that which can be obtained with the equipment specified. The Engineer shall have the right to withdraw such permission at any time when he determines that the alternative equipment is not producing work of equal quality in all respects, to that which can be produced by the equipment specified. Upon withdrawal of such permission by the Engineer, the Contractor will be required to use the equipment originally specified and shall, in accordance with the directions of the Engineer ' remove and dispose off or otherwise remedy, at his expense, any defective or unsatisfactory work produced with the alternative equipment.

Neither the Employer nor the Contractor shall have any claim against the other for either the withholding or the granting of permission to use alternative equipment, or for the withdrawal of such permission.

Nothing in this clause shall relieve the Contractor of his responsibility for furnishing materials or producing finished work of the quality specified in these specifications.

## 1.6      Storage of Materials

Articles or materials to be incorporated in the work shall be stored in such a manner as to ensure the preservation of their quality and fitness for the work, and to facilitate inspection.

## 1.7      Defective Materials

All materials which the Engineer has determined as not conforming to the requirements of the drawings and specifications will be rejected whether in place or not. They shall be removed immediately from the site of the work, unless otherwise permitted by the Engineer. No rejected material, the defects of which have been subsequently corrected, shall be used in the work, unless approval in writing has been given by the Engineer. Upon failure of the Contractor to comply promptly with any order of the Engineer made under the provisions in this clause, the Engineer shall have authority to cause the removal of rejected material and to deduct the cost thereof from any payments due or to become due to the Contractor.

## 1.8 Quarry Materials

Quarry material is rock, sand, gravel, earth, or other mineral material, other than local borrow or selected material, obtained on the project. Quarry material does not include materials such as cement, lime, marble powder etc. obtained from established commercial sources.

Quarry Materials shall be furnished by the Contractor from any source he may select, except that when mandatory local sources of certain materials are designated in the Special Provisions, the Contractor shall furnish material from such designated mandatory sources.

The furnishing of quarry materials from any source is subject to the provisions of "Examination of drawings, Specifications, and item of Work".

Unless approved in writing by the Engineer, material sources shall not be excavated at locations where the resulting scars will present an unsightly appearance from any highway. No payment will be made for material obtained in violation of this provision.

The Contractor shall, at his expense, make any arrangements necessary for hauling over local public and private roads from any source.

Full compensation for furnishing all labour, materials, tools, equipment, and incidentals, and for doing all the work involved in conforming to the provisions in this clause, for furnishing and producing materials from any source shall be considered as included in the price paid for the contract item of work involving such material and no additional compensation will be allowed therefore.

## 1.9 Trade Names and Alternatives

For convenience in designation on the plans or in the specifications, certain articles or materials to be incorporated in the work may be designated under a trade name or the name of a manufacturer and the catalogue information. The use of an alternative article or material that is of equal quality and of the required characteristics for the purpose intended will be permitted, subject to the following requirements:

The responsibility of proof as to quality and suitability of alternatives shall be upon the Contractor and he shall furnish all information necessary as required by the Engineer. The Engineer shall be the sole judge as to the quality and suitability of alternative articles or materials and his decision shall be final.

Whenever the specifications permit the substitution of a similar or equivalent material or article, no tests or action relating to the approval of such substitute material will be made until the request for the substitution is made in writing by the Contractor accompanied by complete data as to the equality of the material or article proposed. Such request shall be made well in time to permit approval without delaying the work.

## 1.10      Frequency of Tests & Test Designation

Frequency of tests for the items of construction has been given in subsequent chapters. Test designation and procedure will be used as given in the latest version of relative publication.

## 1.11      Testing

Unless otherwise specified, all tests shall be performed in accordance with the methods used by AASHTO/ASTM and shall be made by the contractor under the supervision of the Engineer or his designated representative.

Whenever the specifications provide an option between two or more tests, the Engineer will determine the test to be used.

Whenever a reference is made in the specifications to a specification manual, or a test designation either of the American Society For Testing and Materials, the American Association of State Highway and Transportation Officials, Federal Highway Specification, or any other recognized national organization, and the number or other identification representing the year of adoption or latest revision is omitted, it shall mean the specification, manual or test designation in effect on the day 30 days prior to the date for submission of bids. Whenever said specification manual or test designation provides for test reports (such as certified mill test reports) from the manufacturer, copies of such reports, identified as to the lot of material, shall be furnished to the Engineer. When material that cannot be identified with specific test reports is proposed for use, the Engineer may, at his discretion, select random samples from the lot for testing. Test specimens from the random samples, including those required for retest, shall be prepared in accordance with the referenced specification and furnished by the Contractor at his expense. The number of such samples and test specimens shall be entirely at the discretion of the Engineer. Unidentified metal products such as sheet plate, hardware, etc. shall be subject to the test requirements prescribed by the Engineer.

When desired by the Engineer, the Contractor shall furnish, without charge, samples of all materials entering into the work and no material shall be used prior to approval by the Engineer. Samples of material from local sources shall be taken by or in the presence of the Engineer, otherwise the samples will not be considered for testing.

## 1.12 Construction Stakes, Lines and Grades

The Engineer will furnish design survey data and jointly locate with contractor, all points of intersection and of tangents and basic benchmarks. The plans indicate the properties of horizontal and vertical curves, together with rates of super elevation where required. The contractor shall set construction stakes establishing lines, slopes, and continuous profile-grade in road work, and center line and bench marks for bridge work, culvert work, protective and accessory structures and appurtenances and will furnish the Engineer with the original copy of the field notes together with all necessary information relating to lines, slopes and grades. These stakes and marks shall constitute the field control by and in accordance with which the contractor shall establish other necessary controls and perform the work.

If, in the opinion of the Engineer, modification of the line or grade is advisable, before or after stakeout, the Engineer will issue detailed instructions to the Contractor for such modification and the Contractor will revise the stakeout for further approval. No change in bid unit price will be made for such modifications.

The profiles and cross sections on the plans indicate the elevation of the top of road surface or as otherwise noted on the plans. The contractor shall be responsible for the preservation of all stakes and marks, and if any of the construction stakes or marks has been destroyed or disturbed, the Contractor will replace them at his own expense.

The Contractor shall be responsible for the accuracy of all lines, slopes, grades, and other survey work.

## 1.13 As-Built Drawings/Shop Drawings

During construction, the Contractor shall keep an accurate record of all deviations of work as actually installed from that shown or indicated on the Contract Drawings or revised during construction. Upon completion of the Works, the Contractor shall deliver all 'M Built' drawings to the Engineer.

All shop drawings/fabrication drawings shall be prepared by the Contractor and submitted to the Engineer before the start of the work. The Engineer shall check and approve or return the same to the Contractor for correction/modification. All works are to be executed in accordance with shop drawings, approved before the commencement of the works. Shop drawings should truly reflect the provisions of typical drawings. Any deviation from the provision of contract drawings, shall not be allowed unless written approval is issued by the Engineer.

## 1.14 Utility Lines

The Contractor shall conduct his operations, make necessary arrangements, take suitable precautions and perform all required works incidental to the protection of and avoidance of interference with power transmission, telegraph, telephone and natural gas lines, oil lines water and sewerage mains and other utilities within the areas of his operations in connection with his contract and the Contractor shall save harmless and indemnify the Employer in respect of all claims, demands, proceedings, costs, charges and expenses whatsoever arising out of or in relation to any such interference.

### 1.15 Safety Precautions

The Contractor shall adequately provide for the safety, health and welfare of persons and for the prevention of damage to works, materials and equipment for the purpose of or in connection with the Contract.

### 1.16 Inspection

The Engineer shall, at all times, have safe access to the work during its construction, and shall be furnished with every reasonable facility for ascertaining that the materials and the workmanship are in accordance with the requirements and intentions of these Specifications, the Special Provisions, and the plans/drawings. All works done and all materials furnished shall be subject to inspection by Engineer.

The inspection of the work or materials shall not relieve the Contractor of any of his obligations to fulfill his contract as prescribed. Work and materials not meeting such requirements shall be made good and unsuitable work or materials may be rejected, notwithstanding that such work or materials have been previously inspected by the Engineer or that payment therefore has been included in a progress estimate.

### 1.17 Removal of Rejected and Unauthorized Work

All works, which have been rejected, shall be remedied, or removed and replaced by the Contractor in an acceptable manner and no compensation will be allowed to him for such removal, replacement, or remedial work.

Any work done beyond the lines and grades shown on the plans or established by the Engineer, or any extra work done without written authority will be considered as unauthorized work and will not be paid for.

Upon order of the Engineer, unauthorized work shall be remedied, removed, or replaced at the Contractor's expenses.

Upon failure of the Contractor to comply promptly with any order of the Engineer made under this Item, the Employer may cause rejected or unauthorized work to be remedied, removed, or replaced and to deduct the costs from any payment due or to become due to the Contractor.

### 1.18 Alternative Methods of Construction

Whenever the plans or specifications provide that more than one specified methods of construction or more than one specified type of construction equipment may be use to perform portions of the work and leave the selection of the method of construction or the type of equipment to be used up to the Contractor. it is understood that the Employer does not guarantee that every such method of construction or type of equipment can be used successfully throughout all or any part of any project. It shall be the Contractor's responsibility to select and use the alternative or alternatives, which will satisfactorily perform the work under the conditions encountered.

In the event some of the alternatives are not feasible or it is necessary to use more than one of the alternatives on any project, full compensation for any additional cost involved shall be considered as included in the contract price paid for the item of work involved and no additional compensation will be allowed thereof.

## 1.19 Conformity with Contract Documents and Allowable Deviations

Work and materials shall conform to the lines, grades, cross sections, dimensions and material requirements, including tolerances, shown on the plans or indicated in the specifications. Although measurement, sampling and testing may be considered evidence as to such conformity, the Engineer shall be the sole judge as to whether the work or materials deviate from the plans and specifications, and his decision relating to any allowable deviations there from shall be final.

## 1.20 Trial Section

Contractor shall submit complete methodology of trial section for approval of the Engineer. Trial sections shall be prepared for each type of road pavement layer. In spite of the approval of Engineer for trial section, contractor shall be responsible for the quality of work. Contractor will provide minimum of following information's in the methodology.

- i) Equipment to be used.
- ii) Layer thickness adopted.
- iii) Per day production. iv) Results of tests.

## 2. Scope

The Standard Specifications is a part of contract documents which shall be read in conjunction with the following contract documents which are mutually explanatory to one another and mentioned hereunder, with the order of precedence as given in the Condition of Contract.

- (i) Contract Agreement.
- (ii) Instruction to bidders.
- (iii) Addenda.
- (iv) Letter of acceptance.
- (v) Supplementary conditions.
- (vi) Special Provisions.
- (vii) Conditions of Contract Part - 11, (viii) Conditions, of Contract Part - 1.
- (ix) Drawings.
- (x) General Specifications.
- (xi) The bid and Appendices "A to L.

### 3. Abbreviations and Definitions

Wherever in these specifications or in other contract documents the following abbreviations and terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

#### 3.1 Abbreviations

AASHTO	-	American Association of State Highway and Transportation Officials.
ASTM	-	American Society for Testing and Material
AWG	-	American Wire Gauge
AWPA	-	American Wood Preservers Association
BS	-	British Standard Code of Practice
ACI	-	American Concrete Institute
FHWA	-	U.S. Federal Highway Administration
PCA	-	Portland Cement Association
Wt.	-	Weight
Lb.	-	Pound
AWS	-	American Welding Society
Gallon	-	U.S. Gallon
In.	-	Inch
Ft.	-	Foot
Yd.	-	Yard
Ltr.	-	Litre
mm	-	Millimeter
cm.	-	Centimeter
m	-	Meter
Km	-	Kilometer
SM	-	Square Meter
o	-	degree
Sq. cm.	-	Square Centimeter
CM	-	Cubic Meter
Ha	-	Hectare
Kg	-	Kilogram
Ton	-	Metric Ton (1000 Kg)
°C	-	Degree Centigrade
°F	-	Degree Fahrenheit

## 3.2 Definitions

Wherever in these specifications or in other contract document the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

### Accepted

- Completion of the work item to the Engineer's satisfaction

### Addendum

- A written amendment or revision to the Contract documents or plans issued to bidders prior to the final date and time for submission of Tenders in the Instruction to Tenderer."

### Aggregates

- Crushed stone or processed gravel (shingle)

### Amenities

- Recreational facilities and similar items provided to improve living conditions at site - characteristics conducive to pleasantness.

### Apron

- A concrete, rock or masonry slab forming a part, or for the protection of a structure.

### Asphalt Base Course

- The lowermost layer of specified thickness of an asphalt concrete pavement which may include an asphalt levelling course.

### Asphalt Concrete

- High quality, thoroughly controlled hot mixture of **asphalt cement and** well-graded, high quality aggregate, thoroughly compacted into a uniform, dense mass.

### Asphalt Concrete Pavement

- All courses of asphalt-aggregate mixtures placed above the layer of base course, sub-base or improved subgrade. When placed directly on the sub-grade, it is called full-depth asphalt pavement.

### Auxiliary Lane

- That portion of the roadway adjoining the traveled way for speed change or other purposes supplementary to through traffic movements.



**Barrage**

- A low dam or weir across a river equipped with a series of gates to regulate the water surface level above the weir.

**Base Course**

- The layer of specified material and thickness placed immediately below the surfacing.

**Batten**

- Beam, structural member.

**Beldar**

- Unskilled labour employed on maintenance gangs for **canals or roads**.

**Bid/Tender Price**

- The sum of the products of the quantities of work with the quoted prices in the Tender by the Contractor.

**Bill of Quantities and list of Prices**

- A list showing work quantities and specifying unit price and/or lump sum for specific items of work.

**Blinding Lave**

- A layer of concrete or other material (Generally thin) covering the **surface** of excavated ground or fill, forming a stable surface on which **further work** may be constructed.

**Boulder**

- A rock fragment, usually rounded by weathering or abrasion, with an average dimension of 10 centimeters or more.

**Boundary**

- Limit of right-of-way or other zones.

**Bridge**

- Any structure other than a culvert, which carries a utility, facility, or railroad, highway, pedestrian, or other traffic over a water course, over, under or around any obstruction and with a clear span of more than 6.50 M.

**Bund**

- A continuous embankment, dike or levee (generally associated with training or containing the flow of rivers).

**Catchment**

- The watershed or area which contributes runoff to a drain or other channel.

**Contractor**

- The individual firm or corporation contracting with the Employer/Client for performance of the prescribed work.

**Contract Price**

- The sum of the products of the quantities with the agreed prices appearing in the agreement between the Contractor and the Engineer/Employer.

**Construction Limit**

- Construction limit of a project is area between left & right side of catch points of road under construction, where as in case of structures this limit will extend to area, which is required for execution of permanent structure

**Cubic Meter**

- A volume equivalent to 1.0 M x 1.0 M x 1.0 M.

**Cuboid**

- Crushed stone particles with each face fractured and in roughly cuboid shape.

**Culvert**

- Any structure, other than a bridge which provides an opening under a roadway for drainage or irrigation proposes and with a clear span of 6.5 M or less.

**Cum**

- With or associated with - for example, 'Railroad-cum-road' bridge.

**Cusec**

- A rate of flow of one cubic foot per second.

**Daywork**

- Work to be paid for on the basis of actual labour, material, and plant used - Force account. **Detour (Diversion)**
- A temporary roadway, which leaves the main, route and rejoin it later, for the uninterrupted flow of traffic.

**Drawings**

- The approved plans (drawings), profiles, typical cross-sections, revised drawings and supplemental drawings, or exact reproduction thereof, which show the location, character, dimensions and details of the work.

**Earth**

- Sediments or other unconsolidated accumulations of solid particles, produced by the physical and chemical disintegration of rock, and which may or may not contain organic matter.

**Engineer**

- The duly authorized representative of the Client/Employer for controlling the project site, acting directly or through his duly authorized representatives, who is responsible for engineering supervision of the work.

**Equipment**

- All machinery and equipment, together with the necessary supplies for up keep and maintenance and also tools and apparatus necessary for the proper construction and acceptable completion of the work

**Fix**

- Any item of construction which requires special placement in the works.

**Flexible Pavement Structure**

- Any combination of improved subgrade, subbase, base and asphalt surfacing placed on the subgrade to support the traffic load and reduce its intensity at the subgrade surface.

**Forms or Formwork**

- Shuttering including supports and falsework.

**Frustration of a Contract**

- Rendered impossible of performance by external cause beyond the contemplation of the parties.

**Gang Headed**

Experienced workman or labour incharge of small groups of workmen or labour.

**Gasoline**

- Motor spirit, petrol. **Godown**
- Warehouse, store room or storage shed.

**Grade**

- The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal center-line of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

**Gravel**

- Small sized stone, shingle or rock fragments usually rounded in shape formed from rocks or boulders by glacial or weathering action.

**Guide Bank (for Bund)**

- A protective and training embankment or levee for directing river flow.

**Highway**

- A general term denoting public way for purposes of vehicular travel, including the entire area within the right-of-way. (Recommended Usage: in urban areas-highway or street; in rural areas-highway or road).

**Install**

- To place in special position any hardware, equipment or fixture for completing a job.

**Kilometer**

- A distance equal to 1000 meters.

**Laboratory**

- A testing laboratory approved by NHA or any testing laboratory, which may be designated by the Engineer.

**Levelling Course**

- The layer of specified material of variable thickness placed generally on an existing road surface to compensate for depressions and undulations in order to correct grades and cross falls according to design.

**Materials**

- Any substance specified for use in the construction of the project and its appurtenances.

**Metalled (roadway)**

- Surfaced, paved (roadway).

**Mile**

- Distance of 5,280 feet. (1,610 M)

**Monsoon**

- Prevailing winds in the Indian Ocean.
- The rainy season associated with the south-west monsoon.

**Motor Spirit**

- Fuel, gasoline.

**Octroi**

- A municipal fee for municipal services.

**Period of Maintenance**

- Period of maintenance shall mean the period of contractor's maintenance named in the contract, calculated from the date of completion of the work as certified by the Hand-over committee.

**Pitching or Rip-Rap**

- Broken stone, brickwork or other materials placed usually on side slopes of Embankments for protection of the earth surface, dry or in cement mortar as specified.

**Prime Cost**

- A net sum entered in the Bill of Quantities by the employer as the sum provided to cover the cost of or to be paid by the Contractor to merchants or others for specific articles or materials to be supplied after deducting all trade discounts and any discount for cash.

**Provide**

- To make available an item for a certain period/time or indefinite time as the case may be.

**Provisional Sum**

- Any sum of money fixed by the Employer and included in the Bill of Quantities to provide for work not otherwise included therein. A provisional sum is only to be expended, either wholly or in part under the Employer's Representatives or the Engineer's direction in accordance with Contract. This sum may or may not be utilised in full or partially through the contractor.

**Regulator**

- A canal structure, usually equipped with gates, for control, or checking, of flow in the canal or an off taking channel,

**Return**

- Report

**Revetment (Material)**

- Rock.

**Right-of-way (ROW)**

- A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

**Roadside**

- A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

**Roadway**

- The portion of a highway within limits of construction.

**Scaffolding**

- Arrangement of struts/columns/pipes to support shuttering or other platforms.

**Setting out**

- Laying out or staking out establishing on the site the lines, levels and grades to which the construction works are to be carried out.

**Shingle**

- ~ See Aggregates.

**Shoulders**

- The portion of the roadway contiguous with the travelled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

**Sidewalk**

- That portion of the roadway primarily constructed for the use of pedestrians.

**Sleepers**

Cross ties, railroad ties.

**Soil Binder**

Portion of Soil passing 0.425 mm (# 40) sieve.

**Special Provisions**

- Additions and revisions to the Standard Specifications and General Conditions of Contract, covering conditions particular to an individual contract.

**Spoil Bank**

- Disposal area for excess excavation, spoil tip or waste dump.

**Structures**

- Bridges, culverts, catch basins, drop inlets retaining walls, manholes, headwalls, service pipes causeways Irish Gages and other features which may be encountered in the work and not otherwise c12ssed herein

**Subbase**

- The layer of specified material and thickness placed between the base course and subgrade.

**Subgrade**

- The top surface of a roadbed upon which the pavement structures and shoulders including curbs are constructed.

**Subgrade level**

- That level of the roadbed (or, embankment) on which other road material has to be placed.

**Subgrade treatment**

- Modification of roadbed material by stabilization.

**Substructure**

- All of that part of a structure below the bearings of simple and continuous spans, or rigid frames, including back walls, wing walls.

**Super-tax**

- A Pakistani taxes on income or profit above a certain level of income or profit.

**Surface Course**

- The uppermost layer of specified thickness of an asphalt concrete pavement; also called "Wearing Course".

**Surfacing**

- The uppermost layer of specified material placed on the travelled way or shoulder. Types of surfacing may consist of surface treatment (hot surface dressing) of asphalt concrete surface course, or concrete pavement.

**Supply**

- Primarily meaning to deliver any item on permanent basis.

**Tender**

- Bid proposal.

**Tenderer**

- A firm or individual submitting a Tender.

**Traffic Lanes**

- That portion of a travelled way allowing the movement of a single line of vehicles.

**Unmetalled (Roadway)**

- Unsurfaced, unpaved (roadway)/ dirt road.

**Variation Order**

- A document compiled to include changes, substitutions and additional work items not covered in the B.O.Q for the sanction of the competent Authority and shall include increase or decrease in quantities or rates also.

**Work**

- The work shall mean the furnishing of all labour, materials, equipment and other incidentals necessary . or convenient to the successful completion of the project and carrying out of all the duties and obligations imposed by the contract.

**Wagon (railway)**

- A railroad freight car

**Wayleave**

- Permission to cross land, right of entry as defined in the land acquisition act of the Government of Pakistan.

**Well**

- A concrete or masonry caisson incorporated in foundations.



**Working Drawings**

- Stress sheets, shop drawings, erection plans, false work plans, form work plans, cofferdam plans, bending diagrams for reinforcing steel, or any other supplementary plans or similar data which the contractor is required to submit to the Engineer for approval.

**Written Undertaking**

- A written promise.

# EARTHWORK

## ITEM 100 GENERAL

### 100.1 DESCRIPTION

Earthwork will consist of all necessary work for the excavation and placing in embankment or backfill or disposal by dumping of earth, rock or other material from or to the roadway or adjacent thereto or from borrow areas, including the excavation of side and interception ditches, the removal of unsuitable subgrade material, the formation of laybys, the widening of cuts and the flattening of cut slopes whether to obtain material for embankments of backfill, or to increase the stability of the slopes, clearing and grubbing, the selective removal of trees, stripping and the removal of existing obstructions within the approved cross section for excavation, in accordance with these specifications and in conformity with the lines, grades, sections and dimensions shown on the drawings or as directed by the Engineer.

### 100.2 SOIL INFORMATION

Any information concerning the properties of the soil or sub soil and other geotechnical information shown on the drawing or other documents forming part of the contract is for information only. The contractor is obliged to make his own assessment of site conditions prevailing. No claim for extra cost or time extension will be entertained based on the information provided.

The Contractor shall be deemed to have visited the site prior to making his bid and shall ascertain the nature of the earth and rock, its quantity, locations and suitability to meet the specified requirements, and he shall base his bid estimates solely on his own soil investigation. After the award of the contract no claim for a revision of bid prices depending on the sources of soil information will be entertained.

### 100.3 EXPLOSIVES

Where explosives are used the Contractor shall provide suitable buildings or warehouses in approved positions for the storage of explosives, which shall be stored in the manner and quantity approved by the Engineer or as per relative laws of government. Such storage places shall be accessible only to authorized personnel. They shall be properly marked, all doors or accesses thereto shall be constructed of materials as directed by the Engineer and provided with secure locks and all necessary means for preventing access by unauthorized persons. The Contractor shall be responsible for the prevention of any unauthorized issue or improper use of any explosives. The handling of explosives shall be entrusted only to experienced and responsible men, to the satisfaction of the Engineer. And in conformity with the statutory regulations.

All drilling and blasting shall be done in such a manner as to bring the excavation as close as possible to the required cross sections, and to disturb as little as possible the material to be left in place. Blasting by means of drill holes, tunnels, or any other method shall be performed at the entire risk and responsibility of the Contractor who shall have no claim to payment for extra work occasioned by breakage outside the approved cross-sections or dimensions.

The greatest care shall be taken by the Contractor during all blasting operations to ensure that no injury be done to persons or damage to property or to the finished work. Shots shall be properly loaded and capped, and only a moderate charge shall be used in each hole. A record of all explosives used, showing locations and amounts, shall be kept by the Contractor for checking by the Engineer.

Where directed by the Engineer, the Contractor shall provide heavy mesh blasting mat for protection of persons, property and the work. If necessary, blasting shall be restricted to time prescribed by the Engineer.

The Engineer may prohibit and order the rock to be excavated by other means, if, in his opinion, it would be dangerous to persons or adjacent structures, or is being carried out in a reckless manner. If traffic on the road has to be interrupted, the Contractor shall obtain approval of his schedule for such interruption from the proper authorities and shall satisfy the Engineer that he has obtained it. No extra payment shall be admissible for such arrangements as described here above.

#### **100.4 REMOVAL OF EXISTING OBSTRUCTIONS**

The pay items under Items 101, 103, 105, 106, 107 and 108 shall include the cost of removal of all material regardless of his nature, encountered within the limits of the approved cross-section, including the removal and disposal, as required by the Engineer, of existing brick, stone, concrete or masonry, rock boulders or fragments, old pavements, culverts, bridges or parts thereof, retaining walls or any other material encountered during the excavation, unless a separate item exists for such features.

#### **100.5 REMOVAL OR DIVERSION OF WATER**

Except where provided for, no separate payment will be made for control of or removal of water during or after earthwork operations. The cost of sheeting, shoring, cofferdams, pumping and draining shall be included in the bid prices for earthwork. The Contractor shall provided necessary facilities of dewatering and for draining or diverting watercourses when necessary for the protection of the contract work or where required by the Engineer.

The Contractor shall provide such drainage outlet ditches or canals as may be necessary to effect proper drainage before rain is expected. Such drainage ditches or canals for protection of work during construction and their maintenance and clearing to make them continuously effective during the work shall not be separately, but shall be deemed to be included in other items of work. The Contractor shall also provide, fix maintain and operate such engines, pumps, hoses, chutes and other appliances as the necessary to keep the accumulated water at a level required for the safety of the structures as directed by the Engineer.

## 100.6 DITCHES

The Contractor shall construct side ditches, interception ditches, any inlet and outlet ditches as shown on the Drawings or where ordered by the Engineer, whether for temporary or permanent drainage. In order to keep water away from the embankment, subgrade, and / or pavement during construction, the Contractor shall at all times ensure adequate drainage by scheduling ditch and outlet so that the drainage is operative before work is stated on the embankment, subgrade or pavement. He shall clean and trim all such drainage ditches from time to time, so that there may be free flow of water throughout the whole period of the Contract. Ditches shall first be trimmed according to approved cross-sections, and final trimming, including the repair of any damage that may have been done during the construction work, shall be carried out after completion of the other construction work and shall be condition for final approval and acceptance.

Unless otherwise specified no separate payment will be made for the excavation of side ditches, interception ditches, inlet and outlet ditches but such payment will be made under item 105 or 106 whichever applicable.

Where indicated on the drawings or when required by the Engineer, the Contractor shall take cross-sections of existing stream channels, and in collaboration with the Engineer, mark them with details of the excavation required for the relocation of the stream channel. Work shall not be proceed without written approval of the marked cross-sections by the Engineer.

## 100.7 EXCAVATION FOR CULVERTS

Except where otherwise specified excavation and backfill for culvert and drainage pipes, except granular backfill to under drains, will not be paid for separately, but shall be considered as a subsidiary obligation of the Contractor covered under the contract price for the various classes of pipe culvert as provided in Item 501.

## 100.8 LANDSLIDES, BENCHES, FLATTENING OF SLOPES

The Engineer may order the removal of material resulting from landslides, the construction of benches in above the cut slopes or in the embankment slope or where in his opinion the slope shows signs of instability, the flattening of the slope. Payment of all such work shall be at contract prices in item 106 or 108 as the case may be.

## 100.9 SURVEY AND LEVELING PRIOR TO COMMENCE OF EARTHWORK

The Contractor shall be responsible for the setting out of the work in accordance with Clause 17 of the General Conditions of Contract. Notwithstanding that project drawings have been issued to the Contractor, the Contractor shall also be responsible for taking joint cross-sections on the proposed alignment of the road, submitting three copies of the plotted cross-sections and longitudinal profile to the Engineer and obtaining the approval of the Engineer to such cross-section and longitudinal profile before any work in connection with Earthwork is commenced. These cross-sections and longitudinal provide that shall be in the form and manner as instructed in writing by the Engineer.

## 100.10 MEASUREMENT AND PAYMENT

The quantities of the various classes of excavation or embankment to be measured for payment under the contract shall be limited to the lines and level as taken under Clause 109.9 above. However if the levels so taken differ appreciably from design levels the matter shall be referred to the client.

Excavation and filling beyond the lines and level shown on the drawings, approved profiles and cross-sections will not be paid for. The Engineer will decide the angle of the slope of cuts and fills as the work proceeds on the basis of evaluation of the soil characteristics. The actual lines of the cuts and fills as made will be duly measured and recorded by the Contractor. The Engineer will check these records and will approve the measurements, if correct, as a basis of payment. Excess of excavation shall be backfilled, as directed by the Engineer, with subbase materials without extra payment to the Contractor; excess of fill may be either left in place or removed as required by the Engineer. The quantities of excavation, backfill and earthwork to be paid for in Items 103, 106, 107 and 108 respectively shall be the number of cubic meters of material measured by the average end-area method, except where the error may exceed plus or minus five percent as compared with the prismoidal formula in which case the Engineer will authorize the use of the more accurate method. However, the Contractor shall request such authority before he submits his quantities for approval. Quantities measured on the average end-area basis, once they have been submitted and approved, shall not be subject to review for the purpose of applying a more accurate method.

# CLEARING AND GRUBBING

## 101.1 DESCRIPTION

This work shall consist of removal to the specified depth, grubbing and disposal of all surface objects, as and where directed in writing by the Engineer, stumps, roots, bushes and trees with less than 150 mm girth, vegetation, logs, rubbish and other objectionable material except such objects as are designated to remain or are to be removed in accordance with other section of specification.

## 101.2 CONSTRUCTION REQUIREMENTS

### 101.3 Clearing / Grubbing

In roadway cut areas, all surface objects or any object to the depth of 30 Cm. below subgrade level such as stumps, roots, vegetation, bushes, logs, rubbish shall be cleared and / or grubbed as directed by the Engineer. In roadway fill areas where clearing and grubbing is required, same shall be carried out to the depth of 30 Cm below natural surface level as described above.

Operation of clearing and grubbing shall in no way be deemed of effect any level or volume change of the area.

After clearing and grubbing, the compaction of the area will be restored to its original value without any extra payment. However Engineer may direct in writing to the Contractor for stripping (if so required) under item 103 or for compaction under item 104, Compaction of Natural Ground, if the original compaction is less than the required for respective zone. Payment of these items will be made separately under the relative items used of such purpose.

Before bottom layer of embankment is placed, contractor will grub up and remove without extra payment, any vegetation that may, in the meantime have grown on surface previously cleared and grubbed.

All trees having girth less than 150 mm measured at (600) mm above ground and falling within the construction limits shall be felled & removed by the contractor. The excavation and removal of trees, roots and stumps including backfilling and compacting of holes and restoring the natural ground to the original condition shall be responsibility of the contractor for which no extra payment shall be made to him. The trees, stumps & roots remains the property of the Employer, which shall be delivered at designated place as directed by the Engineer.

### 101.4 Protection and Restoration

The Contractor shall prevent to all pipes, conduits, wires, cables or structure above or below ground. No land monuments, property markers, or official datum points shall be damaged or removed until the Employer / Engineer has witnessed or otherwise their locations and approved their removal. The Contractor shall so control his operations as to prevent damage to shrubs, which are to be preserved. Protection may include fences and boards latched to shrubs, to prevent damage from machine operations. Any damage as a result of contractor's operation shall immediately be rectified by him at his own expense.

## 101.5 MEASUREMENT AND PAYMENT

### 101.6 Measurement

Clearing and grubbing will be measured for payment only on areas so designated in writing by the Engineer or shown on the drawings. The quantity to be paid for shall be number of square meters satisfactorily cleared and grubbed. Any tree having girth of less than 150 mm (measured 600 mm above ground level) shall be measured to be under this item.

Engineer shall ensure that a minimum of 500 SM area is designated for clearing and grubbing in any stretch of roadway for the sake of ease to construction activities.

Clearing and grubbing carried out by the Contractor in roadway cut areas and borrow pits shall be measured for payment.

### 101.7 Payment

The quantities determined as provided above will be paid for at the contract unit price for the pay item mentioned below and shown in the Bill of Quantities, which price and payment shall be full compensation for clearing and grubbing and restoration of area, to its original condition.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
101	Clearing and Grubbing	SM

## REMOVAL OF TREES

### 102.1 DESCRIPTION

This work shall consist of the removal of trees and stumps alongwith their roots to a depth, to ensure complete removal of roots and stumps their disposal as provided in Special Provision or as directed in writing by the Engineer.

### 102.2 CONSTRUCTION REQUIREMENTS

Such individual trees as the Engineer may designate and mark in white paint shall be left standing uninjured. All other trees to be removed shall be counted and an inventory prepared showing girth of the tree stem.

When necessary to prevent injury to other trees or structures or to minimise danger to traffic, trees shall be cut in sections from top downwards.

Hole or loose earth resulting from the removal of trees shall be filled and recompactd to a degree of compaction of adjoining area. Any extra material required for such purpose shall not be measured for payment.

### 102.3 GENERAL REQUIREMENTS

Contractor shall prevent damage to all under-ground utilities, such as pipes cables or conduits etc. For this purpose if so required, removal of trees shall be carried out manually. Any under-ground or over-ground property damaged by the contractor shall be immediately repaired by the contractor at his own expense.

### 102.4 MEASUREMENT AND PAYMENT

#### 102.5 Measurement

Engineer and Contractor shall jointly measure the girth and number of trees to be removed under this item. Any tree having a girth of less than 150 mm measured six hundred (600) mm above ground level shall be measured under this item, as the same shall be removed under item "Clearing and Grubbing".

#### 102.6 Payment

The quantities determined as provided above shall be paid for at the contract unit price for the pay item mentioned below and shown in the Bill of Quantities which price shall be deemed to include all cost of labour equipment and incidental related to the item.



<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
102a	Removal of trees, 150-300 mm girth	Each
102b	Removal of trees, 301-600 mm girth	Each
102c	Removal of trees, 601 mm or over girth	Each

## **COMPACTION OF NATURAL GROUND**

### **104.1 DESCRIPTION**

The natural ground or surface ready for construction purposes after clearing and grubbing, or stripping, (if required) will be considered as (natural) Ground for the purpose of this item. The compaction of natural ground shall be carried out through a written order by the Engineer.

### **104.2 CONSTRUCTION REQUIREMENTS**

Up to a depth of twenty (20) cm below the natural ground, all sods and vegetable matters shall be removed and clear surface shall be broken up by ploughing and scarifying to compact to the degree as defined below:-

<b><u>For height of Embankment below sub grade level.</u></b>	<b><u>Percent of Maximum Dry Density as determined by AASHTO T-180.*</u></b>
0 to 30 cm	95
30 to 75 cm	93
Over 75 cm	90
Below the foundation of structures	95

#### **104.2.1 Compaction of original ground surface in areas of high water levels and salinity**

Compaction of the natural ground surface in such areas will be difficult if not impossible. See Items 108, etc. under Formation of Embankment for construction requirements under these conditions, where compaction of Natural Ground shall not be carried out.

### **104.3 MEASUREMENT AND PAYMENT**

#### **104.3.1 Measurement**

The measurement shall be made by multiplying the length and breadth of the area approved in writing by the Engineer to be paid under this item. The measurement of the item shall be in Square meter.

Any subsidence of levels of Natural Ground due to compaction under this item shall not be measured for payment, the contractor is expected to take care of such factors while bidding.

Intersection At Karachi  
University**104.3.2 Payment**

The payment under this item shall be made for at the contract unit price for Square meter of compaction of (natural) ground measured as above and shall be deemed to include cost of scarification, watering, mixing, levelling, rolling, labour, equipment, tools, and incidentals necessary to complete this item.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
104	Compaction of Natural Ground	SM

# ROADWAY AND BORROW EXCAVATION FOR EMBANKMENT

## 105.1 DESCRIPTION

The work shall consist of excavating the roadway and borrow pits, removal and satisfactory disposal of all materials taken from within the limits of the work, also such excavation as is necessary for inlet and outlet ditches of structures and shall include all excavation, shaping and sloping for the construction, preparation of all embankment, subgrade, shoulders, intersections and approaches as directed and in conformity to the alignment, grade, level and cross-sections shown on the plans or established by the Engineer.

## 105.2 CLASSIFICATION OF EXCAVATION

### 105.2.1 Road Way Excavation

Roadway Excavation shall comprise all excavation that is not classified as structural excavation carried out within the limits of roadway including permanent drainage ditches and side slopes in cut.

Roadway Excavation shall further, be classified as "Common Excavation", or "Rock Excavation", (common excavation shall include all the materials of whatever nature encountered but not including rock excavation).

#### **a) Common Excavation**

Common excavation shall consist of the removal and satisfactory disposal of all eolian, alluvial and residual materials, in place unaltered and unweathered strata, which are not firm or rigid enough to possess all the characteristics of "Rock Excavation". Boulders of less than one quarter (1/4) cubic meter volume shall also be classified as "Common Excavation". Eolian and alluvial materials consist of gravel, shale, volcanic ash, loess, dunes and, loams, sands and clays or any combination of these materials, and termed as Common Excavation.

#### **b) Rock Excavation**

This includes firm and rigid igneous, metamorphic and sedimentary rocks. Boulders larger than quarter (1/4) cubic meter in volume will also be considered as "Rock Excavation", provided these are firm and stable lying in continuous bed and constitute more than 50% by volume as compared to other type of materials in the total mass.

The classification of Hard, Medium or Soft Rock shall be same as described under item 106.2 of General Specifications.

### 105.2.2 Borrow Excavation

Borrow Excavation shall comprise all excavation taken from borrow pits. Material from borrow pits shall normally be used for the construction of embankment or for the backfill when there is no material available from roadway excavation or structural excavation. Permission to use material from borrowpit shall first be obtained in writing from the Engineer. Nevertheless the total quantity of material from roadway excavation and structural excavation after deduction of the material declared unsuitable by the Engineer, shall be considered available for use in the work, and any material used from borrow pits for formation of embankment shall not be measured for payment.

In making his bid, the Contractor shall inspect the site and prepare his estimate of the haulage cost on the basis of his own survey of the possible nature and locations of the borrow pits. Their distance from the work sites shall not be grounds for extra payment or revision of the contract price.

The consent of the landowner or tenant for excavating the borrow material and hauling along private access roads shall be secured by the Contractor who shall, if required, pay for such concession. Borrow pits shall be left in a condition acceptable to the landowner and / or tenant and the Engineer.

### 105.2.3 Structural Excavation

The description method of measurement and payment of this section shall conform to as specified in item 107.

## 105.3 CONSTRUCTION REQUIREMENTS

All material removed from excavation shall be used in the formation of embankment, subgrade, shoulders, and at such other places as directed, unless it is declared unsuitable and ordered to waste by the Engineer. No excavated material shall be wasted without written permission from the Engineer, and when such material is to be wasted, it shall be so placed that it will present a neat appearance and not offer any danger to abutting property.

The material shall be declared unsuitable if the soaked CBR (96 hours) is less than five (5) percent or if fails under A-6 or A-7 of AASHTO soil classification.

During construction of the roadway, the road bed shall be maintained in such a condition that it will be well drained at all times.

All slopes, except in solid rock or other material shall be trimmed precisely as per cross-sections, and care must be exercised that no material shall be loosened beyond the required slopes. In blasting rock slopes, a reasonably uniform face shall be left, regardless of whether or not the excavation is carried beyond the specified side slope. All breakage and slides shall be removed by the contractor and disposed of as directed by the Engineer.

Rock, shale and other unsuitable road bed material encountered in cuts shall be excavated to required width and depth indicated on the plans or as otherwise directed. Any overbreakage below the depth shown on the plans will not be paid for. Backfill of the overcut shall be of approved earth material and

shall have the same density requirements as specified on the plans and shall be at the expense of contractor.

Borrowpits shall be located so that the nearest edge of the pit is at least thirty (30) meters from the roadway toe of slope unless otherwise directed by the Engineer.

Permission to use any borrow material, including its suitability, shall be obtained in writing from the Engineer before execution of work. It is responsibility of the contractor to submit a request for test at least fifteen (15) working days prior to the day the contractor intends to begin taking material from the borrow area.

In no case shall borrow material be obtained from downstream of any hydraulic structure. However the borrowpit may be established at five hundred (500) meters upstream of the hydraulic structure. The side slopes of the pits or channels shall be constructed as shown on the plans or directed by the Engineer. In no case the side slopes of borrow pit be steeper than a slope; 1:5 (V:H).

Upon abandonment of borrow pit or quarry area, the contractor shall, at his own expense, clean and trim the borrow pit or quarry area, the right of way, and adjoining properties which were occupied during execution of work, all to the satisfaction of the Engineer.

All drilling and blasting shall be done in such a manner as will most nearly complete the excavation to the required grade line, and produce the least disturbance of the material to be left in place. Blasting by means of drill holes or any other methods shall be performed at the entire risk and responsibility of the contractor. Care shall be taken to ensure that no injury be done to persons or properties or to the finished work. Blasting shall be restricted to the hours prescribed by the local authorities or the Engineer.

Where between two successive cross-sections of the road, the properties of rock boulders, in sizes larger than a one quarter (1/4) of a cubic meter, to earth is more than 50%, the excavation will be considered wholly as rock.

Rock material above ground level such as stones, boulders, piles of stone, and dry stones walling whose individual sizes are greater than one quarter of a cubic meter shall be removed and disposed of if directed in writing by the Engineer and shall be paid under relevant item of work in the Bill of Quantities.

## 105.4 MEASUREMENT AND PAYMENT

### 105.4.1 Measurement

When the Bill of Quantities specifies for "Common Excavation", "Rock Excavation" and "Borrow Excavation" the quantities of the different classes of excavation shall be computed as follows: **a)**  
**Common Excavation**

The unit of measurement for common excavation shall be in cubic meter and be computed by average end area method based on cross-sections duly approved by the Engineer prior to commencement and completion of required excavation.

The excavated material approved for fill under any item of the Bill of Quantities shall be used in the manner as described under the relevant item of work, irrespective of haulage distance.

**b) Rock Excavation**

Authorized "Rock Excavation" to be measured in cubic meters shall consist of area that is necessary to provide the design section and grade or as directed by the Engineer. Any over breakage beyond the lines shown on the plans and outside of the tolerances set for subgrade in cuts shall not be paid for. The Engineer shall define the beginning and ending points of areas classified as "Rock Excavation". Any area over excavated in the subgrade shall be reinstated at the cost of contractor as directed by the Engineer.

The pay quantity for "Rock Excavation" shall be computed by means of average end area method from approved cross-sections based on original ground elevations after the authorized removal of unsuitable or overburden materials, if required.

For disposal of excavated rock material, same procedure shall be followed as described above for the "Common Excavation" specified in sub item No.105.4.1 (a).

**c) Borrow Excavation**

No measurement shall be made for any Borrow Excavation, however this material if used in any of the Bill items, shall be measured and paid as provided under the relative items of work.

**105.4.2 Payment**

No payment for Roadway or Borrow Excavation shall be made under this item as the same is deemed to be included under relative item of Formation of Embankment.

# EXCAVATION OF UNSUITABLE OR SURPLUS MATERIAL

## 106.1 DESCRIPTION

The work shall consist of excavation and disposal of unsuitable or surplus material arising from roadway excavation, which is declared in writing by the Engineer to be unsuitable for use or surplus to the requirements of the project, When excavation of unsuitable material requires special attention for a known condition on a specific project, construction requirements and payment shall be covered under relevant Provisions.

## 106.2 CONSTRUCTION REQUIREMENTS

All suitable material excavated within the limits and scope of the project shall be used in the most effective manner for the formation of the embankment, for widening of roadway, for backfill, or for other work included in the contract.

Any material surplus to these requirement or any material declared in writing by the Engineer to be unsuitable shall be disposed of and levelled in thin layers by the Contractor outside the right of way within 7 Km of excavation. The Engineer shall decide regarding the unsuitability of the material by conducting appropriate laboratory tests.

When unsuitable materials are ordered to be removed and replaced, the soil left in place shall be compacted to a depth of twenty (20) cm to the density prescribed under Item 108.3.1. Payment for such compaction shall be included. in the contract prices for the excavation materials.

If the unsuitable material, which is to be removed, is below standing water level and the replacement material is gravel or a similar self-draining material of at least thirty (30) cm in depth, the compaction may be dispensed with if approved by the Engineer.

Rock excavation shall be classified as under:

### **a) Hard Rock**

Any rock which can not be removed with Ripper of a 200 H.P. Bulldozer and constitutes a firm and continuous bed of rock only.

### **b) Medium Rock**

Any rock which can not be removed with the blade of 200 H.P. Bulldozer but can be removed by the ripper, will be termed as Medium Rock, irrespective of the fact that it is removed by blasting.

### **c) Soft Rock**

Any rock which can be removed with the blade of a 200 H.P. Bulldozer. This item will be termed as Soft Rock, irrespective of the fact that it is removed by blasting.



**106.3 MEASUREMENT AND PAYMENT**

**106.3.1 Measurement**

When the contractor is directed to excavate unsuitable material below the surface of original ground in fill areas, the depth to which these unsuitable materials are to be removed will be determined by the Engineer. The contractor shall schedule his work in a such a way that authorized cross sections can be taken before and after the material has been removed. Only material which is surplus to the requirements of the project or is declared in writing by the Engineer to be unsuitable will qualify for payments under pay Item No. 106a, 106b, 106c, and 106d as the case may be.

The cost of excavation of material which is used anywhere in the project shall be deemed to be included in the pay Item relating to the part of the work where the material is used.

The under mentioned Pay Item Nos. 106a, 106b, 106c, and 106d shall include the cost of obtaining the consent of the owner or tenant of the land where the disposal of surplus or unsuitable material is made.

Unsuitable or surplus material shall be measured in its original position and its volume shall be calculated in cubic meters using end area method.

**106.3.2 Payment**

The quantities determined as provided above shall be paid for at the contract unit price respectively for each of the particular pay Items listed below and shown in the Bill of Quantities which prices and payment shall constitute full compensation for all costs involved in the proper completion of the work prescribed in this item.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
106a	Excavate Unsuitable Common Material	CM
106b	Excavate Unsuitable Rock Material	
	i. Hard Rock      CM    ii. Medium Rock      CM    iii. Soft Rock      CM	
106c	Excavate Surplus Common      CM      Material	
106d	Excavate Surplus Rock Material	
	i. Hard Rock      CM    ii. Medium Rock      CM    iii. Soft Rock	

## **STRUCTURAL EXCAVATION AND BACKFILL**

### **107.1 DESCRIPTION**

Structural excavation shall include the removal of ail material of whatever nature, necessary for the construction of foundations of bridges, culverts, retaining walls, headwalls, wing walls, catch basins, manholes, inlets and other structures not otherwise provided for in these specifications and in accordance with the plans or as directed by the Engineer. It shall include the furnishing of all necessary equipment and construction of all cribs, cofferdams, caissons, dewatering, sheeting, shoring etc., which may be necessary for the execution of the work. It shall also include the subsequent removal of cofferdams and cribs and the placement of all necessary backfill at hereinafter specified. It shall also include the disposing of excavated material, which is not required for backfill, in a manner and in locations so as not to affect the carrying capacity of any channel and not to be unsightly.

### **107.2 MATERIAL REQUIREMENT FOR BACKFILL**

#### **107.2.1 Backfill around structure**

Backfill around structure shall be made with the following material.

- a. Granular backfill of selected material as specified here under
- b. Common backfill shall be carried out from excavated material or any other borrow material approved by the Engineer.

#### **107.2.2 Grading backfill**

Granular backfill material shall meet the following requirements. **a)**

##### **Grading Requirement**

<b><u>mm</u></b>	<b><u>Inch.</u></b>	<b><u>A</u></b>	<b><u>B</u></b>
25	V1	100	100
19	3 / 4"	60-100	75-100
4.75	No.4	50-85	55-100
2.0	No.10	40-70	40-100
0.425	NO.40	25-45	20-50
0.075	No.200	0-15	5-15

- b)** Material satisfying the requirements of coarse sand failing upper soil classification A-3 (AASHTO). In case, coarse sand is utilised for granular fill it shall be ensured that the same is confined properly with approved material.
- c)** The material shall have a Plasticity Index of not more than size (6) as determined by AASHTO T-89 and T-90.

### 107.2.3 Common backfill

Use of excavated material as backfill may be allowed under this item. Use of borrow material for common backfill shall be allowed subject to approval of borrow material by the Engineer.

### 107.2.4 Rock backfill

Rock material of small size shall be permitted in the backfilling of structures or walls subject to the approval of methodology by the Engineer.

## 107.3 CONSTRUCTION REQUIREMENTS

### 107.3.1 Structural excavation

#### **a) General**

All substructures, where practicable, shall be constructed in open excavation and, where necessary, the excavation shall be shored, braced, or protected by cofferdams in accordance with approved methods. When footings can be placed in the dry without the use of cribs or cofferdams, backforms may be omitted with the approval of the Engineer, and the entire excavation filled with lean concrete to the required elevation of the top of the footing. The additional concrete shall be at the expense of the Contractor.

In case the contractor has excavated additional volumes than specified thereunder, the contractor shall at his own expense backfill the volume with approved material as directed by Engineer.

The classification of Hard, Medium or Soft Rock shall be same as described under item 106.2 of General Specifications.

#### **b) Preservation of channel**

Unless otherwise specified, no excavation shall be made outside of caissons, cribs, cofferdams, piling, or sheeting, and the natural stream bed adjacent to the structure shall not be disturbed without permission from the Engineer. If any excavation or dredging is made at the site of the structure before caissons, cribs or cofferdams are in place, the Contractor shall, without extra charge, after the foundation base is in place, backfill all such excavation to the original ground surface or river bed with material approved by the Engineer. Material deposited within the stream area from foundation or other excavation or from filling of cofferdams shall be removed and the stream bed freed from obstruction thereby.

#### **c) Depth of Footings**

The elevation of the bottoms of footings, as shown on the drawings, shall be considered as approximate only and the Engineer may order, in writing, such changes in dimensions or elevation of footings as may be necessary to secure a satisfactory foundation.

**d) Preparation of Foundations of Footings**

- i) All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, either levelled, stepped, or roughened, as may be directed by the Engineer.
- ii) When masonry is to rest on an excavated surface other than rock special, care shall be taken not to disturb the bottom of the excavation, and the final levelling of the grade shall not be made until just before the masonry is to be placed.

**e) Cofferdams and Cribs**

- i). For substructure work, the contractor shall submit, upon request, drawings showing his proposed method of cofferdams construction and other details left open to his choice or not fully shown on the Engineer's drawings. The Contractor shall not start work until the Engineer has approved such drawings.
- ii). Cofferdams and cribs for foundation construction shall be carried to adequate depths and heights, be safely designed and constructed, and be made as water tight as is necessary for the proper performance of the work which must be done inside them. In general, the interior dimensions of cofferdams and cribs shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside the forms. Cofferdams or cribs, which are tilted or moved laterally during the process of sinking, shall be righted, reset, or enlarged so as to provide the necessary clearance and this shall be solely at the expense of the Contractor.
- iii) When conditions are encountered which, in the opinion of the Engineer, render it impracticable to dewater the foundation before placing masonry, he may require the construction of a concrete foundation seal of such dimensions as may be necessary. The foundation water shall then be pumped out and the balance of the masonry placed in the dry. When weighted cribs are employed and the weight is utilized to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal. During the placing of a foundation seal, the elevation of the water inside the cofferdam shall be controlled to prevent any flow through the seal, and if the cofferdam is to remain in place, it shall be vented or ported at low water level.
- iv) Cofferdams or cribs shall be constructed so as to protect green concrete against damage from a sudden rising of the stream or river and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into the substructure masonry without written permission from the Engineer.
- v) Unless otherwise provided, cofferdams or cribs with all sheeting and bracing shall be removed after the completion of the substructure, care being taken not to disturb or otherwise injure the finished masonry.

**f) Pumping**

- i) Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping of water will be permitted during the placing of concrete or for a period of at least twenty four (24) hours thereafter, unless it is done from a suitable sump pit separated from the concrete work by a watertight wall or other effective means.
- ii) Pumping to unwater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.

**g) Inspection**

After each excavation is completed the Contractor shall notify the Engineer, and no concrete or masonry shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

In case if an existing structure is to be replaced with a new structure the quantities for dismantling the structure shall be paid under item 510 (Dismantling of structures) and additional excavation required shall be carried out under this item.

**h) Classification of Excavation**

Classification of excavation shall be made as described under items 106.2 of this Specification

**107.3.2 Excavation in Embankments**

Unless otherwise specified, the Contractor may choose with the approval of the Engineer to excavate for structures, culverts, and pipe culverts after the embankment has been placed. Any space remaining after the placing of such structures or culverts shall be filled with material approved by the Engineer and compacted as follows:

Layers of not more than 20 cm in loose thickness shall be placed and compacted in succession, with mechanical tampers, plate compactors or hand guided rollers operated transversely to the roadway, to the densities specified in the item 108.3.1. Moisture content shall be adjusted as directed by the Engineer. Proper benching shall be made to ensure bonding of existing and new material without any extra payment.

The excavation in embankment and the placing of backfill for the purposes described above shall not constitute any claim for payment. also if sand or granular backfill is used by the contractor for his convenience, no extra payment will be made.

### 107.3.3 Backfill

- a) Granular backfill where-ever directed shall be placed in the position and in the required depth, shown on the drawings or where and as required in writing by the Engineer and it shall be well compacted in layers not exceeding twenty (20) cm in thickness to 100 percent of Max. dry density as per AASHTO T-180 (D). In case of water logged areas the thickness of the layer shall not exceed fifty (50) centimeters or as directed by the Engineer. Volume of granular fill around structures shall be calculated within the vertical limits of approved excavation for such a structure, where as the horizontal limits shall be those as specified on drawings.
- b) Common backfill shall consist of earth free from large lumps, wood and other organic materials and of a quality acceptable to the Engineer. It shall be placed in the position and to the required depths shown on the Drawings and / or as required in writing by the Engineer and it shall be well compacted in layers not to exceed twenty (20) cms in depth to the density, 95 percent of maximum dry density, as per AASHTO T- 80 (D).
- c) The rock backfill material whose individual sizes are not more than 30 cm shall be placed in the position to the required depth as specified and the voids shall be filled in layer of fine material approved by the Engineer. The compacting efforts shall be made so as to achieve the desired compaction approved visually by the Engineer. The depth of the layer in any case shall not exceed sixty (60) centimeters. However in water logged areas, the thickness may be increased as directed by the Engineer. Rock backfill will not be placed within two meters from concrete face of any structure.
- d) All spaces excavated and not occupied by abutments, piers or other permanent work shall be refilled with earth or granular fill as approved by the Engineer up to the surface of the surrounding ground, with a sufficient allowance for settlement. All such backfill shall be thoroughly compacted and, in general, its top surface shall be neatly graded.
- e) The fill behind abutments and wing walls of ail bridge structures shall be deposited in well-compacted, horizontal layers not to exceed twenty (20) cm. in thickness. The common backfill in front of such units shall be placed first to prevent the possibility of forward movement. Special precautions shall be taken to prevent any wedging action against the masonry, and the slope bounding the excavation for abutments and wingwalls shall be destroyed by stepping or roughening to prevent wedge action. Jetting of the fill behind abutments and wingwalls will not be permitted.
- f) Fill placed around culverts and piers shall be deposited on both sides to approximately the same elevation at the same time. Where the Contractor does not have proper equipments to ensure compaction in restricted areas, Engineer may allow backfill with sand saturation method, at no extra cost to the Client.
- g) Adequate provision shall be made for the through drainage of all backfill. French drains shall be placed as weep holes.
- h) No backfill shall be placed against concrete or masonry structure before fourteen (14) days of placement and backfilling shall be carried out on both sides of the structure simultaneously.

## 107.4 MEASUREMENT AND PAYMENT

### 107.4.1 Measurement

#### **a) Structural Excavation**

The quantities of structural excavation to be paid for shall be the number of cubic meters of material measured in its original position computed by the average end-area method, and excavated to the satisfaction of the Engineer.

Structural Excavation will be classified for measurement and payment as "Structural Excavation in Common Material", "Structural Excavation in Common Material Below Water Level", "Structural Excavation in Rock Material" and according to whether the excavation is in earth or rock and according to whether the excavation is above or below the water level which is the constant level to which the water naturally rises in a foundation pit.

The volume of earth or rock to be measured for structural excavation shall consist of a prismoid bounded by the following planes:-

- 1) The vertical limits for computing pay quantities will be vertical planes 50 centimeters outside of the neat lines of footings or foundations as shown on the Drawings or as directed by the Engineer.
- 2) The upper limit for payment of structural excavation shall be the ground surface as it existed prior to the start of construction operations, except where structural excavation is performed within roadway excavation or ditch excavation areas, the upper limit shall be the planes of the bottom and side slopes of said excavated areas.
- 3) The lower limits for computing pay quantities of structural excavation or structure backfill shall be a plane at the bottom of the completed footings, foundations, structures or lean concrete.

Measurement for structural excavation shall not include material removed below the footing grade and beyond specific limits to compensate for anticipated swell or as a result of effective swell during pile driving, or additional material resulting from slides, slips, cave-ins, silting or fillings, whether due to the action of the elements or to carelessness of the Contractor. The depths of the footings shown on the drawings are approximate only and any variation found to be necessary during construction shall be paid for at the contract unit price.

#### **b) Granular Backfill**

The quantities of Granular Backfill to be paid for shall be the number of cubic meters of material laid and compacted in place within the fine of structure and limits defined in Item 107.4.1 (a) above, computed and accepted by the Engineer.

**c) Common Backfill**

The quantities of Common Backfill to be paid for shall be the number of cubic meters of material laid and compacted, placed within the lines of structure and limits defined in Item 107.4.1(a) above and accepted by the Engineer.

**107.4.2 Payment**

The quantities determined as provided above shall be paid for at the contract unit price respectively for each of the particular pay item listed below that is shown in the Bill of Quantities, which price and payment shall be full compensation for all the costs involved in the proper completion of the work prescribed in this item.

<b><u>Pay Item No.</u></b>	<b><u>Description</u></b>	<b><u>Unit of Measurement</u></b>
107a	Excavate Excavation in Common Material	CM
107b	Excavate Excavation in Common Material Below Water Level	CM
107c	Excavate Excavation in Rock Material	
	i. Hard Rock	CM
	ii. Medium Rock	CM
	iii. Soft Rock	CM
107d	Granular Backfill Type-	CM
107e	Common Backfill	CM



# FORMATION OF EMBANKMENT

## 108.1 DESCRIPTION

This work shall consist of formation of embankment, including preparation of area for placing and compaction of embankment material in layers and in holes, pits and other depressions within the roadway area in accordance with the specifications and in conformity with the lines, grades, thickness and typical cross-section shown on the plans established by the Engineer.

## 108.2 MATERIAL REQUIREMENTS

Material for embankment shall consist of suitable material excavated from borrow, roadway excavation or structural excavation and shall include all lead and lift. Borrow material will be used only when material obtained from roadway or structural excavation is not suitable or is deficient for embankment formation and shall include all lead and lift.

The material under this item shall conform to the following specification.

- a) Contractor shall use AASHTO Class A-1, A-2, A-3, A-4 or A-5 soil as specified in AASHTO M-145 or other material approved by the Engineer.
- b) CBR of the material shall not be less than five (5) percent, determined in accordance with AASHTO TA 93. CBR value shall be obtained at a density corresponding to the degree of compaction required for the corresponding layer.
- c) Swell value of the material for embankment formation shall not exceed five tenth (0.5) percent. However, while establishing the swell value, surcharge weights representing the overburden will be used. In case sandy material is used for embankment formation, it shall be properly confined at no extra payment with a material and to the extent as approved by the Engineer and sandy material shall not be used on slopes of embankment.
- d) In areas subject to flood and prolonged inundation of the embankment, such as at bridge sites, the material used in embankment, unless rock, shall be AASHTO Class A1 (a), A1 (b) and A-2-4, soils. Other soils may be used only with the written consent of Engineer.

## 108.3 CONSTRUCTION REQUIREMENTS

### 108.3.1 Formation of Embankment with Borrow Common Material

Material for embankment, obtained and approved as provided above, shall be placed in horizontal layers of uniform thickness and in conformity with the lines, grades, sections and dimensions shown on the Drawings or as required by the Engineer. The layers of loose material other than rock shall be not more than 20 cm. thick, unless otherwise allowed by the Engineer after a trial section is prepared and approved.

The material placed in layers and that scarified to the designated depth for formation of embankment shall be compacted to the density specified below:

<b><u>Depth in centimeters below subgrade level</u></b>	<b><u>Percent of Maximum Dry Density as determined by AASHTO T-180.*</u></b>
0 to 30	95
30 to 75	93
Over 75	90

\* Method 'B' or 'D' whichever is applicable, or corresponding Relative Density in case of sand fill.

In-place density determinations of the compacted layers shall be made in accordance with AASHTO T-191 or other approved methods. For all soils, with the exception of rock fill materials, containing more than 10% oversize particles (retained on 3/4 inch/ 19 mm sieve), the in-place density thus obtained shall be adjusted to account for such oversize particles or as directed by the Engineer. Subsequent layers shall not be placed and compacted unless the previous layer has been properly compacted and accepted by the Engineer.

Material for embankment at locations inaccessible to normal compacting equipment shall be placed in horizontal layers of loose material not more than 15 centimeters thick and compacted to the densities specified above by the use of mechanical tampers, or other appropriate equipment.

The compaction of the embankment shall be carried out at the designated moisture content consistent with the available compacting equipment.

Embankment material that does not contain sufficient moisture to obtain the required compaction shall be given additional moisture by means of approved sprinklers and mixing. Material containing more than the optimum moisture may not, without written approval of the Engineer, be incorporated in the embankment until it has been sufficiently dried out. The drying of wet material may be expedited by scarification, diskings or other approved methods.

When materials of widely divergent characteristics, such as clay and chalk or sand, drawn from different sources, are to be used in the embankment they shall be deposited in alternate layers of the same material over the full width of the embankment to depths approved by the Engineer. Rock, clay or other material shall be broken up, and no accumulation of lumps or boulders in the embankment will be permitted. No surplus material shall be permitted to be left at the toe of embankment or at the top of cut sections.

Side slopes shall be neatly trimmed to the lines and slopes shown on the drawings or as directed by the Engineer, and the finished work shall be left in a neat and acceptable condition.

### 108.3.2 Formation of Embankment with Rock Material

Embankment formed of material consisting predominantly of rock fragment of such size that the material cannot be placed in layers of the thickness prescribed without crushing, pulverizing or further breaking down the pieces, such material may be placed in layers not exceeding in thickness than the approximate average size of the rocks except that no layer shall exceed eighty (80) centimeters of loose measurement and compacted by a vibratory roller with the minimum mass as shown in the following table.

<b>Mass per meter width of vibrating roll (Kg / M)</b>	<b>Depth of fill layer (mm)</b>	<b>Number of passes of the roller on each layer</b>
2300 – 2900	400	5
2900 – 3600	500	5
2600 – 4300	600	5
4300 – 500	700	5
>5000	800	5

The material shall be carefully placed in layers, so that all larger stones will be well distributed and voids completely filled with smaller stones, clean small shells, shale, earth, sand, gravel, to form a solid mass. After placing rock material, surface shall be covered with a layer of fine material having thickness less than twenty (20) centimeters. Such fine material shall be reserved from roadway excavation by the Contractor. Should such material be available but not reserved, Contractor will supply and place borrow material for forming smooth grade without extra payment.

Each layer shall be bladed or levelled with motor grader, bulldozer or similar equipment capable of shifting and forming the layer into a neat and orderly condition. No rock larger than eight (8) centimeters in any dimension shall be placed in the top fifteen (15) centimeters of embankment unless otherwise allowed by the Engineer.

Material for each layer should be consolidated with heavy weight vibratory roller until settlement as checked between two consecutive passes of roller is less than one (1) percent of the layer thickness. In evaluation of settlement, survey points should be established and rolling continued until difference of levels as checked after two consecutive passes is less than one (1) percent of the total layer thickness. Moreover initial rolling of overlaid fine material shall be done without watering to ensure their intrusion in voids of rock layer beneath. Watering shall be done when voids are properly filled.

Embankments, which are formed of material that contain rock but also contain sufficient compactable material other than rock or other hard material to make rolling feasible, shall be placed and compacted in the manner prescribed above and to the point when settlement is within above mentioned requirement. Compaction test will be made whenever the Engineer determines they are feasible and necessary. Each layer must be approved by the Engineer before the next layer is placed. When rock to

be incorporated in fill is composed largely of weak or friable material, the rock shall be reduced to a maximum size not exceeding fifty (50) percent of the thickness of the layer being placed.

**108.3.3 Formation of Embankment on Steep Slopes**

Where embankments are to be constructed on steep slope, hill sides or where new fill is to be placed and compacted against existing pavement or where embankment is to be built along one half the width at a time, the original slope of the hill side, of existing pavement or adjacent to half width of embankment shall be cut in steps of twenty (20) centimeters depth. Benching shall be of sufficient width to permit operation of equipment possible during placing and compaction of material.

Cut material shall be incorporated with the new embankment material and compacted in horizontal layers. No extra payment will be allowed for such an operation.

**108.3.4 Formation of Embankment on Existing Roads**

Before fill is placed and compacted on an existing roadway, the existing embankment and / or pavement may be levelled by cutting, rooting or scarifying by approved mechanical means to a level to be determined by the Engineer. The earth, old asphalt or other material arising as a result of this operation will be declared either suitable or unsuitable, for use in the embankment or other items, by the Engineer. If the material is declared suitable it will be measured under relative item and if it is declared unsuitable, it will be measured under item 106a.

**108.3.5 Formation of Embankment in Water Logged Areas**

Where embankments are to be placed in water logged areas and which are inaccessible to heavy construction equipment, a special working platform shall be first established, consisting of a blanket of fill material placed on top of the soft layer. The material of the working table shall consist of normal or processed granular fill, obtained from borrow excavation. This material shall conform to the following specifications:

<b><u>Sieve Description</u></b>	<b><u>Percentage of Weight Passing</u></b> <b><u>Mesh Sieve, AASHTO T-27</u></b>
---------------------------------	---

3 inch (75 mm)	100
----------------	-----

The remaining grading shall be such as to avoid intrusion into the working platform material of subgrade or natural ground surface material. For this condition to be met it will be required that the ratio.

D <sub>15</sub> (Working Platform Material) ----- (Natural Ground Material)	is less than 5. D <sub>85</sub>
---	---------------------------------

D<sub>85</sub> and D<sub>15</sub> mean the particle diameters corresponding to 85% and 15%, respectively, passing (by weight) in a grain size analysis.

Construction of this working table shall proceed from one edge of the soft area by using the fill as a ramp for further material transport.

The thickness of the working table as prescribed above shall be approximately 0.5 meter unless directed otherwise by the Engineer, and the width shall be that of the embankment. The placement and compaction of the working table shall be carried out by use of light equipment, as directed by the Engineer.

No density requirements are specified for the working platform, however, subsequent layers above it shall be compacted to the densities specified in Item 108.3.1.

### 108.3.6    General Requirements

To avoid interference with the construction of bridge abutments and wing walls, the Contractor shall at points determined by the Engineer, suspend work on embankments and / or in cuts forming the approaches to any such structure until such time as the construction of the later is sufficiently advanced to permit the completion of the approaches without the risk of interference or damage to the bridge works. The cost of such suspension of work shall be included in the contract unit prices for embankment. In carrying embankments up to or over bridges, culverts or pipe drainage, care shall be taken by the Contractor to have the embankments brought to equally on both sides and over the top of any such structure. Contractor shall make special arrangements to ensure proper compaction in restricted spaces and around structures. No compensation shall be made to the Contractor for working in narrow or otherwise restricted areas.

When as a result of settlement, an embankment requires the addition of material up to 30 cm in thickness to bring it up to the required grade level, the top of the embankment shall be thoroughly scarified before the additional materials being placed, without extra payment to Contractor for the scarification.

The Contractor shall be responsible for the stability of all embankments and shall replace any portions that in the opinion of the Engineer have been damaged or displaced due to carelessness or neglect on the part of the Contractor. Embankment material which may be lost or displaced as a result of natural causes such as storms, cloud-burst or as a result of unavoidable movement or settlement of the ground or foundation upon which the embankment is constructed shall be replaced by the Contractor with acceptable material from excavation or borrow. No additional compensation will be allowed for the replacement.

During construction, the roadway shall be kept in shape and drained out at all times. When unsuitable material has been placed in the embankment by the Contractor, he shall remove it without extra payment.

## 108.4 MEASUREMENT AND PAYMENT

### 108.4.1 Measurement

The quantities to be paid for shall be the number of cubic meters calculated on theoretical designed lines and grades and the ground levels as established under clause 100.9, compacted in place, accepted by the Engineer formed with material resulting from: i) Formation of Embankment from Borrow Excavation

Measurement shall be made as under:-

Formation from Borrow = Total Embankment Quantity (minus) Roadway excavation Quantity (minus) structural excavation Quantity.

#### ii) Formation from structural Excavation

This quantity shall be the same as calculated for structural excavation irrespective of its haulage distance except -that declared unsuitable by the Engineer.

#### iii) Formation from Roadway Excavation

This quantity shall be the same as calculated for Roadway Excavation. The contractor will be supposed to use material from Roadway Excavation irrespective of haulage distance. However if contractor, for his own convenience, uses the material from borrow, the payment will still be made under this item 108 (a) & 108 (b).

In the measurement of "Formation of Embankment on steep slopes" no allowance will be made for the benching or volume of material cut out from the hill side or from the first half width fill to accommodate the compacting equipment but will be calculated only on the net volume of fill placed against the original hill sides, the old embankment or the first half width fill.

### 108.4.2 Payment

#### **a) Formation from Borrow Excavation.**

The quantity to be paid for shall be the number of cubic meters placed in embankment, measured as provided above for material from borrow excavation and such a payment will be deemed to include cost of excavation, payment of royalty, levies and taxes of Local, Provincial and Federal Government, cost of hauling including all lead and lift, spreading, watering, rolling, labour, equipment, tools and incidental necessary to complete this item.

#### **b) Formation from Structural Excavation.**

The quantity to be paid for shall be the number of cubic meters placed in embankment and measured as provided above for material from structural excavation and such payment will be deemed to include cost of excavation, hauling, dumping, spreading, watering, rolling, labour, equipment, tools and incidental necessary to complete this item.

**c) Formation from Roadway Excavation**

The quantity to be paid for shall be the number of cubic meters placed in embankment and measured as provided above for material from roadway excavation and such payment will be deemed to include cost of excavation, hauling, dumping, spreading, watering, rolling, labour, equipment, tools and incidental necessary to complete this item.

<b><u>Pay Item No.</u></b>	<b><u>Description</u></b>	<b><u>Unit of Measurement</u></b>
108a	Formation of Embankment from Roadway Excavation in Common Material	CM
108b	Formation of Embankment from Roadway Excavation in Rock Material	CM
	i. Hard Rock	CM
	ii. Medium Rock	CM
	iii. Soft Rock	CM
108c	Formation of Embankment from Borrow Excavation in Common Material	CM
108d	Formation of Embankment from Structural Excavation in Common Material	CM
108e	Formation of Embankment from Structural Excavation in Rock Material	CM
	i. Hard Rock      CM    ii. Medium Rock      CM    iii. Soft Rock      CM	

# **SUBGRADE PREPARATION**

## **109.1 DESCRIPTION**

The subgrade preparation shall be that part of the work on which, the subbase is placed or, in the absence of subbase, act as the base of the pavement structure. It shall extend to the full width of the road bed including the shoulders and laybys as indicated on the Drawings or as specified herein.

## **109.2 CONSTRUCTION REQUIREMENT**

### **109.2.1 Prior Work**

Before commencing the work all culverts, drains, ditches including fully compacted backfill over them outlets for drainage, head walls / wing walls of culverts and any other minor structure below thirty (30) centimeters of existing subgrade level or all structures which will be below thirty (30) centimeters of newly placed subgrade level, shall be in such operative conditions as to ensure prompt and effective drainage and to avoid damage to subgrade by surface water. No work of subgrade preparation will be started before the prior work herein described have been approved by the Engineer.

### **109.2.2 Compaction Requirement**

All materials down to a depth of 30 cm below the subgrade level in earth-cut or embankment shall be compacted to at least 95 percent of the maximum dry density as determined according to AASHTO T-180 Method 'B' or V whichever is applicable, or corresponding Relative Density as per D4254-83 (ASTM).

### **109.2.3 Subgrade Preparation in Earth Cut**

In case bottom of subgrade level is within thirty (30) cm of the natural ground, the surface shall be scarified, broken up, adjusted to moisture content and compacted to minimum density of ninety five (95) percent of the maximum dry density as determined by AASHTO T-180 Method D. Subsequent layer of approved material shall be incorporated to ensure that the depth of subgrade layer is thirty (30) cm. In case, the bottom of subgrade 4 s below the natural ground by more than Thirty (30) cm, the material above the top of subgrade shall be removed and subsequent layer of thirty (30) cm shall be scarified, broken up, adjusted to moisture content and compacted to the same degree of compaction as described above.

In case, unsuitable material is encountered at the sub grade level within a depth of thirty (30) cm, the same shall be removed in total and replaced by the approved material. The contractor shall be paid for removal of unsuitable material as per pay Item 106a and for replacement of approved material, the payment will be made under pay Item 108c.

### **109.2.4 Subgrade Preparation in Rock Cut**

Excavation in rock shall extend to the subgrade level as shown on drawings. Rock shall be undercut nearly to required elevation and sections shown on the plans or as directed by the Engineer. Transverse



and longitudinal profiles checked by template shall be accurate to the requirement. Cuts below subgrade level shall be backfilled with selected subbase material and compacted to minimum ninety eight (98) percent of the maximum dry density as determined by AASHTO T-180, method U. No compensation shall be made to the Contractor for over-cut or remedial measures as described above. No rock shall be higher than two (2) centimeters above the under cut section elevation. The under cut material shall be placed in embankment or disposed of at the direction of Engineer.

### 109.2.5 Subgrade in Embankment

When the subgrade is formed in embankment, its width shall be the full width of top of embankment and material placed in the upper part of embankment down to a depth of thirty (30) centimeters below subgrade level shall meet compaction requirement of 109.2.2. Soils having a minimum value of C.B.R of seven (7) percent and swell value of not more than 0.3 percent shall be used. C.B.R less than seven (7)% may be used in case, the design allows for it. Unsuitable material if encountered within the existing formation layer as per laboratory specified test, shall be removed, disposed of and replaced by suitable one as per direction of the Engineer of which the payment will be made under relevant items of work.

Rollers and other equipments of approved size and type, accepted by the Engineer, shall be used for compaction. Water shall be added to obtain optimum moisture content; if necessary. Contractor shall ensure proper compaction in restricted areas by use of special equipments and rollers. No compensation shall be made for extra work due to restricted space.

Performance of this item of work shall not be paid for under this section but shall be deemed to be covered by the contract price for pay item 108a, through 108e, Formation of Embankment.

### 109.2.6 Subgrade Level in Existing Road

Where indicated on the Drawings or directed by the Engineer that the existing road surface is to be used as the subgrade, the correct elevation on which the base or subbase is to be laid shall be obtained, where necessary, either by means of levelling course or by excavation. The levelling course shall be constructed to the requirements of the Engineer and paid for under the appropriate Pay Item involved. Excavation shall include disposal of any surplus material in the adjacent embankment or elsewhere as directed by the Engineer.

In case, the design level of subgrade is within 30 cm of the existing ground/road then the item shall be measured and paid accordingly.

### 109.2.7 Subgrade reinforcement

When the width of the existing pavement, either to be scarified or not, is insufficient to contain the subbase or base to be placed upon it, the Engineer may order to strengthen and support the subbase or base on one or both sides of the existing pavement. This work shall consist of the removal and disposal of any unsuitable material and its replacements with suitable material to such width and depth as required by the Engineer.

The excavated material shall, if declared suitable for use elsewhere in the embankment by the Engineer be so used, and payment for its removal shall be covered under the contract price of Pay Item No. 108a; if declared unsuitable it shall be disposed of and paid as provided in Item 106a. The finished compacted surface of the subgrade shall be as specified in Item 109.2.3.

### 109.2.8 Protection of Compacted Work

Any part of the subgrade that has been completed shall be protected and kept well drained. Any damage resulting from carelessness of the Contractor shall be repaired as directed by the Engineer without additional payment.

The Contractor shall be responsible for all the consequences of traffic being admitted to the subgrade. He shall repair any ruts or ridges occasioned by his own traffic or that of others by reshaping and compacting with rollers of the size and type necessary for such repair. He shall limit the area of subgrade preparation to an area easily maintained with the equipment available. Subgrade preparation and subbase or base placing shall be arranged to follow each other closely. The subgrade, when prepared too soon in relation to the placing of the subbase, is liable to deteriorate, and in such case the Contractor shall, with out additional payment, repair, reroll, or recompact the subgrade as may be necessary to restore it to the state specified herein.

### 109.2.9 Templates and Straightedges

The Contractor shall provide for the use of the Engineer, satisfactory templates and straightedges in sufficient numbers to check the accuracy of the work, as provided in these specifications and no subsequent work shall be permitted until the subgrade levels have been checked and approved by the Engineer. For tolerances, referred to the, "Table for Allowable Tolerances" in these specifications.

## 109.3 MEASUREMENT AND PAYMENT

### 109.3.1 Measurement

The quantity to be paid for shall be the number of square meters of subgrade prepared as herein before prescribed and accepted. Subgrade in rock cuts and on embankment not consisting of the existing road surface in fill area shall not be measured for direct payment.

Subgrade preparation on "Existing Surface" shall only be measured for payment when ordered by the Engineer.

### 109.3.2 Payment

The quantities, determined as provided above, shall be paid for at the contract unit price respectively, for each of the particular pay items listed below that is shown in the Bill of Quantities which prices and payment shall be full compensation for furnishing of material, water, equipment, tools, labour, and all other items necessary for completion of work.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
109a	Subgrade preparation in Earth Cut	SM
109b	Subgrade preparation in Existing Cut	
	i. Without any fill	SM
	ii. With fill less than 30 cms	SM

## **DRESSING AND COMPACTION OF BERMS**

### **114.1 DESCRIPTION**

This work shall consist of scarification of berms, which are undulated, or out of level. The existing material shall be scarified, watered, mixed and properly levelled and compacted according to specification described here under or as directed by the Engineer

### **114.2 MATERIAL REQUIREMENTS**

In this item no fresh material is required, however, if fresh material is used it shall be measured and paid under other relative items of works.

### **114.3 CONSTRUCTION REQUIREMENTS**

#### **114.3.1 Dressing of berm without the use of extra material**

In case the berms show undulation of more than 5 cms in level from the reconstructed pavement structure, the berms shall be scarified to a depth of 15 cm and material will be watered, mixed and compact with appropriate equipment approved by the Engineer

#### **114.3.2 Dressing of berm with the use of extra material**

In case the difference of elevation of existing berm with respect to reconstructed road structure 'is less than 15 cm than additional material (to be measured under other items of work) shall be added to bring the level of berms in conformity with the lines and grades of the existing road. Existing and fresh material shall be properly mixed, watered and compacted as directed by the Engineer.

#### **114.3.3 Compaction requirement**

Compaction requirement of the fresh and existing material shall be in accordance with the type of material used in berms, as under:-

<b><u>Depth in cm</u></b>	<b><u>Compaction requirements as per AASHTO T-180 (D)</u></b>
0 - 15 (Top layer)	95% for common earth material
0 - 15 (Top layer)	100% for subbase material

### 114.3.4 Compaction of slopes

While reinstating/dressing of berms, it shall be ensured that compaction requirements are observed on slopes of the berms. The degree of compaction shall be as per direction of the Engineer.

## 114.4 MEASUREMENT AND PAYMENT

### 114.4.1 Measurement

Measurement under this item shall be made in square meter of berms dressed or compacted in accordance with theoretical lines, or sections shown on the drawings, or as per existing edge of road.

In case partial fresh material is used to compensate for shortage of material in the top layer the quantity of such material shall be measured by survey levels of existing ground and designed lines, grades or sections shown on the drawing.

The quantity of material thus measured shall be paid under other items of works of formation of embankment 1 subbase.

### 114.4.2 Payment

The payment of this item shall be made for at the contract unit price per square meter of dressed and compacted berm measured as above, for scarification watering, mixing, rolling, labour, equipment, tools and incidentals necessary to complete this item.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
114a	Dressing of berm without SM	extra material.
114b	Dressing of berm with SM	extra material.

## SURFACE COURSES AND PAVEMENT

### ITEM 300 GENERAL

This section describes the requirements and procedures for execution of surface courses and pavements. The materials to be used shall conform to specifications and testing procedures as per American Association of State Highway and Transportation Official (AASHTO) or the American Society for Testing and Material (ASTM) as indicated in their latest editions. Samples of materials for laboratory tests and their subsequent approvals shall be utilized according to these references unless otherwise directed by the Engineer.

Materials which do not conform to the requirements of these specifications will be rejected whether in place or not. They shall be removed immediately from the site of the work at the expense of contractor. While subgrade/subbase and paving operations are in progress, a detour shall be provided for vehicular flow in order to avoid any public inconvenience and thoroughly be maintained till completion of that particular section of the project or as a whole. In order to expedite the passage of public traffic through or around the work, the contractor shall install road signs, warning lights, flares, barricades and other facilities for the safety, convenience and direction of public traffic. Also where directed by the Engineer, the contractor shall furnish competent flagmen whose sole duties shall consist of directing the movement of public traffic through or around the work. The cost of furnishing and installation of such road-signs, lights, flares barricades and other facilities, shall be included in the respective work item. Should the Engineer point out the inadequacy of warning and protective measures, and require additional measures, such action on the part of the Engineer shall not relieve the contractor from responsibility for public safety or abrogate his obligation to furnish and pay for these services.

## ASPHALTIC MATERIAL

### 301.1 ASPHALT CEMENT

Asphalt Cement shall be an oil asphalt, or a mixture of refined liquid asphalt and refined solid asphalt, prepared from crude asphaltic petroleum. It shall be free from admixture with any residues obtained by the artificial distillation of coal, coal tar, or paraffin and shall be homogeneous and free from water. No emulsification shall occur when a thirty (30) gram sample is boiled for two (2) hours with two hundred and fifty (250) cubic centimeters of distilled water in a five hundred (500) cubic centimeters Erlenmeyer flask equipped with a reflux condenser.

Asphalt Cement shall be classified by penetration and when tested in accordance with the standard methods of tests of the AASHTO, the grades of asphalts shall conform to the requirements set forth in Table 301-2. The grade of asphalt to be used shall be in accordance with these specifications or the Special Provisions or as directed by the Engineer.

### 301.2 ENVIRONMENTAL FACTORS

In areas where highly frost susceptible soils and severe low temperature conditions are encountered, it may be necessary to remove and replace soils susceptible to frost heave or take other precautions prior to pavement construction. In extremely hot climates, asphalt mixes should be designed to resist rutting and maintain stiffness at high temperatures.

Because asphalt mixtures are influenced by temperature, it is recommended that different asphalt grades be used where different temperature conditions prevail. Table below gives recommended asphalt grades for various temperature conditions.

**SELECTING ASPHALT GRADE**

Temperature Condition	Asphalt Grade
Cold, mean annual air temperature ≤ 7 degree C (45 degree F)	AC-10
	AR-4000
	80 / 100 pen
Warm, mean annual air temperature between 7 deg. C (45 deg. F) And 24 deg. C (75 deg. F)	AC-20
	AR-8000
	60 / 70 pen
Hot, mean annual air temperature ≤ 24 degree C (75 degree F)	AC-40
	AR-8000
	40 / 50 pen

\* Both medium setting (MS) and slow setting (SS) emulsified asphalts are used in emulsified asphalt base mixes. They can be either of two types: cationic (ASTM D 2397 -or AASHTO M 208) or anionic (ASTM D977 or AASHTO M 140). Selecting one of the two shall depends on the type of aggregate used for better affinity.

The grade of emulsified asphalt is selected primarily on the basis of its ability to satisfactorily coat the aggregate. This is determined by coating and stability test (ASTM D 244, AASHTO T 59). Other factors important in the selection are the water availability at the job site, anticipated weather at the time of construction, the mixing process to be used, and the curing rate.

### 301.3 CUT-BACK ASPHALT

Liquid asphalts (cut back) shall consist of materials conforming to the following classifications. When tested in accordance with the standard methods of tests of the AASHTO, the grades of liquid asphalt shall conform to the requirements specified in the Table 301-3 and 301-4.

Medium curing products designated by letters MC, shall consist of asphalt cement fluxed or blended with a kerosene solvent.

Rapid curing products designated by the letters RC, shall consist of asphalt cement with a penetration of grade 80-100, fluxed or blended with a naphtha solvent.

### 301.4 EMULSIFIED ASPHALT

Asphaltic emulsions shall be composed of a bituminous base uniformly emulsified with water and an emulsifying or stabilizing agent. They shall be classified according to use as Rapid Setting or Slow Setting, and shall conform to the requirements specified in Table 301-5.

The bituminous base used in manufacturing RS-1 type emulsion shall be asphalt cement, Grade 120-150 or Grade 200-300, as designated by the Engineer.

The bituminous base used in manufacturing SS1 type emulsion shall be paving asphalt, Grade 60-70 or Grade 120-150, as designated by the Engineer.



**APPLICATION TEMPERATURES****TABLE 301-1****Application Temperature Range, °C**

<b>Asphalt Type / Grade</b>	<b>Mixing Temp</b>	<b>Spraying Temperature Road Mixes</b>
a) Asphalt Cement (All grades)	As required to achieve viscosity of 75-150 secs. Saybolt-Furol or as required to achieve a Kinematic Viscosity of 150-300 centistokes.	160 (Max)
b) Emulsified Asphalts		
RS-1	-	-
RS-2	-	-
MS-1	10-70	20-70
MS-2	10-70	20-70
MS-2h	10-70	20-70
HFMS-1	10-70	20-70
HFMS-2	10-70	20-70
HFMS-24	10-70	20-70
SS-1	10-70	20-70
SS-1h	10-70	20-70
CRS-1	10-70	20-70
CRS-2	-	-
CMS-2	-	-
CMS-2h	10-70	10-70
CSS-1	10-70	10-70
CSS-1h	10-70	10-70
c) Cutback Asphalts (RC, MC, SC)		
30 (MC only)	-	-
70	-	20 min.
250	55-80	40 min.
800	75-100	55 min.
3000	80-115	-

**TABLE 301-2****REQUIREMENTS FOR ASPHALT CEMENT (AASHTO M-20)**

	40 - 50		60 - 70		80 - 100		120 - 150	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Penetration at 77°F (25°C) 100g 5 Sec.	40	50	60	70	80	100	120	150
Flash point Cleveland Open Cup, °F (°C)	450 (232)	-	450 (232)	-	450 (232)	-	425 (218)	-
Ductility at 77 °F (25 °C) 5 cm per min. cm.	100	-	100	-	100	-	100	-
Solubility in trichloroethylene percent	99	-	99	-	99	-	99	-
Thin-film oven test, 1/8 in. (3.2 mm), 325 °F (163 °C) 5 hr Loss on heating, percent	-	0.80	-	0.80	-	1.0	-	1.3
Penetration, of residue, percent of original	58	-	54	-	50	-	46	-
Ductility of residue at 77 °F (25 °C) 5 cm. per min., cm.	-	-	50	-	75	75	75	-

**TABLE 301-3****REQUIREMENTS FOR ASPHALT CEMENT (AASHTO M-20)**

	MC - 70		MC - 250		MC - 800	
	Min.	Max.	Min.	Max.	Min.	Max.
Water, percent .....	-	0.2	-	0.2	-	0.2
Flash point (tag. Open cup), Degree C .....	38	-	66	-	66	-
Kinematic Viscosity at 60 °C (140 °F) (See Note 1) Centistokes .....	70	140	250	500	800	1600
Distillation test						
Distillate, percentage by volume of total distillate at 360 °C (680 °F)						
At 225 °C (437 °F) .....	0	20	0	10	-	-
At 260 °C (500 °F) .....	20	60	15	55	0	35
At 315 °C (600 °F) .....	65	90	60	87	45	80
Residue from distillation at 360 °C (680 °F) Volume percentage of Sample by difference .	55	-	67	-	75	-
Tests on residue from distillation						
Penetration, 100g., 5 sec., at 25 °C (77 °F)...	120	250	120	250	120	250
Ductility, 5 cm / min. cm (see note 2) .....	100	-	100	-	100	-
Solubility in Trichlorethylene, percent .....	99.0	-	99.0	-	99.0	-

Note: 1 .As an alternate, Saybolt Furol viscosities may be specified as following:

Grade MC-70 Furol Viscosity at 50°C (122°F) - 60 to 120 Sec.  
Grade MC-250 Furol Viscosity at 60°C (140°F) - 125 to 250 Sec.  
Grade MC-800 Furol Viscosity at 82.2°C (180°F) - 100 to 200 Sec.

2. If penetration of residue is more than 200 and its ductility at 25°C (77 °F) is less than 100 cm., the material will be acceptable if its ductility at 15.5 °C (60°F) is more than 100 cm.

**TABLE 301-4****REQUIREMENTS FOR RAPID-CURING TYPE ASPHALTS (AASHTO M-81)**

	MC - 70		MC - 250		MC - 800	
	Min.	Max.	Min.	Max.	Min.	Max.
Water, percent .....	-	0.2	-	0.2	-	0.2
Flash point (tag. Open cup), Degree C .....	-	-	27	-	27	-
Kinematic Viscosity at 60 °C (140 °F) (See Note 1) Centistokes .....	70	140	250	500	800	1600
Distillation test						
Distillate, percentage by volume of total distillate at 360 °C (680 °F)						
At 190 °C (374 °F) .....	10	-	-	-	-	-
At 225 °C (437 °F) .....	50	-	35	-	15	-
At 260 °C (500 °F) .....	70	-	60	-	45	-
At 315 °C (600 °F) .....	85	-	80	-	75	-
Residue from distillation at 360 °C (680 °F) Volume percentage of Sample by difference .	55	-	65	-	75	-
Tests on residue from distillation						
Penetration, 100g., 5 sec., at 25 °C (77 °F)...	80	120	80	120	80	120
Ductility, 5 cm / min. of 25 °C (77 °F) cm .....	100	-	100	-	100	-
Solubility in Trichlorethylene, percent .....	99.0	-	99.0	-	99.0	-

Note: 1 As an alternate, Saybolt Furol viscosities may be specified as following:

Grade RC-70 Furol Viscosity at 50°C (122°F) - 60 to 120 Sec.  
Grade RC-250 Furol Viscosity at 60°C (140°F) - 125 to 250 Sec.  
Grade RC-800 Furol Viscosity at 82.2°C (180°F) - 100 to 200 Sec.

**TABLE 301-5**  
**REQUIREMENTS FOR EMULSIFIED ASPHALTS (AASHTO M-140)**

Type .....	Rapid-Setting				Slow-Setting			
	RS - 1		RS - 2		SS - 1		SS - 1h	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Test on Emulsions:								
Viscosity, Saybolt Furol at 77°F (25 °F) Sec.....	20	100	-	-	20	100	20	100
Viscosity, Saybolt Furol at 122°F (50 °F) Sec.....	-	-	75	400	-	-	-	-
Settlement 5 days, percent (a) .....	-	5	-	5	-	5	-	5
Storage stability test 1 day (b) .....	-	1	-	1	-	1	-	1
Demulsibility, 35 ml. 0.02 NcaCl <sub>2</sub> percent .....	60	-	60	-	-	-	-	-
Cement mixing test, percent .....	-	-	-	-	-	2.0	-	2.0
Sieve test, percent .....	-	0.10	-	0.10	-	0.10	-	0.10
Residue by distillation, percent .....	55	-	63	-	57	-	57	-
Test on Residue from Distillation Test, Penetration, 77 °F (25 °C) 100g. 5 Sec.....	100	200	100	200	100	200	40	90
Ductility, 77 °F (25 °C) 5 cm/min. cm .....	40	-	40	-	40	-	40	-
Solubility in trinchloroethylene, percent .....	97.5	-	97.5	-	97.5	-	97.5	-
<b>Suggested uses</b>	Surface treatment, penetration macadam and lack coat		Surface treatment & penetration macadam		Plant of road mixture with graded and fine aggregates, a substantial quantity of which passes aNo.8 (2.3mm) sieve and a portion of which may pass a No.200 (0.075 mm) sieve; slurry seal treatments.			

- a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days time; or the Engineer may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.
- b) The 24-hr. (1 day) storage stability test may be used instead of the 5 days settlement test.
- c) The demulsibility test shall be made within 30 days from date of shipment.

## BITUMINOUS PRIME COAT

### 302.1 DESCRIPTION

This work shall consist of furnishing all plant, labour, equipment, material and performing all operations in applying a liquid asphalt prime coat on a previously prepared and untreated; earth sub grade, waterbound base course, crushed aggregate base course, tops of roadway shoulders, and as otherwise shown on the plans in strict accordance with the specification and in conformity with the lines shown on the drawings.

### 302.2 MATERIAL REQUIREMENTS

Asphaltic material shall conform to the requirements of the item 301- "Asphaltic Materials", either cutback or Emulsified Asphalt, which ever is specified in the Bill of Quantities.

### 302.3 CONSTRUCTION REQUIREMENTS

Prime coat shall be applied when the surface to be treated is dry; except that when emulsified asphalt is used, the surface may be reasonably moist. The application is prohibited when the weather is foggy or rainy, or when the atmospheric temperature is below fifteen (15) degree C unless otherwise directed by the Engineer. Prior to the application of the prime coat, all loose materials shall be removed from the surface and the same shall be cleaned by means of approved mechanical sweepers or blowers and/or hand brooms, until it is as free from dust as is deemed practicable. No traffic shall be permitted on the surface after it has been prepared to receive the bituminous material. Prior to the application of prime coat on bridge decks and concrete pavements, the surfaces shall be cleaned of all loose material as described in Section 302.3. All expansion joints shall be cleaned and filled with bituminous material as directed by the Engineer. Areas to be primed will be classified as under:

- (i) The top of earth surface or water bound base courses from a point twenty (20) centimeters outside the edge of the pavement line to 20 cms outside the line on the opposite side of the roadway.
- (ii) The top of the shoulders from the inter-section of embankment slope and top pf subgrade to the edge of the pavement line.
- (iii) The bridge wearing surface from curb to curb and end to end of bridge wearing surface.
- (iv) Other surfaces as shown on the plans or ordered by the Engineer.

Primed surface shall be kept undisturbed for at least 24 hours, so that the bituminous material travels beneath and leaves the top surface in non- tacky condition. No asphaltic operations shall start on a tacky condition.

### 302.3.1 Equipment

The liquid asphaltic material shall be sprayed by means of a pressure distributor of not less than 1000 litre capacity, mounted on pneumatic tyres of such width and number that the load produced on the road surface will not exceed hundred (100) Kg per cm width of tyre. It shall be of recognized manufacturer.

The tank shall have a heating device able to heat a complete charge of asphaltic liquid up to one hundred eighty (180) degree C. The heating device shall be so that overheating will not occur. Consequently, the flames must not touch directly on the casting of the tank containing the asphaltic liquid or gases therefrom. The Contractor will be responsible for any fire or accident resulting from heating of bituminous materials. The liquid shall be circulated or stirred during the heating. The tank shall be insulated in such a way that the drop in temperature when the tank is filled and not heated, will be less than two (2) degree C per hour. A thermometer shall be fixed to the tank in order to be able to control continuously the temperature of the liquid. The thermometer shall be placed in such a way that the highest temperature in the tank is measured. The tank shall be furnished with a device that indicates the contents. The pipes for filling the tank shall be furnished with an easily interchangeable filter.

The distributor shall be able to vary the spray width of the asphaltic liquid in steps of maximum 10 cm, to a total width of four (4) M. The spraying bar shall have nozzles from which the liquid is sprayed fan-shaped on the road surface equally distributed over the total spraying width.

The distributor shall have a pump for spraying the liquid driven by a separate motor, or the speed of the pump shall be synchronized with the speed of the distributor. The pump shall be furnished with an indicator showing the performance in litres per minute. At the suction side the pump shall have a filter easily exchangeable. A thermometer shall be fixed, which indicates the temperature of the liquid immediately before it leaves the spraying bar.

The distributor shall be furnished with a tachometer indicating the speed in meter per minute. The tachometer shall be visible from the driver's seat. The function of the distributor shall be so exact that the deviation from the prescribed quantity to be spread on any square meter does not exceed 10%. The distributor shall be equipped with a device for hand spraying of the bituminous liquid, to cover any irregular area or covering the area improperly sprayed.

### 302.3.2 Application of Asphaltic Material

Immediately before applying prime coat, the full area of surface to be treated shall be swept with a power broom to remove all dirt and other objectionable material. If required by the Engineer, the surface shall be made moist but not saturated. Asphaltic Materials shall be applied at

temperature stated in Item 301 by approved pressure distributors operated by skilled workmen. The spray nozzles and spray bars shall be adjusted and frequently checked so as to ensure uniform distribution. Spraying shall cease immediately upon any clogging or interference of any nozzle and remedial measures taken before spraying is resumed.

The rate for application of asphaltic material (cut back/emulsified) shall be as under:

TYPE OF SURFACE	LITRES PER SQUARE METER	
	<u>Minimum</u>	<u>Maximum</u>
1. Subgrade, Subbase, Water bound base course, and Crushed stone base course.	0.65	1.75
2. Bridge, Wearing Surfaces, Concrete Pavement	0.15,	0.4

However, the exact rate shall be specified by the Engineer determined from field trials.

The test methods shall be determined by the Engineer and performed by the Contractor in the presence of Engineer.

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

The surface of structures and trees adjacent to the area being treated shall be protected in such manner as to prevent their being splattered or marred.

Where no convenient detour is available for traffic, operations shall be confined to one-half the roadway width at a time. The Contractor shall provide proper traffic control so that vehicles may proceed without damage to the primed area. Work shall not be started on the portion of the road not covered by previous application until the surface previously covered has dried and is ready for traffic.



## 302.4 MEASUREMENT AND PAYMENT

### 302.4.1 Measurement

The unit of measurement shall be square meter as actually covered by prime coat in accordance with these specifications. No measurement or payment will be made for the areas primed outside the limits, specified, herein, shown on the plans or designated by the Engineer.

Blotting material will not be measured for payment and shall be considered subsidiary to the prime coat.

### 302.4.2 Payment

The payment for area primed measured as stated above, shall be made for the contract unit price per SM, which payment shall be full compensation for furnishing all labour, material, tools, equipment and incidentals and for performing all the work involved in applying prime coat, complete in place in accordance with these specifications:

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
302	Bituminous Prime Coat.	SM

## **BITUMINOUS TACK COAT**

### **303.1 DESCRIPTION**

The work covered by this section shall consist in furnishing all plant, labour, equipment and applying asphaltic material on a previously prepared asphaltic layer, in addition to performing all operations in connection with the application of a Bituminous tack coat, complete in accordance with these specifications and to the width shown on the typical cross- sections of applicable drawings.

### **303.2 MATERIAL REQUIREMENTS**

Asphaltic material shall conform to the requirements of item 301, "Asphaltic Materials" for emulsified asphalt, or cut back asphalt as called for in the Bill of Quantities.

### **303.3 CONSTRUCTION REQUIREMENTS**

Immediately before applying the tack coat, all loose material, dirt or other objectionable material, shall be removed from the surface to be treated by power brooms and/or blowers, supplemented with hand brooms, as directed by the Engineer. The tack coat shall be applied only when the surface is dry, however for emulsified asphalt, application may be made on a reasonable moist surface. Application of tack coat shall be avoided in case of foggy or rainy weather. Prior to the application, an inspection of the prepared surface will be made by the Engineer to determine its fitness to receive the Bituminous binder and no tack coat will be applied until the surface has been approved.

#### **303.3.1 Equipment**

Equipment shall conform in all respect to the provision under Item 302.3.1 and shall be subject to the approval of the Engineer in addition to the maintenance of the same in a satisfactory working condition at all times. A hand power spray attachment to a bitumen pressure distributor or other container having an independently operated bitumen pump, pressure gauge, thermometer for determining the temperature of the asphalt tank contents and a hose connected to a hand power spray suitable for applying the Bituminous tack coat in the amounts specified - all to be such as to meet the approval of the Engineer, shall be furnished .

### 303.3.2 Application of Asphaltic Material

Asphaltic material shall be applied by means of a pressure distributor, at the temperature stated in Item 301 for the particular material being used. Rates of application of cut back shall be within the range of 0.2-0.4 litres per square meter and for emulsified asphalt the rate shall be within the range of 0.3 - 0.6 litre per square meter; the exact rate shall be specified by the Engineer.

Care shall be taken that the application of asphaltic material is not in excess of the specified quantity; any excess asphalt shall be blotted by sand or similar treatment. All areas inaccessible to the distributor shall be treated manually using the device for hand spraying from the distributor. The surfaces of structures and trees adjacent to the areas being treated shall be protected in such a manner as to prevent their being spattered or marred.

Where no convenient detour is available for traffic, operations shall be confined to one-half the roadway width at a time. The Contractor shall provide proper traffic control so that vehicles may proceed without damage to the treated area. Work shall not be started on the portion of the road not covered by previous application until the surface previously covered has dried and is ready for paving.

Traffic shall be kept off the tack coat at all times. The tack coat shall be sprayed only so far in advance of the surface course as will permit it to dry to a "lucky" condition. The Contractor shall maintain the tack coat until the next course has been placed. Any area that has become fouled, by traffic or otherwise, shall be cleaned by Contractor at his own cost before the next course is applied.

### 303.4 MEASUREMENT AND PAYMENT

#### 303.4.1 Measurement

The quantities of Bituminous Tack Coat shall be measured in square meter for the actual area Tacked with asphaltic material on the prepared surface in accordance with this specification.

#### 303.4.2 Payment

The payment of bituminous Tack coat, measured as stated above shall be paid for at the Contract unit price per square meter, which payment shall be full compensation for furnishing all labour, materials, tools, equipment and incidentals and for performing all the work involved in applying Tack Coat complete in place, as shown on the Drawings and in accordance with these specification.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
303	Bituminous Tack Coat.	SM

# BITUMINOUS SURFACE TREATMENT AND SEAL COAT / PAD COAT

## 304.1 DESCRIPTION

This work shall consist of one or more applications of asphaltic material and one or more covers of aggregates or an application of asphaltic material without aggregates applied in accordance with these specifications and in conformity with the lines and width shown on the typical cross-sections or as established by the Engineer.

## 304.2 MATERIAL REQUIREMENTS

### 304.2.1 Aggregate

Aggregate shall consist of clean, dry, hard, durable, tough, angular, sound crushed stone or crushed gravel of uniform quality, and free from dirt, clay and other objectionable matter. Aggregates from only the sources of established adhesion properties would be used. The percentage of wear by the Los Angeles Abrasion test (AASHTO T-96) shall not be more than forty (40). Aggregate crushing value (ACV) when tested as per BS-812 (1990) shall not exceed 25%. When subjected to five (5) cycles of sodium-sulfate soundness testing as determined by AASHTO T-104, it shall have a weight loss of not greater than ten (10) percent. The moisture content in the aggregate applied directly to the surface of the bituminous material shall not exceed three (3) percent by weight plus one-half (1/2) the water absorption of the aggregate at the time of delivery to the Project. In no case shall free moisture be drawing from the truck bed.

The portion of aggregate retained on the 9.5 mm (3/8 inch) sieve shall not contain more than fifteen (15) percent of particles by weight of flat or elongated, or both, that the ratio between the maximum and the minimum dimensions exceeds 2.5:1. Flakiness Index, tested under BS-812 (1990) part 105, shall be 25 (max) for nominal size 18 mm and 12 mm and 30 (max) for nominal size 9mm.

The nominal sizes of aggregates used for surface treatment; shown against table 304-1 shall be as under:

Size No.1	-	Nominal size	18 mm
Size No.2	-	Nominal size	12 mm
Size No 3	-	Nominal size	9 mm
Size No.4	-	Nominal size	6 mm

The nominal size are defined in the table below:

Nominal Size (mm)	Specified Size *			
	Passing		Retained	
	Sieve (mm)	%age	Sieve (mm)	%age
18	19	100	12.5	85
12	12.5	100	9.5	85
9	9.5	100	6.3	85
6	6.3	100	4.75	85

\* By convention, this item defines a fraction of material within the respective sieves.

For Material passing 31W Sieve, following Table shall be used:

Sieve Designation		Percent Passing by Weight			
Mm	Inch	Size No.1	Size No.2	Size No.3	Size No.4
9.5	3/8	0-15	0-10	-	-
4.75	No.4	0-5	0-5	0-10	-
2.38	No.8	-	-	0-5	0-5
1.18	No.16	-	-	-	0-3
0.75	No.200	0-2	0-2	0-1	0-1

### 304.2.2 Asphaltic Material

The asphaltic material shall conform to the requirements of Item 301 'Asphaltic Materials'. The type shall be one of the following, as shown in the Bill of Quantities or ordered by the Engineer. Spraying temperature shall be as shown against each type.

Table: Spraying Temperatures (°C) for Surface Treatments

Asphalt Type / Grade	Spraying Temperature	Spraying Temperature Surface Treatments
<b>a. Asphalt Cements</b>		
AC-2.5.		130 min.
AC-5		140 min.
AC-10		140 min.
AC-20		145 min.
AC-40		150 min.
AR-1000		155 min.
AR-2000		140 min.
AR-4000		145 min.
AR-8000		145 min.
AR-16000		-
200-300 pen.		130 min.
120-150 pen.		130 min.
85-100 pen.		140 min.
60-70 pen.		145 min.
40-50 pen.		150 min.
<b>b. Emulsified Asphalts</b>		
RS-1		20-60
RS-2		50-85
MS-1		20-70
MS-2		-
MS-2h		-
HFMS-1		20-70
HFMS -2		-
HFMS -2h		-
HFMS -2s		-
SS-1		-
SS-1h		-
CRS-1		50-85
CRS-2		50-85
CMS-2		-
CMS-2h		-
CSS-1		-
CSS-1h		-
Asphalt Type / Grade	Spraying Temperature	Spraying Temperature Surface Treatments
<b>c. Cutback Asphalts (RC, MC, SC)</b>		
30 (MC only)		30 min.
70		50 min.
250		75 min.
800		95 min.
3000		110 min.

### 304.3 CONSTRUCTION REQUIREMENTS

At the time of the application, the weather shall be warm and dry, and the road surface shall be clean and dry. Spraying shall not be done unless the road temperature is above twenty (20) degree C for at least one hour prior to the commencement of spraying operations, and the temperature shall not be less than twenty (20) degree C during the spraying. Prior to applying the asphaltic material, dirt and other objectionable materials shall be removed from the surface and surface shall be primed as per item 302.. If so directed by the Engineer, the surface shall be cleaned by power brooming or wire brush until all loose and foreign materials are removed.

#### 304.3.1 Equipment

Equipment shall conform in all respects to the provisions under Item 302.3.1. The equipment shall be operated by # the manpower specially trained for this work. Necessary safety arrangement for the workers, equipment and traffic shall be ensured during the operations.

#### 304.3.2 Preparation of Surface

Irregularities and surface damage e.g. pot-holes, depressions, ravelling, shall be corrected prior to surface dressing. The Engineer shall also satisfy himself that fundamental pavement defects e.g. base failure, drainage problems etc. have been remedied before surface dressing is attempted. Areas, which are excessively rich in bitumen e.g. 'bleeding', shall be cut out and patched. All patches, however, occasioned shall be thoroughly compacted, sealed and blinded with crusher dust before opening to traffic for several days before surface dressing commences.

Immediately prior to the application of binder all dirt, dust are foreign material shall be removed by thorough brooming and 1 or the use of compressed air. Adhering mud or other soiling may be removed using water and brushes, the general use of water to wash the road shall not be permitted.

### 304.3.3 Application of Asphaltic Materials

Asphalt cement, liquid asphalt and emulsified asphalt shall be applied by means of pressure distributor manual or automatic at the temperature specified for the type and grade of asphalt being used. The rates of application shall be within the ranges given in Table 304-1.

The spread of bituminous materials shall be at least ten (10) cm more than the width to be covered by the aggregate from the spreading device. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas or deficiencies shall be corrected in an approved manner. Junctions of spreads shall be carefully made to assure a smooth riding surface. The length of spread of bituminous material shall not exceed that which trucks loaded with cover coat material can immediately cover. Under no circumstances shall operations proceed in such manner that bituminous material will be allowed to chill, set up, dry, or otherwise impair retention of the cover coat.

The distributor when not spreading shall be so designed that the spray bar or mechanism will not drip bituminous material on the surface of the travelled way. Distribution of the bituminous material shall be so regulated and sufficient bituminous material left in the distributor at the end of each application, so that there will be a uniform distribution of bituminous material. In no case shall the distributor be allowed to expel air with the bituminous material thereby causing uneven coverage. The angle of the spray nozzles and the height of the spray bar shall be so adjusted and frequently checked that uniform distribution is ensured. The distribution shall cease immediately upon any clogging or interference of any nozzle and corrective measures shall be taken before distribution is resumed.

### 304.3.4 Spreading of Aggregate

Immediately after applying the asphaltic material, dry aggregate shall be uniformly and evenly distributed over the treated surface from an approved mechanical aggregate spreader or any other means approved by the Engineer. The truck carrying the aggregate shall move backward as it spreads same, so as to prevent the tyres of the truck and the mechanical aggregate spreader from driving directly on the newly sprayed asphalt. No portion of the binder shall remain uncovered for a period in excess of twenty (20) minutes after spraying.

Immediately after spreading of the aggregate, the treated surface shall be rolled with a self-propelled pneumatic-tyre roller having a minimum contact pressure of 2.8 Kg/square centimeter. A steel-wheeled roller weighing between six (6) to eight (8) tons may be used as a second roller. Rolling shall continue only until a smooth, thoroughly compacted surface is obtained. Procedures of starting, stopping, or turning of any piece of equipment which results in displacement of the cover material or damage to the seal courses be prohibited.

Any place where binder shows on the surface shall, be covered with additional aggregate and further rolled and broomdragged until an even surface results, and does not adhere to Wheels of vehicles. Overlapping the applications of cover material shall be avoided and. all spillage shall be removed from the surface.

The quantity of aggregates to be applied shall be within the ranges specified in Table 304.1.



### 304.3.5 Maintenance of Traffic

Detouring of highway traffic for this work on running road will not be provided for or permitted, except when authorized by the Engineer. All construction operations shall be coordinated to result in the least practicable delay of traffic. One way traffic shall be maintained and traffic speeds restricted to fifteen (15) Km per hour. The contractor shall provide flagmen, warning signs, barricades, and a sufficient number of pilot cars to control traffic through the bituminous sealing operations when so directed by the Engineer. Pilot cars shall be used to lead the traffic through the areas of all distribution and sealing operations. Pilot cars shall be light "Pick up" trucks or other approved vehicles and shall be equipped with signs reading "PILOT CAR - DO NOT PASS in both English and Urdu languages. Two (2) signs shall be mounted on the vehicles so as to be clearly Visible from both directions. One (1) flagman shall be stationed immediately ahead of the application of the bituminous material and one (1) flagman immediately behind the section being rolled. Suitable speed limit signs shall be displayed, and the signs shall move forward with the flagman as the work progresses.

No separate payment shall be made for conformance to this paragraph. All these items being considered subsidiary to the item (s) given in the Bill of Quantities.

### 304.3.6 Working Period

All work shall be so conducted that the work of applying asphalt and aggregate and of all rolling shall be completed during the time from sunrise to sunset and under favorable weather conditions as determined by the Engineer.

### 304.3.7 Maintenance of completed work

When directed by the Engineer, the Contractor will be required to add bituminous material or aggregate or both to the portion of road identified for such purpose on the project. Furnishing additional bituminous material and furnishing, spreading, dragging and rolling of additional aggregate will not be paid for separately but will be considered as subsidiary work pertaining to the relevant item of "Bituminous Surface Treatment".

### 304.3.8 Opening of Traffic and after-care

There shall be no delay in opening a completed surface dressing to traffic at a controlled speed. Prior to opening to traffic any spillage of aggregates shall be removed and any binder drips or wind blown contamination shall be dusted with crusher waste. After 2-3 days under traffic, excess stone will be removed by brushing.

### 304.3.9 Pad Coat

To ensure chipping retention when surface dressing a very hard surface, a pad coat consisting of application of an initial binder spray followed by 6 mm. chipping will be applied. After stabilizing of pad coat under traffic, the appropriate surface dressing will be applied

## 304.4 MEASUREMENT AND PAYMENT

### 304.4.1 Measurement

The quantity of surface treatment to be paid for shall be measured in square meter within the theoretical line in place as shown on drawing. No allowance will be given for material placed outside the theoretical limits of finished surfacing whether placed for, due to requirement of contractor's operations or placed outside the limits due to inadequate control.

### 304.4.2 Payment

The aggregate and asphaltic material measured as stated above shall be paid for at the contract unit price per square meter for a particular item listed below and shown on the bill of quantities, which payment shall be full compensation for furnishing all labour, materials, tools equipment and incidental for performing all the work in the construction of bituminous surface treatment or seal coat complete in place and according to specification, including priming of surface.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
304 a	Single Surface Treatment	SM
304 b	Double surface Treatment	SM
304 c	Triple Surface Treatment	SM
304 d	Seal Coat 1 Pad Coat	SM

**TABLE 304-1**  
**Quantities of Materials for Bituminous Surface Treatments**

Surface Treatment		Aggregate		Bituminous Material	
Type	Application	Size No.	Quantity Kg. / Sq.M	Quantity Litres / Sq.M	Type
Single	Single	2	12.5	1.19	(a)
				1.63	(b)
Double	First	1	24.0	1.19	(a)
				2.14	(b)
	Second	3	12.5	1.19	(a)
				1.63	(b)
Tripple	First	1	24.0	1.90	(a)
				2.14	(b)
	Second	2	12.5	1.19	(a)
				1.63	(b)
Third	3	6.5	0.68	(c)	
Seal Coat / Pad Coat with Aggregate		4	4	0.5	(c)

## Notes:-

- i) Bituminous material types are (a) asphalt cement, (b) cut-back or emulsified and (c) asphalt cement, cut-back and emulsified.
- ii) Quantities of bituminous material may be varied by the Engineer by + 15% depending on site conditions.
- iii) Prime coat shall be applied prior to the surface treatment for the newly constructed pavement at the rate as specified in the item 302.3.2.

# ASPHALT CONCRETE WEARING COURSE – PLANT MIX

## 305.1 DESCRIPTION

This work shall consist of furnishing aggregates and asphalt binder at a central mixing plant, to a specified mixing temperature, transporting, spreading and compacting the mixture in an approved manner on primed or tacked base, subbase, subgrade, bridge deck or concrete pavement in accordance with these specifications and in conformity with the lines, grades and typical cross-sections shown in the drawings or as directed by the Engineer.

## 305.2 MATERIAL REQUIREMENTS

### 305.2.1 Mineral Aggregates

The Aggregates shall consist of coarse aggregates, fine aggregates and filler material, if required and shall be clean, hard, tough, durable and sound particles of uniform quality, geology, petrology and free from decomposed material, vegetable matter, soil, clay, lumps and other deleterious substances.

Coarse aggregate which is the material retained on an AASHTO No. 4 Sieve, shall consist of one hundred (100) % crushed rock or crushed gravel having two (2) faces mechanically crushed. The type of source shall be uniform throughout the quarry location from where such a material is obtained. The coarse aggregates shall be free from an excess of flat or/and elongated particles.

Fine aggregate which is the material passing from AASHTO No. 4 sieve, shall consist of 100% crushed material from rock or boulder. Fine aggregate shall be stored separately, and no natural sand will be allowed in the mix.

When the combined grading of the coarse and fine aggregates is deficient in material passing the AASHTO No. 200 sieve, mineral filler material shall be added as approved by the Engineer. The filler shall consist of finely divided mineral matter such as rock dust, hydrated lime, hydraulic, calcined dust cement or other suitable mineral matter free from lumps, balls or other deleterious material and shall conform to the following gradation:

Sieve Designation		Percent Passing by Weight
mm	Inch	
0.600	No.30	100
0.300	No.50	95-100
0.075	No.200	70-100

The coarse and fine aggregates shall meet the following requirements:

- a) The percent of wear by the Los Angeles Abrasion test (AASHTO T 96) shall not be more than thirty (30).
- b) The loss when subjected to five cycles of the Sodium Sulphate Soundness test (AASHTO T 104) shall be less than twelve (12) percent.
- c) The Sand Equivalent (AASHTO T 176) determined after all processing except for addition of asphalt cement shall not be less than 45.
- d) All aggregates shall have a liquid limit of not more than twenty five (25) and a Plasticity Index of not more than four (4) as determined by AASHTO T-89 and T-90.
- e) The portion of aggregates retained on the 9.5 mm (3/8 inch) sieve shall not contain more than 10 percent by weight of flat and/or elongated particles (ratio of maximum to minimum dimension = 2.5:1).
- f) Stripping test shall be performed on crush aggregates as described under AASHTO-182 and only that material shall be allowed which qualifies the test.
- g) The coarse aggregates shall be checked if desired by the Engineer for cationic and anionic behaviour so that their affinity with the bitumen to be used is verified.
- h) Petrographic examination of the coarse aggregate shall be conducted if so directed by the Engineer.

The percentage of particles having certain proportions between their largest and smallest dimensions (i.e. between the largest distance the particles can fill out between two parallel planes that will permit the particle to pass), shall be determined in the following way:

- i. Form a sample of coarse aggregates, all particles passing No. 4 sieve are eliminated. The sample shall be of sufficient quantity that at least 100 particles remain.
- ii. By means of a sliding calliper, the largest and smallest dimensions, as defined above, are determined for each particle and its proportion calculated (with one decimal).
- iii. The total weights of particles having the proportions two and a half (2.5) or less and three (3) or less, are determined and their percentage in relation to the total sample are calculated.

### 305.2.2 Asphaltic Material

Asphaltic binder to be mixed with the aggregate to produce asphaltic base shall be asphalt cement penetration grade 40-50, 60-70 or 80-100 as specified by the Engineer. Generally it will meet the requirement of AASHTO M-20.

### 305.2.3 Asphalt Concrete Wearing Course Mixture

The composition of the asphaltic concrete paving mixture for wearing course shall conform to Class A and/or Class B shown in the following table:

**Table 305-1**  
**Asphalt Concrete Wearing Course Requirements**

Mix Designation	Class A	Class B
Compacted Thickness	50-80 mm	35-60 mm
Combined Aggregate Grading Requirements		

Sieve Designation		Percent Passing by Weight	
Mm	Inch		
25	1	100	-
19	3/4	90-100	100
12.5	1/2	-	75-90
9.5	3/8	56-70	60-80
4.75	No.4	35-50	40-60
2.38	No.8	23-35	20-40
1.18	No.16	5-12	5-15
0.075	No.200	2-8	3-8

Asphalt Content weight percent of total mix	3.5 (Min.)	3.5 (Min.)
---	------------	------------

The asphalt concrete wearing course mixture shall meet the following Marshal Test Criteria:

Compaction, number of blows each end of specimen	75
Stability	1000 Kg (Min)
Flow, 0.25 mm (0.01 inch)	8-14
Percent air voids in mix	4-7
Percent voids in mineral aggregates	according to table 5.3 MS-2 (Asphalt Institute - USA ), sixth addition, 1993.
Loss of Stability	20% (Max.)

### 305.2.4 Job Mix Formula

At least one week prior to production, a Job-Mix Formula (JMF) for the asphaltic wearing course mixture or mixtures to be used for the project, shall be established jointly by the Engineer and the Contractor.

The JMF shall be established by Marshall Method of Mix Design according to the procedure prescribed in the Asphalt Institute Manual Series No. 2 (MS-2), sixth edition 1993 or the latest Edition.

The JMF, with the allowable tolerances, shall be within the master range specified in Table 305-1. Each JMF shall indicate a single percentage of aggregate passing each required sieve and a single percentage of bitumen to be added to the aggregates.

The ratio of weight of filler (Passing No. 200) to that of asphalt shall range between 1 - 1.5 for hot climate areas with temperature more than 40 °C.

After the JMF is established, all mixtures furnished for the project represented by samples taken from the asphalt plant during operation, shall conform thereto with the following ranges of tolerances:

#### **Combined aggregates -gradation**

Retained No. 4 and larger	± 7.0%
Passing No. 4 to No. 100 sieves	± 4.0%
Passing No. 200	± 1.0%

#### **Asphalt Content**

Weight percent of total mix	± 0.3%
-----------------------------	--------

In addition to meeting the requirements specified in the preceding items, the mixture as established by the JMF shall also satisfy the following physical property:

Loss of Marshall Stability by immersion of specimen in water at sixty (60) degree C. for twenty four (24) hours as compared with the stability measured after immersion in water at sixty (60) degree C. for twenty (20) minutes shall not exceed twenty (20) percent. If the mixture fails to meet this criterion, the JMF shall be modified or an anti-stripping agent shall be used.

Should a change of sources of materials be made a new Job Mix Formula shall be established before the new material is used. When unsatisfactory results or other conditions make it necessary, a new Job Mix Formula will be required.

### 305.3 CONSTRUCTION REQUIREMENTS

Construction requirements for this Item shall conform with the same as specified for Asphaltic Concrete Base Course Plant Mix under Item 203.3, except as modified in the following sub-items.

#### 305.3.1 Preparation of Base Course Surface

Before spreading materials, the surface of the previously constructed and accepted base course on which the mix is to be placed shall be conditioned by application of a tack coat, if directed by the Engineer

#### 305.3.2 Pavement Thickness and Tolerances

The asphalt concrete wearing course shall be compacted to the desired level and cross slope as shown on the drawing or as directed by the Engineer.

The tolerances in compacted thickness of the wearing course shall be  $\pm 3$ mm from the desired thickness shown on the drawings. For determination of thickness one (1) core per hundred meters of each lane will be taken. If the thickness so determined is deficient by more than three (3) mm, but not more than ten (10) mm, payment will be made at an adjusted price as specified in table-1, clause 305.4.2.(2) of this specification.

The surface of the wearing course shall be tested by the Engineer using a 5 meters straightedge at selected locations. The variation of the surface from the testing edge of the straightedge between any two contacts, longitudinal or transverse with the surface shall at no point exceed five (5) millimeters. The cross fall (camber) shall be with + 0.2 percent of that specified, and the level at any point shall be within + three (3) mm of the level shown on the Drawings. All humps or depressions exceeding the specified tolerance shall be corrected by removing the defective work and replacing it with new material, by overlaying, or by other means satisfactory to the Engineer.

#### 305.3.3 Acceptance Sampling and Testing

Acceptance of sampling and testing for this Item with respect to materials and construction requirements, not specified herein, shall be in accordance with the relevant, Tables for Sampling and Testing Frequency" in these specifications.



## 305.4 MEASUREMENT AND PAYMENT

### 305.4.1 Measurement

The quantities of Asphaltic wearing course shall be measured by volume in CM. laid and compacted in place. Measurements shall be based on the dimension as shown on plans or as otherwise directed or authorized by the Engineer. A tolerance of + three (3) mm shall be allowed in compacted thickness of wearing course. However, any asphalt in excess of 3 mm shall not be paid and any layer deficient by more than 3 mm but not exceeding 10 mm shall be paid as per clause 305.4.2 (2) of this specification.

The quantity of bitumen material used is included in the asphalt concrete mixture and will not be measured separately.

Quantities of Bitumen or asphaltic concrete wasted or remaining on hand after completion of the work shall not be measured or paid for.

### 305.4.2 Payment

- 1) The quantity determined as provided above shall be paid for at the contract unit price respectively for each of the particular pay items listed below and shown in the Bill of Quantities , which prices and payment shall constitute full compensation for all the costs necessary for the proper completion of the work prescribed in this item. Asphalt additive or antistripping agent, if allowed and used to meet with JMF requirement shall not be paid directly, payment shall be deemed to be included in the respective pay items of Asphaltic wearing course.

- 2) **Price adjustment.** If the thickness determined as per clause 305.3.2 of this specification is deficient by more than three (3) mm, but not more than ten (10) mm, payment will be made at an adjusted price as specified in table-1 below:-

**Table - 1**

<b>Deficiency in thickness as determined by cores</b>	<b>Proportional Rate of contract Price allowed</b>
0.0 mm to 3.0 mm	100%
3.1 mm to 50.0 mm	90%
5.1 mm to 10.0 mm	80%

When wearing course is more than ten (10) mm deficient in thickness, the contractor shall remove such deficient areas and replace them with wearing course of an approved quality and thickness or the contractor may opt to place an additional layer of wearing course asphalt, grading with a minimum thickness of 35 mm. The contractor will receive no compensation for the above additional work.

Alternately, the Contractor may choose to overlay the area in a thickness of 30 mm (min.) with smooth transition as approved by the Engineer on either side with no extra compensation.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
305a	Asphaltic Concrete for Wearing Course (Class A)	CM
305 b	Asphaltic Concrete for Wearing Course (Class B)	CM

# STRUCTURES

## GENERAL

### 400.1 DESCRIPTION

This item contains a general description of the specific items of work, the materials, construction requirements, and methods of measurement and payment for all concrete structures including bridges, culverts, piles, composite structures of concrete such as barriers and steel, prestressed and post tensioned girder and all brick and stone masonry structures built as indicated on the drawings and in conformity with the lines, grade, dimension in conjunction with any instructions issued by the Engineer. Materials, equipment, workmanship and construction methods applied in the work shall conform to the requirements laid down herein and shall also follow the best modern construction practices with the approval of Engineer. This item shall also include construction of certain structural features and incidental items which are either common to all types of structures or which may apply to any of them.

### 400.2 CLEARING OF SITE

The contractor shall clear the sites for proposed structures of trees, bushes, stumps and debris, in the manner outlined in section 101 "Clearing and Grubbing" cost of which shall be deemed to be included in the price bid for the various items. Special clearing of site such as removal of existing bridges, buildings, concrete pavement etc., will be paid for at the prices tendered for these items, but where no such prices are provided for, all costs in connection with the special clearing shall be deemed to be included in the price tendered for various items of the structures in the Bill of Quantities.

Removal or relocation of public or private utilities such as telephone, telegraph lines, power lines, sewer and water pipe lines, railway tracks and their appurtenances etc., shall be arranged by the Employer's Representative with the concerned Government Agency/Agencies, Autonomous Bodies, Utility companies involved. The Employer shall bear the costs of relocating such utilities.

### 400.3 ALIGNMENT AND GRADE

The structures on vertical curves or the structures which have super-elevated roadways because of horizontal curves and those spans on which definite finished camber is necessary in order to form a uniform grade line, all require special care and attention regarding to the elevation and alignment of their railing and kerbs.

### 400.4 FOUNDATION DATA

Refer to clause 400(A).3 (b)

### 400.5 FINAL CLEARING

Upon completion of structure, the contractor shall clean up the site, remove all temporary buildings, false work, lumber, equipment and all other debris. The contractor shall level off all excavated material not used for back fill around piers, bents, abutment, culvert, headwalls and on embankment slopes. Bridge decks and sidewalks shall be left in clean and workman like condition. No specific payment for clearing up shall be made but the cost shall be included in other items shown on the bill of quantities.

### 400.6 OPENING TO TRAFFIC

Bridges or slab or box culverts having decks constructed with Portland Cement concrete shall remain closed to all traffic and Contractor's equipment subject to the results of tests made of the concrete but not less than twenty eight (28) days after the placing of concrete.

The above time of opening to traffic is applicable when temperatures are above ten (10) degree C. When temperatures are below ten (10) degree C, the time of opening to traffic shall be increased at the discretion of the Engineer. In any event bridges or culverts with concrete decks shall not be opened to traffic without the, approval of the Engineer.

## 400.7 MEASUREMENT AND PAYMENT

### 400.7.1 Measurement

The quantities of various pay items which constitute the completed and accepted structures shall be measured for payment according to the plans and specification for the several pay items appearing in the Bill of Quantities and in term of the prescribed -units provided for the several pay items. Only accepted work shall be included for payment and the measured quantity shall be based on the dimension of component as shown on the plans or as directed in writing by the Engineer.

### 400.7.2 Payment

The quantities measured as provided above shall be paid for at the unit prices bid for the several pay items appearing in the Bill of Quantities which payment and prices shall be full compensation for furnishing, preparing, fabricating, transporting, placing and erecting all material for the complete structure; for all labour, equipment, tool and all other items necessary for the completion of work Such payment shall constitute full payment for completed structure and no allowance will be made for cofferdam construction, form lumber, false work and other incidental expenses.

## CONCRETE

### 401.1 DESCRIPTION

This work consists of furnishing placing, curing, finishing including transport of cement concrete made from approved type of Cement, water, fine and coarse aggregates all in accordance with the requirements in these specifications and conforming to the lines, grades, and typical sections shown on the Drawings or called for in the special Provisions and to the approval of the Engineer.

#### 401.1.1 Classes of Concrete

The classes of concrete recognized in these specifications shall be designated: A,13,QD1,D2,D3,Y and Lean Concrete. The Class of concrete to be used shall be as called for on the Drawings or as directed by the Engineer or specified in the Special Provisions. The following requirements shall govern unless otherwise shown on the Drawings.

Class A1 Concrete shall be used everywhere, for non-reinforced and reinforced concrete structures, except as noted below or directed by the Engineer. Concrete placed under water shall be Class A2 with a minimum cement content of three hundred fifty (350) kg per cubic meter of concrete with a slump between ten (10) and fifteen (15) cm. Concrete placed for piles shall be class A3 with a minimum cement content of four hundred (400) Kg per cubic meter.

Class B Concrete shall be used only where specified.

Class C Concrete shall be used for cribbing, or as otherwise directed by the Engineer or specified in the Special Provisions or on the Drawings.

Class D1,D2 or D3, concrete shall be used for pre-stressed and post tensioned elements, as indicated on drawings.

Class Y concrete shall be used as a filler in steel grid bridge floors, in thin reinforced sections, or as otherwise specified in the Special Provisions.

Lean Concrete shall be used in thin layers underneath footings and when called for on the Drawings or directed by the Engineer.

The concrete of the various classes shall satisfy the requirements shown in Table 401 –1

**Table 401-1  
Portland Cement Concrete Requirements**

Class of Concrete	Min. Cement Kg / Cubic Meter	Maximum Size of Coarse Aggregate (mm)	28 Days Compressive Strength (Min.) (Cylinder) (Kg / Sq.cm)	Consistency (Range in Slump)	Maximum Permissible Water – Cement Ratio
				Vibrated (mm)	
A <sub>1</sub>	300	20	210	25 – 75	0.58
A <sub>2</sub>	350	25	245	100 – 150	0.58
A <sub>3</sub>	400	38	280	100 – 150	0.58
B	250	51	170	25 – 75	0.65
C	275	38	210	25 – 75	0.58
D <sub>1</sub>	450	25	350	50 – 100	0.40
D <sub>2</sub>	500	25	425	50 – 100	0.40
D <sub>3</sub>	550	25	500	50 – 100	0.40
Y	400	13	210	25 – 75	0.58
Lean Concrete	175	51	100	–	–

## 401.1.2 TYPES OF CONCRETE WORKS

### **Under Ground Concrete**

Concrete poured below Natural Surface Level with or without shuttering and shoring.

### **On Ground Concrete**

Concrete poured by erecting formwork with necessary bracings on ground.

### **Elevated Concrete**

Concrete poured by erecting props, bracing and towers to support the formwork at higher levels.

## 401.2 MATERIAL REQUIREMENTS

### 401.2.1 Portland 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 contractor for more than three (3) months after shipment from the factory may be retested before use and shall be rejected if it fails to meet any of the specification requirements.

Portland cement shall conform to the requirements of the Standard Specifications for Portland cement, AASHTO Designation M85 (ASTM Designation C150). The type of the cement to be used, unless otherwise shown on the Drawings, shall be type 1.

Sampling of cement shall be in accordance with AASHTO Designation T-127.

Mill certificates shall accompany delivery of the material to the work.

Cement shall be delivered in sufficient quantities to ensure that there is no suspension of the work of concreting at any time. Different brand or different types of cement from the same mill, or the same brand or type from different mills shall not be mixed or used alternately in the same item of construction unless authorized by the Engineer, after preparing new mix design.

### 401.2.2 Fine Aggregate

The fine aggregate shall consist of sand, stone screenings or other approved inert materials with similar characteristics, or a combination thereof, having clean, hard, strong, sound, durable, uncoated grains free from injurious amount of dust, lumps, soft or flaky particles, shale alkali, organic matter, material reactive with alkalis in the cement loam or other deleterious substances, and shall not contain more than three (3) percent of material passing the No.200 sieve by washing nor more than one percent of clay lumps or one (1) percent of shale. The use of beach sand is prohibited without the written consent of the Engineer.

For exposed work, the fine aggregate shall be free from any substance that will discolour the concrete surface.

The fine aggregate shall be uniformly graded and when tested in accordance with AASHTO Designation T-11 and T-27 shall meet the following grading requirements:

**GRADING OF FINE AGGREGATES**

3/8"	100
No. 4	95 – 100
No. 16	45 – 85
No. 50	10 – 30
No. 100	2 – 10
No. 200	0 – 3



In case if fine aggregates fail under Fineness Modulus or Gradation however material passing No. 4 in combined aggregate, qualifies for these requirements, then the material can be accepted.

Fine aggregates shall be of such quality that mortar specimens, prepared with standard Portland cement and tested in accordance with AASHTO Designation T-71, shall develop a compressive strength at 7 days of not less than 90 percent of the strength developed by a mortar prepared in the same manner with the same cement and graded sand having a fineness modulus of 2.3 to 3. 1. Natural aggregates if required shall be thoroughly and uniformly washed before use. Sand equivalent (T-176) shall be 75 min.

For the purpose of determining the degree of uniformity, a fineness modulus determination shall be made upon representative samples submitted by the Contractor from such sources as he proposes to use. Fine aggregate from any one source having a variation in fineness modulus of greater than 0.20 either way from the fineness modulus of mix design samples submitted by the Contractor may be rejected till new trial mixes are prepared and tested by the contractor.

Testing of the aggregate is specified under Item 401.3.9 of these specifications.

### 401.2.3 Coarse Aggregate

The coarse aggregate shall consist of crushed or broken stone, gravel or other approved inert materials with similar characteristics, or a combination thereof, having clean, hard, strong, sound, durable uncoated particles, free from injurious amount of soft, friable, thin elongated, or laminated pieces, alkali, organic or other deleterious matter and conforming to the requirements of these Specifications.

The coarse aggregate shall be of uniform grading with maximum sizes as required for the various classes of concrete as shown in Table 401-2 and when tested in accordance with AASHTO Designation T-11 & T-27 shall meet the following grading requirements.

**TABLE 401.2  
GRADING OF COARSE AGGREGATES**

Designated Sizes	Percentage by Weight Passing Laboratory Sieves Having Square Openings, in Inches							
	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"
1/2" to No. 4	-	-	-	-	100	90-100	40-70	0-15*
3/4" to No. 4	-	-	-	100	90-100	-	20-55	0-10*
1" to No. 4	-	-	100	95-100	-	25-60	-	0-10*
1 1/2" to No. 4	-	100	95-100	-	35-70	-	10-30	0-5
2" to No. 4	100	95-100	-	35-70	-	10-30	-	0-5
1 1/2" to 3/4"	-	100	90-100	20-55	0-15	-	0-5	-

2" to 1"	100	90-100	35-70	0-15	-	0-5	-	-
----------	-----	--------	-------	------	---	-----	---	---

\*Not more than five 5 percent shall pass No.8 sieve.

Coarse aggregate shall contain not more than one (1) percent by weight of material passing the No.200 sieve by washing and not more than five (5) percent of soft fragments.

It shall have an abrasion loss of not more than forty (40) percent at five hundred (500) revolutions, when tested in accordance with AASHTO T-96.

When tested in accordance with AASHTO TA 04, for five cycle, the loss with the sodium sulphate soundness test shall be not more than 12 percent.

Natural aggregates shall be thoroughly washed before use. Testing of coarse aggregate is specified under Item 401.3.9 of these Specifications.

The aggregate shall be non-alkali / silica reactive where the concrete is to be poured under water or exposed to humid conditions. In case the Contractor proposes to use the aggregate having the alkaline / siliceous characteristics with the intention to use it with Blast Furnace Slag Cement, he will under take to carry out the job with out any extra cost and shall arrange to conduct the necessary tests as directed by the Engineer.

#### 401.2.4 Combined Aggregate

The coarse and fine aggregate shall be combined in the proportions according to the approved trial mixes for each class of concrete.

#### 401.2.5 Rubble or Cyclopean Concrete

Rubble or cyclopean concrete shall consist of tough, sound, and durable rock. The stone shall be free from coatings, seams, or flaws of any character. In general, the percentage of wear shall not exceed fifty (50) when tested in accordance with the Standard Method of Testing for Abrasion of Coarse Aggregate by the use of the "Los Angeles Machine", ASTM C535.

#### 401.2.6 Storage of Cement and Aggregates

- a) All cement shall be stored, immediately upon arrival on the site of the work, in weather-proof building, which will protect the cement from dampness. The floor shall be raised from the ground. The buildings shall be placed in locations approved by the Engineer. Provisions for storage shall be ample, and the shipments of cement as received shall be separately stored in such a manner as to provide easy access for identification and inspection of each shipment. Storage buildings shall have capacity of a sufficient quantity of cement for at least thirty (30) days use. Bulk cement, if used, shall be transferred to elevated air tight and weatherproof bins. However, if approved, sacked cement on small jobs may be stored in the open, upon a raised platform provided that ample waterproof covering is ensured. Stored cement shall meet the test requirements at any time after storage when the Engineer orders retest. At the time of use all cement shall be free flowing and free of lumps. Cement bags shall be weighed at random to check for variation.

Copies of cement records shall be furnished to the Engineer showing such detail as, the quantity used during the day run or at each part of the work Cement held in storage for a period of over sixty (60) days, or cement, which, for any reason the Engineer may suspect of being damaged, shall be subject to a retest before being used in the work.

- b) The handling and storing of concrete aggregates shall be such as to prevent segregation or the inclusion of foreign materials. The Engineer may, require that aggregates be stored on separate platforms at satisfactory, locations.

In order to secure greater uniformity of the concrete mix, the Engineer may require that the coarse aggregate be separated into two or more size Different sizes of aggregate shall be stored in separate bins or in separate stock piles to prevent the material at the edges of the piles from becoming intermixed.

If aggregates are stored on the ground the bottom layer of aggregate shall not be disturbed or used without reclining and as approved by the Engineer.

#### 401.2.7 Water

The water for curing, for washing aggregates and for mixing shall be subject to the approval of the Engineer. It shall be free from oil and shall contain not more than one thousand (1,000) parts per million of chlorides nor more than one thousand three hundreds (1,300) parts per million of sulphates (S04). In no case shall the water contain an amount of impurities that will cause a change in the setting time of Portland cement of more than twenty five (25) percent nor a reduction in the compressive strength of mortar at fourteen (14) days of more than five (5) percent when compared to the result obtained with distilled water.

In non-reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than two thousands (2,000) parts per million of chlorides nor more than one thousand five hundreds (1,500) parts per million of sulphates as S04.

In addition to the above requirements, water for curing concrete shall not contain any impurities in a sufficient amount to cause discolouration of the concrete or produce etching of the surface.

When required by the Engineer, the quality of the mixing water shall be determined by the Standard Method of Test for Quality of Water to be used in concrete, AASHTO Methods of Sampling and Testing, Designation: T 26.

#### 401.2.8 Admixtures

Admixtures shall only be allowed to be used with written permission from the Engineer. If air-entraining agents, water reducing agents, set retarders or strength accelerators are permitted to be used, they shall not be used in greater dosages than those recommended by the manufacturer, or permitted by the Engineer, and shall conform to the requirements for each of the agents specified by the manufacturer.

### 401.3 CONSTRUCTION REQUIREMENTS

The manufacturing, transport, handling and placing of concrete shall conform with the requirements given hereinafter.

Unless otherwise specified, ordinary Portland cement shall be used for all types of concrete. When sulphate resisting cement or other type of cement is required, it will be specified on the Drawings/or in BOQ or ordered by the Engineer.

#### 401.3.1 Proportioning of Concrete

All. Weighing shall proportion concrete, except as specified herein. The proportions by weight of cement, fine aggregates, coarse aggregates and water necessary to produce concrete of the required strength and the Engineer shall approve consistency. Such approval may be withdrawn at any time, and changes in the proportions may be required for the purpose of required workability, density, impermeability, durability and strength.

Based on the approved mix proportions, the Contractor shall prepare lists showing the number of kilograms of the various material to be used in the batch size adopted. The required consistency shall also be shown. Such lists are subject to approval by the Engineer, and shall be posted at the mixer. The amount of water in the mix is the total amount of free water, including the free water held by the aggregates.

No concrete shall be placed in the works until the results of the twenty eight (28) days test indicate that the design proportions are satisfactory as per requirements under Item 401.3.10 "Testing of Compressive Strength". Adjustment of the proportions shall be subject to the following provisions:

- a) Adjustment for variation in workability - If it is found impossible to obtain concrete of the desired workability with the proportions originally approved, the Engineer shall make such changes as are necessary.
- b) Adjustment for new materials - No change in the source or character of the material shall be made without due notice to the Engineer and no new materials shall be used until the Engineer has accepted such materials and has approved new proportions based on trial mixes. The Contractor's attention is drawn to the time required to prepare and test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date so that the progress of the work is not delayed.

#### 401.3.2 Consistency

Concrete shall have a consistency such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcement steel but individual particles of the coarse aggregate when isolated shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be determined to be as dry as is practicable to satisfy the requirements for transportation and placing the concrete as described hereinafter.

Consistency of concrete shall be determined as specified in AASHTO T-119. The Consistency of concrete at the time of delivery shall be shown in Table 401.1 or as designated by the Engineer.

### 401.3.3      Mixing Concrete

**a)      Mixing General**

The concrete shall be mixed only in the quantity required for immediate use. Concrete that has developed an initial set shall be rejected.

Concrete shall be thoroughly mixed in a mixer of an approved size and type that will ensure a uniform distribution of the materials throughout the mass.

All concrete shall be mixed in mechanically operated mixers. Mixing plant and equipment for transporting and placing concrete should be arranged with an ample auxiliary installation to provide a minimum supply of concrete in case of breakdown of machinery or in case the normal supply of concrete should be disrupted. The auxiliary supply of concrete shall be sufficient to complete the casting of a section up to a construction joint.

Equipment having components made of aluminium or magnesium alloys, which would have contacted with plastic concrete during mixing, transporting or pumping of Portland cement concrete, shall not be used.

Concrete mixers shall be equipped with adequate water storage and a device for accurately measuring and automatically controlling the quantity of water used.

Materials shall be measured by weighing, except as otherwise specified or where other methods are specifically authorized by the Engineer. The apparatus provided for weighing the aggregates and cement shall ensure accurate measurement of each ingredient.

The accuracy of all weighing devices except that for water shall be such that successive quantities can be measured to within one (1) percent of the desired value. Cement in standard packages (bags) approved by the Engineer need not be weighed. The water measuring device shall be accurate to plus or minus half percent + 0.50%. All measuring devices shall be subject to the approval of the Engineer. Scales and measuring devices shall be tested at the expense of the Contractor as frequently as the Engineer may deem necessary to ensure their accuracy.

Weighing equipment shall be isolated so that vibration or movement of other operating equipment do not effect the accuracy of reading. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the Engineer more than one (1) percent for cement, one and half (1.112) percent for any size of aggregate, or one (1) percent for the total aggregates in any batch.

Where volumetric measurements are authorized by the Engineer, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowances shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregates. Boxes or similar containers of the exact volume required shall be filled and struck off. Measurement by wheel barrow volumes will not be permitted.

**b) Mixing at Site**

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixer shall be restored or replaced when any part or sections is worn two and half (2.5) cms. or below than the original height of the manufacturer's design. Mixers and agitators, which have an accumulation of hard concrete or mortar, shall not be used.

When bulk cement is used and volume of the batch is one cubic meter or more, the scale and weigh hopper for Portland cement shall be separate and distinct from the aggregate hopper or hoppers. The discharge mechanism of bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall also be interlocked against opening when the amount of cement in the hopper is underweight by more than one percent or overweight by more than three (3) percent of the amount specified.

When the aggregates contain more water than the quantity necessary to produce a saturated surface-dry condition, representative samples shall be taken and the moisture content determined for each kind of aggregate.

The temperature of mixed concrete, immediately before placing, shall be not more than thirty two (32) degree C. Aggregates and water shall be cooled as necessary to produce concrete within this temperatures limit. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.

The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregates. All water shall be in the drum by the end of the first quarter of the specified mixing time.

Cement shall be batched and charged into the mixer by means that will not result in loss due to the effect of wind, or in accumulation of cement on surfaces of conveyors or hoppers, or in other conditions, which reduce or vary the required quantity of cement in the concrete mixture.

The entire contents of a batch mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch except water shall be deposited simultaneously into the mixer.

All concrete shall be mixed for a period of not less than one and half (1.1/2) minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed.

Mixers shall be operated with an automatic timing device that can be locked by the Engineer. The time device and discharge mechanism shall be so interlocked that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.

In case of failure of the timing device, the Contractor will be permitted to operate while it is being repaired, provided he furnishes an approved timepiece equipped With minute and second hands. If the timing device is not repaired within twenty four (24) hours, further use of the mixer will be prohibited until repairs are made.

The first batch of concrete material placed in the mixer shall contain cement, sand, and water in excess to the requirement of mix, to ensure that the drum does not extract mortar from the mix changing its design characteristics. When mixing is to stop for a period of one hour or more, the mixer shall be thoroughly cleaned.

**c) Plant Mixing**

At central mixing plant, batches shall be discharged from the weighing hopper into the mixer either directly by gravity or by an elevating container large enough to contain the batch. The plant shall be arranged to ensure that there is no loss of cement during transfer from weighing hopper to the mixer drum. The mixing time shall neither be less than fifty (50) second, nor more than ninety (90) seconds.

The plastisizer, accelerator or retarder or water-reducing admixture, if required, shall be fed separately at the rate recommended by the manufacture, or as established by laboratory trials.

**d) Transit Mixing**

Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, watertight, and so constructed that the concrete can be mixed to ensure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant. The truck mixer shall be equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in case the concrete batch is poured within twenty five (25) minutes of adding water.

The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer, and stamped in metal on the mixer. Truck mixing shall be continued for not less than fifty (50) revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than six (6) rpm, nor more than ten (10) rpm.

Mixing shall begin within thirty (30) minutes after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above thirty two (32) degree C, this limit shall be reduced to fifteen (15) minutes. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgment of the Engineer, the aggregate is sufficiently free from moisture, so that there will be no harmful effects on the cement.

**e) Partial Mixing at the Central Plant**

When a truck mixer, or an agitator provided with adequate mixing blades, is used for transportation, the mixing time at the stationary plant mixer may be reduced to thirty (30) seconds and the mixing completed in a truck mixer / agitator. The mixing time in the truck mixer or agitator equipped with adequate mixing blades shall be as specified for truck mixing.

**f) Stiff Concrete Mix**

For mixing concrete of zero slump to be laid by pavers, gravity mixer shall not be used. Only force mixer of moving blades shall be allowed to ensure homogenous mix.

**g) Hand Mixing**

Hand mixing of materials shall not be allowed in any case.

#### 401.3.4 Hauling and Delivery of Mixed Concrete

**a) Hauling**

Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place.

Truck agitators shall be loaded not to exceed the manufacturer's rated capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

Bodies of non-agitating hauling equipment shall be so constructed that leakage of the concrete mix, or any part thereof, will not occur at any time, and they shall be self-cleaning during discharge.

For zero slump concrete to be laid by paver, concrete will be allowed to be hauled in open trucks. However concrete hauled in open-top vehicles shall be protected during hauling against rain, or exposure to the sun for more than twenty (20) minutes when the ambient temperature exceeds twenty five (25) degree C.

No additional water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixer agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within one hour, or before two hundred fifty (250) revolutions



of the drum or blades, whichever comes first, after the introduction of cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is thirty (30) degree C or above, a time less than one hour will be required except when retarder is used in which case it shall be one (1) hour.

When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is thirty (30) degree C or above, the time between the introduction of cement to the aggregates and discharge shall not exceed forty five (45) minutes..

**b) Delivery**

The organization supplying concrete shall have sufficient plant capacity and transportation vehicles to ensure continuous delivery at the rate required. The rate of the delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing, and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed twenty (20) minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing with the minimum rehandling and without damage to the structure of the concrete.

**c) Retempering**

The concrete shall be mixed only in such quantities as are required for immediate use and any concrete that has developed initial set shall not be used. Concrete that has partially hardened shall not be retempered or remixed.

## 401.3.5 Handling and Placing Concrete

**a) General**

In preparation for the placing of concrete all sawdust, chips and other construction debris and extraneous matter shall be removed from inside the formwork, and struts, stays and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

No concrete shall be used that does not reach its final position in the forms within the time stipulated above under Item 401.3.4 "Hauling and Delivery of Mixed Concrete".

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying concrete to the forms shall be permitted only on written authorization of the Engineer. In any case the Engineer will reject the use of equipment for concrete transportation that will allow segregation, loss of fines, or in any other way will have a deteriorating effect on the concrete quality.

Open troughs and chutes shall be of metal or metal lined; where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discharged clear off the structure.

When placing operations would involve dropping the concrete more than one and half (1.1/2) meters, it shall be conveyed through sheet metal or other approved pipes. As far as practicable, the pipe shall be kept buried in the newly placed concrete. After initial set of the concrete the forms shall not be jarred and no loading of any kind shall be placed on the ends of projecting reinforcement bars.

The concrete shall be placed as nearly as possible to its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

**b) Pneumatic Placing**

Pneumatic placing of concrete will be permitted only if authorized by the Engineer. The equipment shall be so arranged that no vibration will occur that might damage freshly placed concrete.

Where concrete is conveyed and placed by pneumatic means, the equipment shall be suitable in kind and adequate in capacity for the work. The machine shall be located as close as practicable to the work. The discharge lines shall be horizontal or inclined upwards from the machine.

At the conclusion of placing the concrete, the entire equipment shall be thoroughly cleaned.

**c) Pumping**

The placing of concrete by pumping will be permitted only if specified in the Special Provisions or if authorized by the Engineer. The equipment shall be so arranged that no vibration will occur that might damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is obtained. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned.

**d) Placing Concrete Under Water**

Concrete shall not be placed under water except where inevitable in which case approval must be sought from the Engineer and the work carried out under his immediate supervision. In this case the method of placing shall be as hereinafter specified.

Concrete deposited under water shall be class A concrete with a minimum cement content of three hundred fifty (350) Kg per cubic meter of concrete.

The slump of concrete shall be maintained between ten (10) and fifteen (15) cm. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie, a bottom-dump bucket, or other approved means, and it shall not be disturbed after being placed. Water must not be allowed to flow past the fresh concrete surface.

A tremie shall consist of a tube having a diameter of not less than 25 cm constructed in sections having flanged couplings fitted with gaskets with a hopper at the top. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of work so as to prevent water entering the tube and shall be completely submerged in concrete at all times; the tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, but always keeping it in the placed concrete. The flow shall be continuous until the work is completed.

When the concrete is placed with a bottom-dump bucket, the top of the bucket shall be open. The bottom doors shall open freely downward and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until well above the concrete.

Dewatering may proceed when the concrete seal is sufficiently hard and strong. All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, chipping or other means, which will not injure the surface of the concrete.

**e) Compaction**

Concrete, during, and immediately after placing shall be thoroughly compacted, except lean concrete under footings and concrete deposited under water. Concrete in walls, beams, columns, etc. shall be placed in horizontal layers not more than thirty (30) centimetres thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding layer has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the layers. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer, which has not taken an initial set.

The compaction shall be done by mechanical vibration. The concrete shall be vibrated internally unless special authorization of other methods is given by the Engineer or is provided herein. Vibrators shall be of a type, design, and frequency approved by the Engineer.

The intensity of vibration shall be such as visibly to affect a mass of concrete with a 3 cm slump over a radius of at least half a meter. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms and shall be applied at the point of placing and in the area of freshly placed concrete. The vibrators shall be inserted into and withdrawn from the concrete slowly. The vibration shall be of sufficient duration and intensity to compact the concrete thoroughly but shall not be continued at anyone point to the extent that localized' areas of grout are formed. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. Vibration shall not be applied directly to the reinforcement or to sections or layers of concrete that have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation and vibrators shall not be used to transport concrete neither in the forms nor in troughs or chutes.

Vibration shall be supplemented by such external vibrator as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the normal vibrators.

## 401.3.6 Casting Sections and Construction Joints

### a) **General**

The concrete in each integral part of a structure shall be placed continuously, and the Contractor will not be allowed to commence work on any such part unless sufficiently inspected and approved material for the concrete is at hand, and manpower and equipment are sufficient to complete the part without interruption in the placing of the concrete.

Construction joints shall be allowed only where specified on the plans or otherwise approved. If not detailed on the plans, or in the case of emergency, construction joints shall be placed as directed. Shear keys or inclined reinforcement shall be used where necessary to transmit shear or bond the two sections together. When shear keys or inclined reinforcement are not provided, the concrete shall be roughened as directed. Joints in the concrete due to discontinuity of work shall be avoided as far as possible. Such joints, when necessary, shall, be constructed to meet the approval of the Engineer.

When the placing of concrete is temporarily discontinued, the concrete after becoming firm enough to retain its shape, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. Where a "leathered edge" might be produced at a construction joint, as in the sloped top surface of a wing wall, an inset formwork shall be used to produce an edge thickness of not less than 15 centimetres in the succeeding layer. Work shall not be discontinued within fifty (50) centimetres of the top of any face, unless provision has been made for a coping less than 50 centimetres thick, in which case, if permitted by the Engineer, the construction joint may be made at the underside of coping.

Immediately following the discontinuance of placing concrete all accumulations of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. Care shall be exercised, during the cleaning of the reinforcing steel, not to injure or break the concrete steel bond near the surface of the concrete.

### b) **Slab Culverts**

In general, the lean concrete below the foundation shall be placed and allowed to set before the reinforced concrete is started.

After the construction of masonry abutment walls, as specified in Special Provisions, the concrete bed plate and curtain walls shall be constructed monolithically. Construction joints in wing walls where unavoidable shall be horizontal and so located that no joint will be visible in the exposed face of the wing wall above the ground line.

### c) **Box Culverts**

Vertical construction joints shall be at right angles to the axis of the culvert.

In general, the base slab or footings of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. In this case, suitable \*provision shall be made for

bonding the sidewalls to the culvert base, preferably by means of raised longitudinal keys so constructed as to prevent, as far as possible, the percolation of water through the construction joint.

In the construction of box culverts one and quarter (1.114) meters or less in height, the sidewalls and top slab may be constructed as a monolithic unit. When this method of construction is used, necessary construction joints shall be vertical and at right angles to the axis of the culvert.

In the construction of box culverts more than one and quarter (1.114) meters in height the concrete in the walls shall be placed and allowed to set before the top slab is placed. In this case, appropriate keys shall be left in the sidewalls for anchoring the cover slab.

If possible, each wingwall shall be constructed as a monolithic unit. Construction joints, where unavoidable, shall be horizontal and so located that no joint will be visible in the exposed face of the wingwall above the ground line.

**d) Girders, Slabs and Columns**

For simple spans, concrete shall preferably be deposited by beginning at the center of the span and working from the center toward the ends. Concrete in girders shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers. For continuous spans, where required by design considerations, the concrete placing sequence shall be shown on the plans or in the Special Provisions.

Concrete in girder haunches less than one (1) meter in height shall be placed at the same time as that in the girder stem, and the column or abutment tops shall be cut back to form seats for the haunches. Whenever any haunch or fillet has a vertical height of one (1) meter or more, the abutment or columns, the haunch; and the girder shall be placed in three successive stages; first, to lower side of haunch; second, to the lower side of the girder; and third to completion.

For haunched continuous girders, the girder stem (including haunch) shall be placed to the top of stem. Where the size of the pour is such that it cannot be made in one continuous operation, vertical construction joints shall preferably be located within the area of contraflexure.

Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided. The floors and girders of through girder superstructures shall be placed in one continuous operation unless otherwise specified, in which case a special shear anchorage shall be provided to ensure monolithic action between girder and floor.

Concrete in T-beam or deck girder spans may be placed on one continuous operation or may be placed in two separate operations; each of which shall be continuous; first, to the top of the girder stems and second, to completion. In the latter case, the bond between stem and slab shall be provided by suitable shear keys or by artificially roughening the surface of the top of the girder stem. In general, suitable keys may be formed by the use of timber blocks approximately five (5) by ten (10) cm in cross-section and having a length of ten (10) cms less than the width of the girder stem. These key blocks shall be spaced along the girder stems as

required, but the spacing shall be not greater than thirty (30) cms center to center. The blocks shall be removed as soon as the concrete has set sufficient to retain its shape.

Concrete in box girders may be placed in two or three separate operations. In either case the bottom slab shall be placed first. Bond between the bottom slab and stem shall be positive and mechanical. If the webs are placed separately from the top slab, bond between the top slab and webs shall be secured in the same manner as for T-beams. Requirements for shear keys for T-beams shall also apply to box girders, except that keys need not be deeper than the depth to the top of bottom slab reinforcement.

Concrete in columns shall be placed in one continuous operation, unless otherwise directed. The concrete shall be allowed to set at least 24 hours before the caps are placed.

When friction collars are used to support cap forms, the concrete of columns shall have been poured at least seven (7) days earlier.

Unless otherwise permitted, no concrete shall be placed in the superstructure until the column forms have been stripped sufficiently to determine the character of the concrete in the columns. The load of the superstructure shall not be allowed to come upon the bents until the test cylinders representing the bents have obtained the minimum compressive strength but in no case in less than seven (7) days.

**e) Construction Joints**

Construction joints shall be made only where shown on the Drawings or called for in the pouring schedule, unless otherwise approved by the Engineer. If not detailed on the Drawings, construction joints, also in cases of emergency shall be placed to meet the approval of the Engineer. Shear keys or reinforcement shall be used, unless otherwise specified, to transmit shear or to bond the two sections together.

Before depositing new concrete on or against concrete, which has hardened, the forms shall be re-tightened. The surface of the hardened concrete shall be roughened as required by the Engineer, in a manner that will not leave loose particles of aggregate or damage concrete at the surface.' It shall be thoroughly cleaned of foreign matter and laitance. When directed by the Engineer, the surface of the hardened concrete which will be in contact with new concrete shall be washed with water to ensure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and watered surfaces, including vertical and inclined surface, shall first be thoroughly covered with a coating of mortar of the same proportion of sand and cement as the class of concrete used against which the new concrete shall be placed before the grout or mortar has attained its final set.

The placing of concrete shall be carried out continuously from joint to joint. The face edges of all joints, which are exposed, to view shall be carefully finished true to line and elevation.

**f) Rubble or Cyclopean Concrete**

Rubble or cyclopean concrete shall consist of Class B concrete containing large embedded stones. The stone for this class of work shall be placed carefully so as to avoid damage to the forms or to the partially set adjacent concrete. Stratified stone shall be placed upon its natural bed. Stone shall be washed and saturated with water before placing.

The total volume of the stone shall not be greater than one third of the total volume of the portion of the work in which it is placed. For walls of piers greater than sixty (60) cms in thickness, stone of such size that one man can handle it, shall be used. Each stone shall be surrounded by at least fifteen (15) cms of concrete and no stone shall be closer than thirty (30) cms to any top surface nor any closer than fifteen (15) cms to any coping. For walls or piers greater than one (1) meter in thickness, larger stone (50 Kg or more) may be used. Each stone shall be surrounded by at least thirty (30) cms of concrete, and no stone shall be closer than sixty (60) cms to any top surface nor closer than twenty (20) cms to any coping.

**g) Concrete Exposed to Sea Water**

Unless otherwise specifically provided, concrete for structures exposed to seawater shall be Class A. The clear distance from the face of the concrete to the nearest face of reinforcement steel shall be not less than 10 cms. The concrete shall be mixed for a period of not less than 2 minutes and the water content of the mixture shall be carefully controlled and regulated so as to produce concrete of maximum impermeability. The concrete shall be thoroughly compacted and air pockets shall be avoided. No construction joints shall be formed between levels of extreme low water and extreme high water as determined by the Engineer. Between these levels sea water shall not come in contact with the concrete for a period of not less than thirty (30) days. The original surface, as the concrete comes from the forms, shall be left undisturbed.

**h) Concrete Exposed to Alkali Soils or Alkali Water**

Where Concrete may be exposed to the action of alkaline water or soils, special care shall be taken to place it in accordance with specifications herein. Wherever possible, placing shall be continuous until completion of the section or until the concrete is at least fifty (50) cms, above ground or water level. Alkaline water or soils shall not be in contact with the concrete during placement and for a period of at least seventy two (72) hours thereafter.



**i) Protection of Concrete from Environmental Conditions****i. General**

Precautions shall be taken as needed to protect concrete from damage due to weather or other environmental conditions during placing and curing operations.

Any concrete placed during hot weather or during cold weather shall be at the Contractor's risk and any damaged concrete shall be removed and replaced at the Contractor's expense.

**ii. Rain Protection**

Under conditions of rain, the placing of concrete shall not commence or shall be stopped unless adequate protection is provided to prevent damage to the surface mortar or damaging flow or wash of the concrete surface.

**iii. Work in Hot Weather**

The temperature of concrete shall not exceed thirty two (32) degree C at the time of laying, unless the Contractor incorporates in the mix a plasticiser, of a make and in proportion which he has shown by laboratory tests and full scale trial to be satisfactory, to eliminate detrimental effects of high temperature without introducing any other detrimental effect on quality.

The following may be used to keep the temperature of concrete below the above limitations:

- i) Chilling of concrete water by heat exchange coils or by addition of broken ice, provided that the water shall be free from ice at the time of entry into the mixer.
- ii) Cooling of coarse aggregate by watering, provided that the water content of the aggregate so cooled shall be uniform.
- iii) Reclaiming of aggregate from stock piles by the tunnel method to avoid using the surface layer of the stockpile with shade and wind protection of conveyor elevating to batching plant.
- iv) Night work provided that (i), (ii) and (iii) are proved inadequate or unsatisfactory in their results and providing also that the Engineer has no other reason for refusing permission for night work.

The Engineer shall have power to order the suspension of concrete production in case of not taking precautionary measures by the Contractor as mentioned above.

Under no circumstances will the Contractor be entitled to receive any additional payment for complying with the requirements of this clause.

**iv. Work in Cold Weather**

Except by written approval of the Engineer, concreting operations shall not be continued when a descending air temperature in the shade and away from artificial heat falls below five (6) degree C, nor resumed until an ascending air temperature in the shade and away from artificial heat reaches two (2) degree C. In such cases, the mixing water and / or aggregates shall be heated to not less than twenty one (21) degree C nor more than sixty six (66) degree C, prior to being placed in the mixer by an approved type of heating device so that the temperature of the concrete shall not be less than ten (10) degree C, nor more than twenty seven (27) degree C, at the time of placing. No materials containing frost shall be used. Cement or fine aggregates containing lumps or crusts of hardened materials shall not be used.

### 401.3.7 Concrete Surface Finishing / Rendering

**a) General**

Concrete surface finishes shall be classified as follows:

- Bridge Deck Surface Finish
- Sidewalk Surface Finish
- Ordinary Surface Form Finish
- Class 1 Surface Form Finish

The bridge deck surface finish shall be given to the surface of the bottom slabs of all box type underpass structures.

The requirements for sidewalk surface finish apply to the surface of the bottom slabs in box culverts, except that the acceptable variation from a three-meter straightedge shall be 10 mm, and booming shall be omitted.

The ordinary surface form finish shall be the final finish applied to all surfaces after removal of forms, unless otherwise specified or called for on the drawings.

The Class 1 surface form finish shall be applied only where specified, or as required by the Engineer when the ordinary surface finish did not produce the required smooth, even surface of uniform texture and appearances.

**b) Bridge Deck Surface Finish**

A smooth riding surface of uniform texture, true to the required grade and cross-section, shall be obtained on all bridge roadway decks. The Contractor may use hand tools, or finishing machines or a combination of both, conforming to the requirements specified herein for finishing bridge roadway deck concrete.

Finishing of concrete placed in bridge decks shall consist essentially of compacting and striking off the surface of the concrete as placed and floating with longitudinal floats the surface so struck off.

The placing of concrete in bridge roadway decks will not be permitted until the Engineer is satisfied that the rate of producing concrete will be sufficient to complete the proposed placing and finishing operations within the schedule time, that experienced finishing machine operators and concrete finishers are employed to finish the deck, that fogging equipment and all necessary finishing tools and equipment are on hand at the site of the work and in satisfactory condition for use. Finishing machines shall be set up sufficiently in advance of use to permit inspection by the Engineer during the daylight hours before each pour.

The adjustment and operation of deck finishing machines shall be verified by moving the machine over the full length of the deck section to be placed and traversing the float completely across all end bulkheads before placement of concrete is begun.

Unless adequate lighting facilities are provided by the Contractor, the placing of concrete in bridge decks shall cease at such time that finishing operations can be completed during daylight hours.

Rails for the support and operation of finishing machines and headers for hand-operated stick-off devices shall be completely in place and firmly secured for the scheduled length for concrete placement before placing of concrete. Rails for finishing machines shall extend beyond both ends of the scheduled length for concrete placement to a sufficient distance that will permit the float of the finishing machine to fully clear the concrete to be placed. Rails or headers shall be adjustable for elevation and shall be set to elevations, with allowance for anticipated settlement, camber, and deflection of false work, as required to obtain a bridge roadway deck true to the required grade and cross-section. Rails or headers shall be of a type and shall be so installed that no springing or deflection will occur under the weight of the finishing equipment and shall be so located that finishing equipment may operate without interruption over the entire bridge roadway deck to be finished.

Rails or headers shall be adjusted as necessary to correct for unanticipated settlement or deflection, which may occur during finishing operations

Should settlement or other unanticipated events occur, which in the opinion of the Engineer would prevent pouring of bridge deck conforming to the requirements of these specifications, placing of deck concrete shall be discontinued until corrective measures satisfactory to the Engineer are provided. In the event satisfactory measures are not provided prior to initial set of the concrete in the effected area, the placing of concrete shall be discontinued and a bulkhead installed at a location determined by the Engineer. All concrete in place beyond the bulkhead shall be removed.

Unless otherwise permitted by the Engineer, bridge deck concrete shall be placed in a uniform heading approximately parallel to the bridge pier or bent caps. The rate of placing concrete shall be limited to that which can be finished before the beginning of initial set except that concrete for the deck surface shall not be placed more than three (3) meters ahead of strick off.

After the concrete has been placed, compacted, and consolidated, the surface of the concrete shall be carefully struck off by means of a hand operated strick board operating on headers, or by a finishing machine operating on rails ' A uniform deck surface true to the required grade and cross-section shall be obtained.

Following strike off, the surface of the concrete shall be floated longitudinally. In the event strike-off is performed by means of a hand operated strike board, two (2) separate hand-operated float boards for longitudinal floating shall be provided. The first float shall be placed in operation as soon as the condition of the concrete will permit and the second float shall be operated as far back of the first float as the workability of the concrete will permit.

In the event the strike off is performed with a finishing machine, longitudinal floating of the concrete shall be performed by means of a hand-operated float board or a finishing machine equipped with a longitudinal wooden float. The longitudinal wooden float on the finishing machine shall have a length of not less than two and half (2.5) meters nor more than three and half (3.5) meters. When both strike off and longitudinal floating are to be performed by finishing machines, one machine, with operator, shall be used for strike off and a second machine, with a second operator, shall be used for longitudinal floating. Longitudinal floating may be performed with the same finishing machine that is used for strike off provided that the length of deck unit being placed is not more than 10 meters and the strike off operation is completed for said deck unit before the condition of the concrete requires that longitudinal floating be started.

Finishing machines used for strike off having a wheel base 1.8 meters or less shall be followed by 2 separate hand-operated float boards for longitudinal floating. All the provisions in this Item pertaining to hand operated float boards shall apply to the 2 separate float boards for longitudinal floating.

Longitudinal floats, either hand-operated or machine-operated, shall be used with the long axis of the float parallel to the center line of the bridge roadway. The float shall be operated with a combined longitudinal and transverse motion planning off the high areas and floating the material removed into the low areas. Each pass of

the float shall lap the previous pass by one-half the length of the float. Floating shall be continued until a smooth riding surface is obtained.

In advance of curing operations, the surface of the concrete shall be textured by booming with a stiff bristled broom or by other suitable devices, which will result in uniform scouring. The operation shall be performed at a time and in a manner to produce a hardened surface having a uniform texture.

Hand-operated float boards shall be from three and half (3.5) to five (5) meters long, ribbed and trussed as necessary to provide a rigid float and shall be equipped with an adjustable handle at each end. The float shall be wood, not less than two and half (2.5) cms thick and from ten (10) cm to twenty (20) cm wide. Adjusting screws spaced as not to exceed 60 cms on centers shall be provided between the float and the rib. The float board shall be maintained free of twist and true at all times.

Hand-operated float boards shall be operated from transverse finishing bridges. The finishing bridges shall span completely the roadway area being floated & a sufficient number of finishing bridges shall be provided to permit operation of the floats without undue delay. Not less than two (2) transverse finishing bridges shall be provided when hand-operated float boards are used. When a finishing machine is used for longitudinal floating, one finishing bridge equivalent to the transverse finishing bridge specified herein shall be furnished for use by the Engineer.

All finishing bridges shall be of rigid construction and shall be free of excessive wobble and springing when used by the operators of longitudinal floats and shall be easily moved.

Immediate following completion of the deck finishing operations, the concrete in the deck shall be cured as specified in Item 401.3.8 "Curing Concrete" hereinafter.

The finished surface of the concrete shall be tested by means of a straightedge three (3.0) meters long. The surface shall not vary more than three (3) mm from the lower edge of the straightedge. All high areas in the hardened surface in excess of three (3) mm as indicated by testing shall be removed by abrasive means. After grinding by abrasive mean has been performed, the surface of the concrete shall not be smooth or polished. Ground areas shall not be of uniform texture and shall present neat and approximately rectangular patterns.

Where the concrete of the bridge deck is to be covered by bituminous surfacing, earth, or other cover, two and half 2.5 cms or more in thickness, the surface of the concrete shall not vary more than nine (9) mm from the lower edge of the three (3) meter straightedge.

Bridge deck surfaces under the curbs, railings and sidewalk shall be struck off to the same plane as the roadway and left undisturbed when future widening is shown on the plans.

**c) Sidewalk Surface Finish**

After the concrete has been placed it shall be compacted and the concrete shall be struck off by means of a strike board, floated with a wooden or cork floating and finished with a broom. An approved edging tool shall be used on all edges and at all expansion joints. Brooming shall be transverse to the line of traffic and if water is necessary, it shall be applied to the surface immediately in advance of brooming. The surface shall not vary more than six (6) mm under a three-meter straightedge, and the finished surface shall be free of blemishes.

**d) Ordinary Surface Form Finish**

Ordinary surface finish shall consist of filling holes or depressions in the surface of the concrete, repairing all rock pockets, removing stains and discolouration visible from travelled ways. Ordinary surface finish shall be applied to all concrete surfaces either as a final finish or preparatory to the Class 1 finish. On surfaces, which are to be buried underground or surface, which are enclosed, such as the cells of box girders, the removal of fins will not be required.

Except as provided herein, all form bolts and any metal placed for the convenience of the Contractor shall be removed to a depth of at least two and half (2.5) cms below the surface of the concrete. All rock pockets and other unsound concrete shall be removed. The resulting holes or depression shall be cleaned and filled with mortar. Form bolts projecting into the cells of box girders need not be removed unless permanent access is provided into the cells, in which case such bolts shall be removed flush with the surface of the concrete. Mortar used to fill bolt holes shall consist of one part cement and two parts sand. Other depressions and pockets shall be filled with either packed mortar or air blown mortar as directed by the Engineer. Mortar shall be cured in conformance with the requirements in Item 401.3.8 (c) "Curing Structures".

If rock pockets or holes in the opinion of the Engineer, are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

**e) Class 1 Surface Form Finish**

Class 1 surface finish shall consist of finishing the surfaces of the structure as necessary to produce even surfaces of uniform texture and appearance, free of unsightly bulges, depressions and other imperfections. The degree of care in building forms and character of materials used in form work will be a contributing factor in the amount of additional finishing required to produce even surfaces of uniform texture and appearance, free of unsightly bulges, depressions and other imperfections, and the Engineer shall be the sole judge in this respect.

After completion of the ordinary surface finish, areas, which do not exhibit the required, smooth, even surface. of uniform texture and appearance shall be sanded with power sanders or other approved abrasive means until smooth, even surfaces of uniform texture

and appearance are obtained. The use of power carborundum stones or disks will be required to remove bulges and other imperfections.

Class 1 surface finish shall not be applied until a uniform appearance can be obtained.

Class 1 surface finish may be required to be applied as the final finish for the following surfaces, unless otherwise directed by the Engineer:

- i) All form finish surfaces of bridge super-structures, except the under surfaces between girders and the inside vertical surfaces of T girders.
- ii) All surfaces of bridge piers, columns and abutments, and retaining walls above finished ground and to at least three tenth (0.3) meter below finished ground.
- iii) All surfaces of open spandrel arch rings, spandrel columns and abutment walls.
- iv) All surfaces of pedestrian undercrossings, except floors and surfaces to be covered with earth.
- v) Surface above finished ground of culvert headwalls, endwalls and retaining walls.
- vi) Surface inside of culvert barrels having a height of one and half (1.5) meters or more for a distance inside the barrel at least equal to the height of the culvert.
- vii) All surfaces of railings.

**f) Surface Rendering**

All faces of concrete, which are to come in contact with back fill or pavement materials, shall be applied two coats of hot bitumen of approved quality, before placing any material around concrete.

## 401.3.8 Curing Concrete

**a) General**

All newly placed concrete shall be cured in accordance with these specifications, unless otherwise directed by the Engineer.

**b) Method of Curing**

The curing method shall be one or more of the following as described hereinafter.

- Water Method
- Curing compound Method
- Reinforced Waterproof Paper Method if required by the Engineer.

- Forms-in-Place Method Steam Method Polyethylene Sheeting Method

#### **Water Method**

The concrete shall be kept continuously wet by the application of water for a minimum period of seven (7) days after the concrete has been placed.

Cotton mats, burlaps, rugs, carpets, or earth or sand blankets, may be used as a curing medium to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomized the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period the concrete surface shall be cleared of all curing mediums.

When concrete bridge decks and flat slabs are to be cured without the use of a moisture retaining medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified in the preceding paragraph until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than seven (7) days.

#### **Curing Compound Method**

Surfaces exposed to the air may be cured by the application of an impervious membrane if approved by the Engineer.

The membrane-forming compound used shall consist of a practically colourless liquid. The use of any membrane forming compound that will alter the natural colour of the concrete or impart a slippery surface to any wearing surface shall be prohibited. The compound shall be applied with a pressure spray in such a manner as to cover the entire concrete surface with a uniform film, and shall be of such character that it will harden within 30 minutes after application. The amount of compound applied shall be ample to seal the surface of the concrete thoroughly. Power operated spraying equipment shall be equipped with an operational pressure gauge and means of controlling the pressure.

The curing compound shall be applied to the concrete following the surface finishing operation immediately after the moisture sheen begins to disappear from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any delay in the application of curing compound, which results in any drying or cracking of the surface, application of water with an atomizing nozzle as specified under "Water Method", shall be started immediately and shall be continued until application of the compound which shall not be applied over any free standing water surface. Should the film of compound be damaged from any cause before the expiration of seven (7) days after the concrete is placed in the case of structures, the damaged portion shall be repaired immediately with additional compound.

Curing compounds shall not hard settle in storage. They shall not be diluted or altered in any manner after manufacture. At the time of use, the compound shall be in a thoroughly mixed condition. If the compound has not been used within one hundred twenty (120) days after



the date of manufacture, the Engineer may require additional testing before use to determine compliance to requirements.

An anti-settling agent or combination of anti-settling agents shall be incorporated in the curing compound to prevent caking.

The curing compound shall be packaged in clean barrels or steel containers or shall be supplied from a suitable storage tank located at the job-site. Onsite storage tanks shall have a permanent system designed to completely re-disperse any settled material without introducing air or any other foreign substance. Containers shall be well sealed with ring seals and lug type crimp lids. The linings of the containers shall be of a character that will resist the solvent of the curing compound. Each container shall be labelled with the manufacturer's name, specification number, batch number, number of gallons, and date of manufacture, and shall have a label warning concerning flammability. The label shall also warn that the curing compound shall be well stirred before use. When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required\*herein for container labels.

Curing compound may be sampled by the Engineer at the source of supply and at the job-site.

#### **Reinforced Waterproof Paper Method**

The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the waterproof paper shall be placed. The paper shall remain in place for a period of not less than 72 hours.

Reinforced waterproof paper shall comply with ASTM C 171 specifications. It shall be composed of two sheets of Kraft paper cemented together with a bituminous adhesive and reinforced with fibre. The waterproof paper shall be formed into sheets of such width as to provide a complete cover of entire concrete surface.

All joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have minimum lap of ten (10) cm.

The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.

Should any portion of the sheets be broken or damaged within seventy two (72) hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

Sections of sheets, which have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used

**Forms-in-Place Method**

Formed surfaces of concrete may be cured by retaining the forms-in-place. The forms shall remain in place for a minimum period of seven (7) days after the concrete has been placed, except that for members over five (5) cms in least dimension, the forms shall be in place for a minimum period of five (5) days. Wooden forms shall be kept wet by watering during the curing period.

**Steam Method**

After placing and vibrating, the concrete shall be allowed to attain its initial set before steam is applied. During the placing of concrete and application of steam, provision shall be made to prevent surface drying by means of a coating of approved material. The optimum curing temperature shall not exceed sixty five (65) degree C.

**Polyethylene Sheeting Method**

The wet surface of fresh concrete shall be covered with white polyethylene sheeting as soon as possible without marring the surface and should cover all exposed surfaces of the concrete. The edges of the sheeting shall be weighted securely with a continuous windrow of earth or any other means satisfactory to the Engineer to provide an air-tight cover. Adjoining sheets shall overlap not less than thirty (30) cms. and the laps shall be securely weighted with earth, or any other means satisfactory to the Engineer to provide an airtight cover.

c) **Curing Structures**

All newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, all in accordance with the requirements in Item 401.3.8 (b), "Methods of Curing".

The curing compound method may be used on concrete surfaces, which are to be buried, underground, and surfaces where only Ordinary Surface Finish is to be applied and on which a uniform colour is not required and which will not be visible from any public travelled way.

The top surface of highway bridge decks shall be cured by both the curing compound method, and by the water method. The curing compound shall be applied progressively during the deck finishing operation immediately after finishing operations are completed on each individual portion of the deck. The water cure shall be applied not later than four (4) hours after completion of the deck finishing or, for portions of the decks on which finishing is completed after normal working hours, the water cure be applied not later than 8.00 a.m. the following morning.

When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required.

d) **Curing Precast Concrete Members**

Precast concrete members shall be cured for not less than seven (7) days by the water method or by steam curing for a period in which 80% of strength achieved, at the option of the Contractor. Steam curing for precast members shall conform to the following provisions:

After placement of the concrete, members shall be held for a minimum four (4) hours precasting period.

To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered immediately after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.

Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of the tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner to prevent the loss of steam and moisture.

Steam at jets shall be low pressure and in a saturated condition. Steam at jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed twenty (20) degree C per hour. The curing temperature throughout the enclosure shall not exceed sixty five (65) degree C and shall be maintained at a constant level for a sufficient time necessary to develop the required compressive strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature is representative of the average temperature of the enclosure.

Temperature recording devices that will provide an accurate continuous permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per sixty (60) meters of continuous bed length will be required for checking temperature.

Curing of precast concrete will be considered completed after a termination of the steam curing cycle.

e) **Curing Precast Concrete Members**

All newly placed concrete precast piles, both conventionally reinforced and prestressed shall be cured by the "Water Method" as described in Item 401.3.8(b) except that the concrete shall be kept under moisture for at least fourteen (14) days. At the option of the Contractor steam curing may be used in which case the steam curing provisions in Item 401.3.8(b) "Curing Precast Concrete Members" shall apply except that the concrete shall be kept wet for at least seven (7) days including the holding and steaming period.

### 401.3.9 Testing of Aggregates

Samples of fine and coarse aggregate to be used shall be selected by the Engineer. It shall be the responsibility of the Contractor to designate the source or sources of aggregate and to obtain the necessary samples and submit them for testing at least thirty (30) days before actual concreting operations are to begin.

Samples of aggregates shall be obtained and tested in accordance with the following standard AASHTO methods:-

i) Sampling aggregates	T-2
ii) Sieve analysis	T-27
iii) Amount of material passing the No.200 sieve.	T-11
iv) Organic impurities	T-21
v) Mortar Strength	T-71
vi) Sodium sulphate soundness	T-104
vii) Friable particles	T-112
viii) Abrasion loss	T-96
ix) Specific Gravity	T-84
x) Absorption.	T-85
xi) Production of Plastic Fines.	T-210
xii) Fineness Modulus	T-27
xiii) Sand Equivalent	T-17
xiv) Potential Reactivity of Carbonate Rocks for	
xv) Concrete Aggregate(Rock Cylinder Method)	ASTM C586
xvi) Potential Alkali Reactivity of Cement	
Aggregate Combinations (Morta-Bar Method).	ASTM C227
xvii) Potential Reactivity of Aggregates	
(Chemical Methods)	ASTM C289

No aggregate for testing during the production of concrete shall be sampled at the discharge gates of the bins feeding the weight hopper. The Contractor, at his expense, shall provide safe and suitable facilities for obtaining the samples. No concreting work on the project will be permitted until the Engineer signifies in writing his approval, following the performance of the necessary tests, on all the materials involved in making concrete.

### 401.3.10 Testing of Compressive Strength

Concrete compressive strength requirements consist of a minimum strength at the age of twenty eight (28) days and the minimum strength, which must be attained before various loads or stresses, are applied to the concrete. The various strengths required are specified in Table 401-1.

The compressive strength of concrete will be determined from test cylinders, which have been fabricated from concrete sampled and tested in accordance with AASHTO T 23 and AASHTO T 22.

A set of six (6) cylinders shall be taken from each fifty (50) cubic meters of each class of concrete or fraction thereof placed each day, three (3) of the six (6) cylinders to be tested after seven (7) days and three (3) after twenty eight (28) days.

- a) The minimum average 28 days test result of all samples tested at any time shall be the specified twenty eight (28) days strength.
- b) No individual samples tested after 28 days shall show a test result lower than eighty five (85) percent of the required twenty eight (28) days.

Concrete represented by any single test cylinders that fails to comply with the requirement under (b) above will be rejected unless the Contractor at his expense, provides evidence that the strength and quality of the concrete placed in the work are acceptable. If such evidence consists of tests made on cores taken from the work, the cores shall be obtained and tested in accordance with the specifications of AASHTO T-24.

Test results of the cores shall meet the following requirements:-

- a) Average test result of the cores shall be less than the minimum required twenty eight (28) days strength.
- b) No individual core shall show a strength less than Ninety five (95) percent of the required twenty eight (28) days strength.

Should the above test results fail to comply with the requirements, concrete of that particular pour shall be rejected and removed as directed by the Engineer. Further more contractor shall redesign the concrete mix for approval of the Engineer.

In case, seven (7) days strength shows less than seventy (70) percent of the twenty eight (28) days strength (in case of type-1 cement), Engineer may stop further work on that particular portion of concrete, unless twenty eight (28) days strength gives satisfactory results.

#### **Trial Batches for Mix Productions**

The placing of concrete shall not begin until trial batches of the mix design to be used have been produced by the Contractor and tested and approved by the Engineer. The trial mix proportions shall be such that the average strength of five (5) consecutive test cylinders shall be 20% higher than the specified twenty eight (28) days strength and no individual test cylinder shall be below the specified strength.

When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, test cylinders will be cured under conditions similar to those at the casting site. The compressive strength of concrete determined for such purposes will be evaluated on the basis of individual tests.

#### 401.4 MEASUREMENT AND PAYMENT

##### 401.4.1 Measurement

The quantity of concrete to be paid for shall be the number of cubic meters of concrete of the various classes complete in place and accepted.

In measuring the volume of concrete to be paid for, the dimension to be applied shall be those shown on the Drawings except where others ordered by the Engineer in writing.

Deductions from the theoretical volume of concrete shall be made for the volumes of draining holes, weep holes, pipes and conduits, etc., in case where their cross-sectional areas exceed 500 square centimetres.

The measurement shall not include any concrete used in the construction of cofferdams or falsework.

The volume involved in fillets, scorings, or chamfers ten square centimetres in cross-sectional area or less shall be disregarded when measuring the quantity of concrete to be paid for

Concrete for railings, pipe culverts, etc., is not to be measured under this item, but under separate items.

##### 401.4.2 Payment

The accepted quantity measured as provided above shall be paid for at the contract unit price respectively for the pay items listed below that as per shown in the Bill of Quantities which prices and payment shall be full compensation also for such works as curing, surface finishing and / or rendering as required, formation of construction joints and any such work and incidentals necessary to complete the item except works that are paid for under other pay items.

For all concrete structures or portions, thereof, no separate measurement or payment shall be made for false work, centering, formwork or any other temporary work to complete the concrete structure or portion thereof, payment for all such temporary works shall be deemed to be included in the contract price paid under various items of concrete work.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
401a	Concrete Class:	
	i) Underground	Cm
	ii) On Ground	Cm
	iii) Elevated	Cm
401b	Concrete Class "B"	Cm
401c	Concrete Class "C"	
	i) Underground	Cm
	ii) On Ground	Cm
	iii) Elevated	Cm
401d	Concrete Class D <sub>1</sub>	Cm
	Concrete Class D <sub>2</sub>	Cm
	Concrete Class D <sub>3</sub>	Cm
401e	Concrete Class Y	Cm
401f	Lean Concrete	Cm
401g	Precast Concrete, Class .....	Cm

## **FORMWORK**

### **403.1 DESCRIPTION**

The work shall consist of providing, erecting and removing concrete forms of sufficient strength with all necessary bracings, fasteners, etc. and in conformity with the requirements hereinafter specified.

### **403.2 MATERIAL REQUIREMENTS**

Forms shall be of wood, metal or other approved materials and shall be built mortar tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations.

### **403.3 CONSTRUCTION REQUIREMENTS**

#### **403.3.1 Formwork Design and Drawings**

The Contractor shall prepare working drawings, backup calculations and material data for the form work and shutters to be submitted to the Engineer for approval unless otherwise directed.

The requirements for design of formwork are the same as described under Item 402.3.1 - Falsework Design and Drawings.

#### **403.3.2 Formwork Construction**

Concrete forms shall be constructed and maintained so as to prevent warping and the opening of joints due to the shrinkage of the lumber and shall be true to the dimensions, lines and grades of the structure and with the sufficient strength, rigidity, shape and surface smoothness as to leave the finished works true to the dimensions shown on drawings or required by the Engineer and with the surface finish as specified.

Forms for exposed surfaces shall preferably be lined with metal, plywood, or other approved material, or may with the Engineer's permission, be made of dressed lumber of uniform thickness. Forms shall be filled at all sharp corners (Minimum two (2) cms triangular fillets) and shall be given a level or draft in the case of all projections, such as girders and copings, to ensure easy removal.

Form fasteners consisting of form bolts, clamps or other devices shall be used as necessary to prevent spreading of the forms during concrete placement. The use of ties consisting of twisted wire loops to hold forms in position will not be permitted. Metal ties or anchorage within the forms shall be so constructed as to permit their removal to a depth of at least five(5) cms from the face without injury to the concrete.

Fitting for metal ties shall be of such design that, upon their removal, the cavities that are left will be of the smallest possible size. The cavities shall be filled with cement mortar and the surface left



sound, smooth, even, and uniform in colour. Anchor devices may be cast into the concrete for later use in supporting forms or for lifting precast members. The use of driven types of anchorages for fastening forms or form supports to concrete will not be permitted.

The inside surfaces of forms shall be cleaned of all dirt, mortar and foreign material. Forms, which will later be removed, shall be thoroughly coated with form oil prior to use. The form oil shall be a commercial quality form oil or other approved coating which will permit the ready release of the forms and will not discolour the concrete. All exposed surfaces of similar portions of a concrete structure shall be formed with the same forming material or with materials, which produce similar concrete surface textures, colour and appearance.

Concrete shall not be deposited in the forms until all work in connection with constructing the forms has been completed, all materials required to be embedded in the concrete have been placed for the unit to be poured, and the Engineer has inspected and approved said forms and materials.

The rate of depositing concrete in forms shall be such as to prevent deflections of the forms or form panels in excess of the deflections permitted by these specifications. Maximum deflection allowed due to prop settlement is 5 mm and due to bending of shutters is 3 mm, when measured with 3 meter straight edge.

Forms for all concrete surfaces, which Will not be completely enclosed or hidden below the permanent ground surface, shall conform to the requirements herein for forms for exposed surfaces. Interior surfaces of underground drainage structures shall be considered to be completely enclosed surfaces.

Formwork for concrete placed under water shall be watertight. When lumber is used, this shall be planed and tongued and grooved.

Forms for exposed concrete surfaces shall be designed and constructed so that the formed surface of the concrete does not undulate excessively in any direction between studs, joists, form stiffeners, form fasteners, or wales. Undulations exceeding either two (2) mm or 1/1270 of the center to center distance between studs, joists, form stiffeners, form fasteners, or wales will be considered to be excessive. Should any form or forming system, even though previously approved for use, produce a concrete surface with excessive undulations, its use shall be discontinued until modifications, satisfactory to the Engineer have been made. Portions of concrete structures with surface undulations in excess of the limits herein may be rejected by the Engineer.

Forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall remain in place for periods, which shall be determined, as herein specified. When forms appear to be unsatisfactory in any way, either before or during the, placing of concrete, the Engineer will order the work stopped until the defects have been corrected.

The shape, strength, rigidity, water-tightness, and surface smoothness of reused forms shall be maintained at all times. Any warped or bulged lumber must be resized before being reused. Forms that are unsatisfactory in any respect shall not be reused.

For narrow walls and columns, where the bottom of the form is inaccessible, the lower form boards shall be adjustable so that they may be removed for cleaning out extraneous material immediately before placing the concrete.

### 403.3.3 Removal of Formwork

In the determination of the time for the removal of falsework and forms, consideration shall be given to the location and character of the structure, the weather, and other conditions influencing the setting of the concrete, and the materials used in the mix.

It field operations are not controlled by beam or cylinder tests, the following periods, exclusive of days when the temperature is below five (5) degree Q for removal of forms and supports shall be used as a minimum subject to the approval of the Engineer and to the requirements of Item 402.3.3. Removing Falsework.

- Arch Center 14 Days
- Centering Under Beams 14 Days
- Supports under Flat Slabs 14 Days
- Floor Slabs 14 Days
- Vertical Wall Surfaces 24 Hours
- Columns 24 Hours
- Side of Beams 12 Hours
- Top Slabs R.C. Box Culverts 14 Days

Side forms for cast-in-place beams, girders, columns, or other members where the forms do not resist dead load, bending shall remain in place for at least forty (40) hours after placing concrete for the members. Side forms for precast members may be removed the next day after placing concrete therein.

If high early strength cement is used or by the use of additional cement, these periods may be reduced as directed.

When field operations are controlled by cylinder tests, the removal of forms, supports and housing, and the discontinuance of heating and curing (where applicable) may begin when the concrete is found to have the required compressive strength, provided in no case shall supports be removed in less than seven (7) days after placing the concrete.

All forms shall be removed, except when no permanent access is available to the cells, the forms supporting the deck of box girders and the forms in hollow abutments or piers may remain in place. Prior to completion of forming for the deck forms, the inside of box girders shall be cleared of all loose material and swept clean.

Methods of form removal likely to cause overstressing of the concrete shall not be used. In general, the forms shall be removed from the bottom upwards. Forms and their supports shall not be removed without approval. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In general, arch centering or falsework shall be struck and the arch made self-supporting before the railing or coping is placed. This precaution is essential in order to avoid jamming of the expansion joints and variations in alignment. For filled spandrel arches, such portions of the spandrel walls shall be left for construction subsequent to the striking of centers, as may be necessary to avoid jamming of the expansion joints.

Centers shall be gradually and uniformly lowered in such a manner as to avoid injurious stresses in any part of the structure. In arch structures of two or more spans, the sequence of striking centers shall be approved by the Engineer.

**403.4**      **MEASUREMENT AND PAYMENT**

For all concrete structures, prestressed concrete structures, precast concrete elements or portions thereof, no separate measurement or payment shall be made for formwork supporting such structures. All formwork costs shall be considered as included in the contract prices paid (cost/CM or LM of structural members or lump-sum) for the various items of concrete work and no additional compensation will be allowed thereof.

## **STEEL REINFORCEMENT**

### **404.1 DESCRIPTION**

This work shall consist of furnishing, fabricating and placing of steel reinforcement of the type, size, shape and grade required in accordance with these specifications, and in conformity With the requirements shown on the Drawings and Special Provisions or as directed by the Engineer.

### **404.2 MATERIAL REQUIREMENTS**

All materials shall conform to the requirements hereinafter given. Test reports from approved sources shall be submitted to the Engineer for all steel reinforcement used. These reports shall show the results of chemical and physical tests made

- i) Deformed Billet-Steel Bars (Grades 40 and 60) for Concrete Reinforcement-AASHTO M-31 (ASTM A-615)
- ii) Deformed Steel Wire for Concrete Reinforcement-AASHTO M-225 (ASTM A-496)
- iii) Welded Steel Wire Fabric for Concrete Reinforcement-AASHTO M-55 (ASTM A-185)
- iv) Steel Bar Mats for Concrete Reinforcement-AASHTO M-54 (ASTM A- 184)
- v) Cold-Drawn Steel Wire for Concrete Reinforcement-AASHTO M-32 (ASTM A-82)
- vi) Welded Deformed Steel Wire Fabric for Concrete Reinforcement-AASHTO M-221 (ASTM A-497)
- vii) Structural Shapes for Concrete Reinforcement ASTM A-36

### **404.3 CONSTRUCTION REQUIREMENTS**

#### **404.3.1 Fabrication of Bent Bars**

**a) Order Lists**

Before materials are ordered all order lists and bending diagrams shall be furnished by the Contractor, for the approval of the Engineer. The approval of order lists and bending diagrams by the Engineer shall in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Any expenses incident to the revisions of material furnished in accordance with such lists and diagrams to make it comply with the drawings shall be borne by the Contractor.

**b) Storing and Surface Condition of Reinforcement**

Steel reinforcement shall be stored above the surface of the ground on platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, detrimental rust, loose seals, paint, grease, oil,

or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Surface seams, surface irregularities, or mill scale will not be cause for rejection, provided the minimum dimensions, cross-section area, and tensile properties of a hand-wire brushed specimen meets the physical requirements for the size and grade of steel specified.

**c) Fabrication**

Bent bar reinforcement shall be cold bent to the shapes shown on the drawings or required by the Engineer. Bars shall be bent around a pin having the following diameters(D) in relation to the diameter of the bar (d):

Stirrups & column tie bars  $D = 4xd$

**Other bars having**

$d < 3.5 \text{ cm (1-318") (No. 11 bar)}$   $D = 5xd$

$d > 3.5 \text{ cm (1-318")}$   $D = 10xd$

## 404.3.2 Placing and Fastening

**a) Protection of Material**

Steel reinforcement shall be protected at all times from injury. When steel, placed in position as shown on the Drawings, has easily removable and detrimental rust, loose scale, or dust, it shall be cleaned by a satisfactory method, approved by the Engineer.

**b) Placing and Fastening**

Reinforcing steel shall be accurately placed in the position shown on the Drawings and firmly held during the depositing and finishing of the concrete. Cover, the distance between the external face of the bar and the face of the finished concrete, shall be as indicated on the Drawings. Reinforcing steel bars embedded in concrete shall not be bent after they are in place. Bars shall be tied at all intersections with 16 gauge black annealed wire except that where spacing is less than 1 ft (0.3m) in each direction, alternate intersections need to be tied. All intersections shall be tied in the top mat of reinforcement placed on bridge decks and the top slabs of box culverts. Abrupt bends shall be avoided except where one steel bar is bent around the other.

Stirrups and ties shall always pass around the outside of main bars and be securely attached thereto. All reinforcing steel shall be securely held at the proper distance from steel forms, which remain in place by means of galvanized steel bars or chairs placed on the forms. All reinforcing steel, except as mentioned above, shall be securely held at the proper distance from the forms by means of templates, concrete blocks or galvanized steel chairs. Metal chairs shall not be used against formed surfaces, which will be exposed in the finished structure after the forms are stripped. Blocks for holding reinforcement away from contact with the forms shall be precast concrete blocks of approved shape, and dimensions and shall have 16gauge black annealed tie wires embedded in them. The precast concrete block shall have a compressive strength equal to that specified for the class of concrete to be placed in the work. Layers of bars shall be separated by approved metal chairs or bolsters.

Any broken or damaged concrete spacer blocks shall be removed before concrete is placed. The use of pebbles, pieces of broken stone or brick, metal pipe or wooden blocks as spacers will not be permitted. Reinforcing steel when placed in the work shall be free from flake rust, dirt and foreign material and before any concrete is placed, any mortar, which may be adhering to the reinforcing steel, shall be removed. No concrete shall be deposited until the Engineer has inspected the placing of the reinforcing steel and given permission to place the concrete. The Contractor shall allow the Engineer four hours time after the reinforcement and forms are in place to conduct the inspection. Any bar of incorrect size, length or shape shall be removed and replaced with correct bars. Any bar located or spaced incorrectly shall be relocated or spaced correctly before permission is given to place concrete and such replacements and corrections shall be at the Contractor's expense. All concrete placed in violation of these provisions shall be rejected and removed.

**c) Splicing**

All reinforcement shall be furnished in the full lengths indicated on the Drawings unless otherwise permitted. Splicing of bars, except where shown on the drawings, will not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible and with a minimum separation of not less than forty (40) times bar diameters. Not more than one third (1/3) of the bars may be spliced in the same cross-section, except where shown on the drawings.

Unless otherwise shown on the Drawings, bars shall be lapped with a minimum overlap of forty (40) times the bar diameter. In lapped splices, the bars shall be placed in contact and wired together. Lapped splices will not be permitted at locations where the concrete section is insufficient to provide a minimum clear distance of one bar diameter or one and one third (1-1/3) the maximum size of coarse aggregate between the splice and the nearest adjacent bar.. Welding of reinforcing steel shall be done only if detailed on the Drawings or if authorized by the Engineer in writing. Spiral reinforcement shall be spliced by lapping at least one and one half (1-1/2) turns or by butt welding unless otherwise shown on the Drawings.

**d) Lapping of Bar Mat**

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

**e) Covering**

The minimum covering, measured from the surface of the concrete to the face of any reinforcement bar shall, unless otherwise shown on the Drawings or directed by the Engineer, be not less than 5 cms except as follows:

Top of slab	4.0 cm
Bottom of Slab	3.0 cm
Stirrups and ties in T-beams	3.5 cm

In the footings of abutments and retaining walls the minimum covering shall be 7.5 cm. In work exposed to the action of sea water the minimum covering shall be 10 cm.

## 404.4 MEASUREMENT AND PAYMENT

### 404.4.1 Measurement

The quantity to be paid for shall be the calculated theoretical number of metric tons of reinforcement steel bars, mesh or mats as determined from the approved bar bending diagrams and incorporated in the concrete and accepted, except when reinforcement is paid for under other pay items.

The weight of plain or deformed bars or bar mat will be computed from the theoretical weight of plain round bars of the same nominal size as shown in the following tabulation:

<b>Size mm</b>	<b>Weight in Kilograms Per Meter</b>	<b>Size mm</b>	<b>Weight in Kilograms Per Meter</b>
6	0.222	20	2.466
8	0.395	22	2.984
10	0.616	25	3.853
12	0.888	32	6.313
13	1.042	35	7.553
16	1.578	40	9.865

Clips, ties separators, and other material used for positioning and fastening the reinforcement in place and structural steel shall not be included in the weight calculated for payment under this item. If bars are substituted upon the Contractor's request and as a result more steel is used than specified, only the amount specified shall be measured for payment.

When laps are made for splices, other than those shown on the Drawings or required by the Engineer and for convenience of the Contractor, the extra steel shall not be measured nor paid for.

When continuous bars are shown on the Drawings, without the splices being shown the necessary steel in the splices will be paid for on the basis of the individual bars not being shorter than twelve(12)meters.

For bent bars, the length along centre-line of bar will be paid.

## 404.4.2 Payment

The accepted quantity measured as provided above shall be paid for at the contract unit prices respectively for the pay items listed below and shown in the Bill of Quantities which price and payment shall be full compensation for furnishing materials, labour, equipment and incidentals necessary to complete the item.

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
404a	Reinforcement as per AASHTO M31 Grade 40	Ton
404b	Reinforcement as per AASHTO M31 Grade 60	Ton
404c	Reinforcement as per AASHTO M-225	Ton
404d	Reinforcement as per AASHTO M-55	Ton
404e	Reinforcement as per AASHTO M-54	Ton
404f	Reinforcement as per AASHTO M-32	Ton
404g	Reinforcement as per AASHTO M-221	Ton
404h	Reinforcement (Structural Shapes) as per ASTM A-36	Ton



## **BRICK MASONRY**

### 410.1 DESCRIPTION

This work shall consist of furnishing all materials, equipment and labour required for constructing brickwork as shown on the drawings and in accordance with these specifications.

### 410.2 MATERIAL REQUIREMENTS

#### 410.2.1 Portland Cement

Portland cement shall conform to the requirements set forth under item' 401.2.1.

#### 410.2.2 Sand

Sand for mortar used in brickwork shall conform to the requirement for the fine aggregate specified in item 401.2.2 except that the grading shall be according to AASHTO M 45.

#### 410.2.3 Water

The water used in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, salts or other i ' impurities. No water shall be used without the approval in writing of the Engineer.

#### 410.2.4 Mortar

The mortar for all brickwork-shall consist. of one (1) part of Portland cement to three (3) parts of sand by volume and of sufficient water to produce the proper consistency for the intended use.

#### 410.2.5 Bricks

The size of the bricks shall be standard size (9"x4 1/2"x3")22.86 cm x 11.43 cm x 7.62 cm. They shall be well-burnt without being vitrified. They shall be of uniform colour, regular in shape and size with sharp and square corners and parallel faces. They must be homogeneous in texture and emit a clear ringing sound when struck. They shall be free from flaws and cracks. They shall not absorb more than 116th of their weight of water after being soaked for one hour, and shall show no signs of efflorescence on drying. Compressive strength shall not be less than 140.62 kg/sq.cm (2000 psi).

## 410.3 CONSTRUCTION REQUIREMENTS

### 410.3.1 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.

### 410.3.2 Brick Laying

Brickwork shall not be placed during heavy or prolonged rain to wash the mortar from the bricks. Mortar already spread, diluted by rain shall be removed and replaced before restoring the work.

All bricks to be used in brickwork with mortar joints shall be immersed in water from three (3) to four (4) hours before use.

All bricks shall be skilfully laid with level courses, uniform joints, square corners, plumb verticals and true surface, except where otherwise shown on the Drawings.

All walls and abutments shall be provided with weep holes. Unless otherwise shown on the Drawings or directed by the Engineer, the weep holes shall be placed at the lowest points where free outlets can be obtained and shall be spaced not more than two (2) meters center to center.

All surfaces exposed to weather, shall be struck pointed to give a good workmanlike appearance and to seal the cavities in mortar joints.

### 410.3.3 Curing

All brickwork shall be cured for at least seven (7) days after laying. The, curing method shall be to the satisfaction of the Engineer.

## 410.4 MEASUREMENT AND PAYMENT

### 410.4.1 Measurement

Measurement of brickwork 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 brickwork is incorporated.

The quantities to be measured shall be the number of cubic meters of brickwork laid and accepted.

**410.4.2 Payment**

The quantities measured as provided above 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, labour, equipment and incidentals for performing all the work involved under this item:

<b>Pay Item No.</b>	<b>Description</b>	<b>Unit of Measurement</b>
410	Brickwork	CM

## ANCILLARY WORKS

### ITEM 600 GENERAL

This section shall consist of items of work, which are ancillary or incidental to the other parts of the General Specifications. Such works shall include general items, precast concrete posts and markers, traffic control devices, sidewalks, guard rails, detours, traffic signs, pavement marking, reflectors, fencing and brick edging etc., in accordance with these specifications and in conformity with the lines, grades sections dimensions and locations in the plans or as required by the Engineer.

This section deals with those items of work in which small elements of construction employ construction items such as concrete, brick work, stone masonry, steel reinforcement or structural steel. These items of work have been separately quantified so that contractor can price them by assessing size of each element and extra effort which is essential in addition to the specification requirement of the parent item.

Metal guard-rails, traffic road signs and safety devices, pavement markings, reflectorised pavement studs, and other such fixtures shall meet the requirements of ISO - 9,000 for which certificates of manufacturers and supplies shall be produced.

## CONCRETE KERBS, GUTTERS AND CHANNELS

### 601.1 DESCRIPTION

This work shall consist of kerb, gutter, channel, or combination of kerb and gutter or channel; constructed of the following materials and in accordance with the specifications at the location and of the form, dimensions and designs shown on the Drawings or as directed by the Engineer. The kerb, gutter, channel or in combination may be constructed by one of the following methods.

- i) Cast in place concrete kerbing.
- ii) Precast concrete kerbing.
- iii) Extruded concrete kerbing.

### 601.2 MATERIAL REQUIREMENTS

The concrete for cast in place concrete kerbs, gutters and channels shall be either Class W or class 'C' or as indicated on the Drawings and shall conform to the requirements of that particular class prescribed under item 401.1.1. "Classes of concrete". An air entraining agent, if required, shall be added during mixing an amount to produce five (5) to eight (8) percent air by volume in the mixed concrete.

Precast concrete kerbing units shall consist of class 'C' concrete conforming to the requirement of item 401 and to lengths, shape and other details shown on the Drawings. Kerbing which shows surface irregularities of more than five (5) mm when checked with three meter straight edge or surface pits more than fifteen (15) mm in diameter will be rejected.

Forms to hold the concrete shall be built and set in place as described under item 403-Formwork.

Forms for at least sixty meters of kerb or combination of kerb and gutter or channels shall be in place and checked for alignment and grade before concrete is placed. Curved sections shall have forms of either wood or metal and shall be accurately shaped to radius of curvature shown on the Drawings. Steel Reinforcement if required shall conform to item 404 "Steel Reinforcement".

Expansion joint filler shall be either the performed type conforming to requirement of AASHTO-M 153 or shall be precast fiber board packing.

Joint filler shall consist of one part cement and two parts of approved sand with sufficient quantity of water necessary to obtain the required consistency. The mortar shall be used within thirty (30) minutes after preparation.

The Bonding compound when used shall conform to AASHTO M-200.

## 601.3 CONSTRUCTION REQUIREMENTS

### 601.3.1 Cast-in-Place

#### a) **Excavation and Bedding**

Excavation shall be made to the required depth and the base upon which the kerb or combination of kerb and gutter is to be set shall be compacted to a minimum density of ninety (90) percent of the maximum dry density as determined by AASHTO T-191 Method. All soft and unsuitable material shall be removed and replaced with suitable material acceptable to the Engineer.

Where directed by the Engineer, a layer of cinders or clean sand and gravel, or other approved porous material having a minimum compacted thickness, of fifteen (15) cm shall be placed to form a bed for the kerb or combination of kerb and gutter.

#### b) **Placing Concrete**

Concrete may be placed in the gutter to the full depth required. The top of the kerb or combination of kerb and gutter shall be floated smooth and the edges rounded to the radii shown on the Drawings. Before finishing, the surface of the gutter shall be tested with a three (3) meter straight-edge and any irregularities of more than five (5) mm in three (3) meters shall be eliminated. In finishing concrete only mortar normally present in the concrete shall be permitted for finishing. The use of a separate mortar finishing coat or the practice of working dry cement into the surface of the concrete will not be permitted.

#### c) **Joints**

The kerb and gutter shall be constructed in uniform sections of not more than twenty five (25) meters in length except where shorter sections are required to coincide with the location of weakened planes or contraction joints of the concrete pavement or for closures but no section shall be less than two (2) meters long. The sections shall be separated by sheet templates set perpendicular to the face and top of the kerb and gutter. The templates shall be approximately five (5) mm in thickness, of the same width as that of the kerb or kerb and gutter and not less than five (5) cm greater than the depth of the kerb or kerb and gutter. Templates shall be set carefully and held firmly during the placing of the concrete and shall be allowed to remain in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place. When pre-cut fiber-board packing is used in the expansion joints it may be used in place of the sheet template referred to above, on the approval of the Engineer. In this event the fiber board shall be pre-cut to the shape of the kerb so that its outer edge will be flush with the abutting kerb.

Expansion joints shall be formed in the kerb and gutter at intervals of six (6) to ten (10) meters in order to coincide with the expansion joints of cement concrete pavement or as shown on the Drawing.

**d) Dowels at Expansion Joints in Channels**

At expansion joints in channels and in the channel portion of kerbs and channel built monolithically, painted dowel bars with slip sleeve shall be provided as a load transfer medium at locations shown on the Drawings.

The size and spacing of the dowel bars shall be as indicated on the Drawings. Each dowel shall be set accurately parallel to the top surface of the gutter and accurately at right angles to the expansion joint.

**e) Contraction Joints**

Transverse contraction joints shall be provided opposite to all contraction joints in abutting concrete pavement and other locations shown on the Drawing spaced to a maximum of four (4) meters.

The contraction joints shall be provided by forming grooves in the face and surface of structure at right angle to the kerb alignment and kerb surface. The grooves shall be rectangular in cross-section, five (5) cm deep by five (5) cm wide. The grooves shall be formed in the top of all kerbs and in the exposed roadway face of kerb and in the channel surface of monolithic type kerb and channels and in the surface of channels. The edges of the joints shall be tooled and the joints shall be left clean, neat and of specified width and depth.

**f) Removal of Forms and Finishing**

The forms shall be removed within twenty four (24) hours after concrete has placed except that the, form used against the face of the kerb in a combination of kerb and gutter shall be removed as soon as the concrete has set sufficiently to hold its shape. Minor defects shall be repaired with mortar containing one part of portland cement and two parts of the fine aggregate. Plastering shall not be permitted on the face of a kerb or kerb and gutter and all rejected kerb or gutter shall be removed and replaced without additional compensation. All surfaces which will be exposed in the finished construction of the kerb and gutter shall be finished, while the concrete is still "green" by wetting a wood block of float and rubbing the surface until they are smooth.

**g) Curing**

During seventy two (72) hours following placing of concrete, the kerbs, channels and gutters shall be protected against premature drying by covering with suitable cotton or Hessian mats and by frequent sprinkling with water, with liquid forming compounds or with waterproof paper or by any other method as mentioned in section 401.3.8-Curing, Concrete and approved by the Engineer.

**h) Backfilling**

After forms has been removed and concrete has been cured as specified, the excavation of kerbs, gutters or channels shall be backfilled with suitable earth or granular material tamped into place in layers of not more than fifteen (15) cms each until firm and solid.

### 601.3.2 Pre-Cast

**a) Excavation and Bedding**

Excavation shall be made to the required depth as shown on the Drawings. All soft and unsuitable material shall be removed and replaced with a suitable material acceptable to the Engineer.

Bedding shall consist of Class B Concrete conforming to the requirements of Item 401 and shall be to the section and dimension shown on the Drawings.

**b) Placing**

The precast concrete kerbs shall be set in 1:3 of cement sand mortar to the line, level and grade as shown on the Drawings or as directed by the Engineer.

**c) Joints**

Joints between consecutive kerbs shall be three (3) to five (5) mm wide and filled with cement mortar to the full section of the kerb.

**d) Backfilling**

Backfilling shall meet the requirements of Item 601.3.1 (h).



### 601.3.3 Extruded Concrete Kerbing and Channels

**a) Excavation and Bedding**

Excavation and bedding shall conform to the requirements as described under item 601.3.1 (a).

**b) Placing**

Concrete shall be fed to the machine at a uniform rate. The concrete shall be of such consistency that after extrusion it will maintain the shape of the kerb section without support and shall contain the maximum amount of water that will permit this result. The machine shall be operated under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete which requires no further finishing other than light brushing with a brush filled with water only. The forming tube portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine. A grade line gauge or pointer shall be attached to the machine so that a continual comparison can be made between the kerb being placed and the established kerb grade as indicated by an offset guideline.

The top end face of the finished kerb shall be true and straight and the top surface of the kerb shall be of uniform width, free from bumps or surface pits larger than fifteen (15) mm in diameter. When a straight-edge three (3) meters long is laid on the top or face of the kerb, or surface of the gutter, the surface shall not be more than five (5) mm from the edge of the straightedge except at grade changes or curves.

Where adhesive is used to bond the kerb to an existing pavement, the surface shall be first thoroughly cleaned of all dust, loose material and oil, the cost of which shall be included in other items of work.

**c) Joints**

Expansion joints shall be constructed by sawing through the kerb section to its full depth. The width of the cut shall be such as to admit the joint filler with a tight fit. Preformed joint filler shall conform to the provisions of Item 601.2 and shall be inserted and mortared in place.

If sawing is performed before the concrete has hardened, the adjacent portion of the kerb shall be supported firmly with close fitting shields and the operations of sawing and inserting the joint filler shall be completed before curing the concrete.

Alternatively pre-cut joint fillers shall be permitted to be placed at the location of the expansion joints prior to the placing of the extruded kerb with the approval of the Engineer. The joint fillers shall be set firmly in place in a vertical position to the line and grade of the kerb profile.

**d) Curing and Backfilling**

Curing and backfilling shall be as described in item 601.3.1(g) and Item 601.3.1 (h).

## 601.4 MEASUREMENT AND PAYMENT

### 601.4.1 Measurement

The unit of measurement for concrete kerb, gutter, or combination of kerb and gutter, channel, or extruded kerbs and channels shall be measured by the linear meter along the front face of the section at the finished grade elevation. Deduction in length will be made for drainage structure installed in the kerbings such as catch basins and drop inlets etc. Measurement will not include any area in excess of those shown on the Drawings except for any area authorised by the Engineer in writing.

### 601.4.2 Payment

Measured and accepted quantities shall be paid for at the contract unit price per linear meter for each of the particular pay item listed below and shown in the Bill of Quantities which prices and payment shall constitute full compensation for furnishing and placing all materials for concrete, for reinforcing steel if required on the Drawings for expansion Joints, material, form for drainage opening, excavation, backfilling and dumping and disposal of surplus material and for all labour, equipment, tool and incidentals necessary to complete the item.

Payment for expansion joint filler material used in transverse expansion and contraction joints in kerbs and channel shall be understood to be included in the price tendered per linear meter for the kerbs and channels and shall not be paid for separately.

Concrete and mortar required for bedding of precast concrete kerbs as shown on the Drawings shall not be paid for as separated item, but the cost shall be included in the contract unit price for precast concrete kerb.

Pay Item No.	Description	Unit of Measurement
601a	Concrete Kerb, in place, Type ____	M
601b	Combination of Kerb and Gutter in Place, Type ____	M
601c	Combination of Kerb and Channel in Place, Type ____	M
601d	Pre-Cast Kerb in Place, Type ____	M
601e	Concrete Channel, Type ____	M
601f	Extuded Kerb and Channel, Type ____	M

## PAVEMENT MARKING

### 608.1 DESCRIPTION

This work shall consist of furnishing non reflective or reflective chlorinated rubber based or thermoplastic paint material or retroreflective preformed pavement marking (tape) whichever is called for in the Special Provisions and shown in the Bill of Quantities, for sampling and packing, for the preparation of the surface and for the application of the paint to the pavement surface all in accordance with these Specifications.

The paint shall be applied in conformance to the size, shape and location of the markings as shown in the Drawings.

### 608.2 CHLORINATED RUBBER PAINT

#### 608.2.1 Material Requirements

A standard and acceptable quality of Chlorinated Rubber based paint shall be used. The paint shall be ready for application and shall be of a smooth quality. The paint shall be homogeneous, well dispersed to a smooth consistency and shall not cake, liver, thicken, curdle, gel, settle badly or show any objectionable properties after period of storage not to exceed six (6) months.

#### Composition

<b>a) White Traffic Paint</b>			
i)	Pigment	Titanium Dioxide Rutile and Extenders	100%
ii)	Vehicle	Modified Chlorinated Rubber	52 ± 4
		Solvents	45 ± 4
		Additives i.e. Flow levelling, adhesion improving agents, anti-oxidants, siccatives etc.	1 – 3%
iii)	Paint Composition	Pigments	55 ± 4% by Weight
		Vehicle, Solvent and Additives	
<b>b) White Traffic Paint</b>			
i)	Pigment	Chrome Yellow and Extenders	100%
ii)	Vehicle	Same as for white traffic paint	55 ± 4 by Weight
iii)	Paint Composition	Pigments	45 ± 4% by Weight
		Vehicle, Solvent and Additives	
<b>b) White Traffic Paint</b>			
i)	Pigment	Chrome Black and Extenders	100%
ii)	Vehicle	Same as for white traffic paint	55 ± 4 by Weight
iii)	Paint Composition	Pigments	45 ± 5% by Weight
		Vehicle	

The volatile material shall be of such character that has a minimum solvent action of asphalt, and such that the resins and non-volatile components will be entirely dissolved in the volatile material, and will not precipitate from the solution on standing. The non-volatile material shall be of such quality that it will not darken or become yellow when a thin section is exposed to the sunlight.

Other pavement marking paint may be submitted by the Contractor as an alternative to the above, for the approval of the Engineer.

### 608.2.1.1 Ballotini for Reflective Road Paint

The grading of ballotini dispersed in the paint shall be as follows:

<b>Sieve Sizes</b>	<b>Percentage Retained</b>
No. 12	0
No. 20	30
No. 30	50
No. 50	80
No. 80	100

Glass beads shall conform with AASHTO Designation M-247. At least ninety (90) percent glass beads shall be transparent, reasonable spherical and free from flaws.

The proportion of ballotini to paint shall be not less than five hundred (500) grams per litre of paint.

### 608.2.2 Photometric Requirements for Reflective Road Paint

Other reflective road paints may be considered for use by the Engineer provided they have minimum brightness values at two tenth (0.2) degree and half (0.5) degree divergence expressed as candle power per meter per square meter of surface coating, as follows:

		<u>C o l o u r.</u>		
		<b>White</b>	<b>Yellow</b>	
Divergence Angle (Degree) 0.2	0.5	0.2	0.5	
Incidence Angles 4(Degree)	237	118	129	75
Incidence Angles 40(Degree)	75	43	43	32

### 608.2.3 CONSTRUCTION REQUIREMENTS

Traffic markings shall be applied with approved equipment capable of applying the paint at the specified width and at the specified rate of application. In no case shall the contractor proceed with the work until the equipment, method of application and rate of application as established by a test section have been approved by the Engineer

The painting of lane markers and traffic strips shall include the cleaning of the pavement surfaces, the application, protection and drying of the paint coatings, the protection of pedestrians, vehicular or other traffic on the pavements, the protection of all parts of the road, structures or appurtenances against disfigurement by spatters, splashes or smirches of paint or of paint materials, and the supplying of all tools, labour and traffic paint necessary for the entire work.

The paint shall not be applied during rain, wet weather, when the air is misty, or when, in the opinion of the Engineer, conditions are otherwise unfavourable for the work. Paint shall not be applied upon damp pavement surfaces, or upon pavements which have absorbed heat sufficient to cause the paint to blister and produce a porous paint film.

The application of paint shall preferably be carried out by a purpose-made machine but where brushes are used only round or oval brushes not exceeding 10 cm. in width will be permitted. The paint, when applied, shall be so applied as to produce a uniform, even coating in close contact with the surface being painted.

Traffic paint shall be applied to the pavement at a rate of one (1) litre to two and half (2.5) square meters or less. Contractor shall provide adequate arrangements that applied paint is not disfigured by moving traffic, till its complete drying and sticking to road surface.

## 608.3 HOT-APPLIED THERMOPLASTIC ROAD PAINTS

### 608.3.1 Material Requirements

#### 608.3.1.1 Aggregate

The aggregate shall consist of light coloured silica sand, calcite, quartz, calcined flint, or other material approved by the Engineer.

#### 608.3.1.2 Pigment and Extender

**a) White Material**

The pigment shall be titanium dioxide complying with the requirements of Type A (anatase) or Type R (rutile) of BS 1851.

**b) Yellow Materials**

Sufficient suitable yellow pigment shall be substituted for all or part of the titanium dioxide to comply with the other requirements of this specification

**c) All Materials**

The extender shall normally be whiting (i.e. calcium carbonate prepared from natural chalk) complying with the requirements of BS 1795. The manufacturer may substitute lithopone complying with the requirement of BS 296 for any or all of the whiting.

**d) Binder**

The binder shall consist of synthetic hydrocarbon resin, or, with the approval of the Engineer, gun or wood resin, plasticized with mineral oil.

**e) Composition of mixture.**

The proportions of the constituents of the mixed material as found on analysis shall comply with the requirements of Table 1.

**Table 1**  
**Proportions of Constituents of Mixture**

Constituent	Percentage by Mass of Total Mixture	
	Minimum	Maximum
Binder (Resin & Oil)	18	22
Pigment	6*	-
Pigment and Extendor	18	22
Ballotini	20	-
Aggregate		
Pigment	78	82
Extender & Ballotini		

\*For titanium dioxide only. No minimum is specified for yellow material.

Where specified, 10% in the case of material to which surface ballotini is to be applied by pressure application.

The grading of the combined aggregate, pigment, extender and ballotini (where specified) as found on analysis shall comply with the requirements of table 2.

**Table – 2**  
**Grading of Combined Aggregate, Pigment,**  
**Extender and Ballotini**

<b>Sieve</b>	<b>Percentage by Mass Passing Sprayed</b>
2.80 mm	100
600 mm	75 – 95

## 608.3.2 Sampling and Testing

### Sampling

For the purpose of carrying out the testing, it is essential that adequate and representative samples be taken in the manner prescribed in specification BS 3262 at following stages.

- a) At the manufacturer's plant.
- b) After it has been re-melted by the road application contractor.

### 608.3.3.2 Testing

The samples shall be prepared and tested in accordance with B.S. Specification 3262 (1976) appendix A to H. The test results shall conform the following properties.

- **Softening Point**

The softening point measured in accordance with appendix C shall be not less than 65°C.

- **Colour and luminance**

- a) **White Material**

The luminance factor of white material as delivered by the manufacturer shall be measured in accordance with appendix D and shall not be less than 70 whereas the luminance factor of material obtained from an applicator or melter on site after re-melting measured in accordance with appendix D shall not be less than 65.

- b) **Yellow Material**

The Colour of yellow material shall be approximately BS 381 C Colour No. 355, Lemon. The luminance factor of yellow material as delivered by the manufacturer shall be not less than 60 whereas the luminance factor of material obtained from an applicator or melter on site after re-melting measured in accordance with appendix D shall not be less than 55.

- **Heat Stability**

- a) **White Material**

When tested in accordance with appendix E, the luminance factor of white material as measured in accordance with appendix D shall be not less than 65.

- b) **Yellow Material**

When tested in accordance with appendix E, the luminance factor of yellow material as measured in accordance with appendix D shall be not less than 55.



- **Flow Resistance**

In testing the flow resistance, a cone made and tested in accordance with appendix F, shall not slump by more than 25%.

- **Skid Resistance**

When tested in accordance with appendix G, the skid resistance of a newly laid marking prepared under the stated conditions shall be not less than 45.

### 608.3.3 Manufacturing Packing, and Storing of Paint

#### 608.3.3.1 Manufacturing

The paint shall be produced in a plant owned and operated by the manufacturer following a process which has been used by the manufacturer for at least five (5) years to produce paint. The equipment for mixing and grinding shall be clean, modern, and in good condition.

#### 608.3.3.2 Packing

- The material shall be supplied in sealed containers which do not contaminate the contents and which protect them from contamination.
- Each container shall be clearly and indelibly marked with the manufacturer's name, Batch number, date of manufacture, reflectorisation (if applicable), colour, chemical type of binder and maximum safe heating temperature.

### 608.3.3.3 Storing

The material shall be stored in accordance with the manufacturer's instructions and any material that is in damaged containers of which the seal has been broken, shall not be used.

### 608.3.4 Certification

The Contractor shall furnish a certificate from manufacturer that the material he proposes to use has the required properties, stating the maximum and minimum proportions and grading of the constituents, the acid value of the binder, the setting time, the maximum safe heating temperature, the temperature range of the apparatus and the proposed method of laying.

### 608.3.5 Application of Material to the Road

#### **a) Preparation of Site**

The thermoplastic paint shall only be applied to surfaces, which are clean and dry. Immediately before the application of paint, the surface shall be cleaned with mechanical broom, compressed air or other approved means to remove surplus asphalt, oils, mud, dust and other loose or adhered material. The material shall not be applied if the road surface is at a temperature of less than 50 C.

#### **b) Preparation of Material on Site**

The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material and such that local overheating will be avoided. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material shall be used as expeditiously as possible, and for thermoplastic material, which has natural resin binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

- After transfer to the laying apparatus, the material shall be maintained within the temperature range specified by the manufacturer and stirred to maintain the right consistency for laying.
- On concrete carriageway, a tack coat compatible with the marking material shall be applied in accordance with the manufacturer's instructions prior to the application of thermoplastic material.

**c. Laying**

Carriageway centre lines, lane lines and edge lines shall be laid to a regular alignment by self propelled machine. Other markings may be laid by hand, hand propelled machine or self propelled machine as approved by the Engineer. The surface produced shall be uniform in texture and thickness and appreciably free from blisters and streaks.

**d) Reflectorization by surface Application**

When surface application of ballotini is required, additional ballotini (400 9/M2 to 500 91M2 from the machine) shall be applied by pressure concurrently with the laying of the line with sufficient, velocity to ensure retention in the surface of the line. The ballotini so sprayed shall give uniform cover and immediate reflectivity over the whole surface of the marking.

Ballotini dispensed on the surface of the markings shall conform to the following grading.

Sieve	Percentage by Mass Passing
1.7mm	100
600 $\mu$	80 – 100
425 $\mu$	45 – 100
300 $\mu$	10 – 45
212 $\mu$	0 – 25
75 $\mu$	0 - 5

Not less than 90%, by mass of the ballotini, shall be of transparent glass, spherical in shape and not more than ten (10) percent shall be ovate in shape or have other flaws. The ballotini shall be made of soda glass.

**e) Thickness**

Unless otherwise approved by the Engineer, the material shall be laid to the following thicknesses.

- a) Sprayed lines other than yellow. Not less than 1.5 mm.
- b) Sprayed yellow edge lines not less than 0.8 mm.

The minimum thicknesses specified are exclusive of surface applied ballotini. The method of thickness measurement shall be in accordance with appendix H of BS 3262 (1976).

### 608.3.6 Trial Section

In no case shall the contractor proceed with the work until the equipment, method of application and rate of application conforming the required thickness (as established by a test section) have been approved by the Engineer.

## 608.4 RETOROREFLECTIVE PREFORMED PAVEMENT MARKINGS

### 608.4.1 Materials - Requirements

The performed markings shall consist of white or yellow films with pigments selected to conform to standard highway colours. Ceramic and glass beads shall be incorporated to provide immediate\* and continuing retroreflection. Ceramic skid particles shall be bonded to a top urethane layer to provide a skid resistant surface.

The preformed markings shall be capable of being adhered to asphalt cement concrete (ACC) or Portland Cement Concrete (PCC) by a pre-coated pressure sensitive adhesive. A primer may be used to precondition the pavement surface. The preformed marking film shall mold itself to pavement contours by the action of traffic. The pavement marking film wearing courses during the paving operation in accordance with the manufacturer's instructions, approved by the Engineer. Following proper application and tamping, the markings shall be immediately ready for traffic. The bidder, when bidding, shall identify proper solvents and / or primers (where necessary) for proper application, and recommendation for application that will assure effective product performance. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

The marking film shall be durable retroreflective plisot polymer pavement marking film for performed longitudinal markings subject to low to medium traffic volumes and moderate wear conditions such as repeated shear action from crossover or encroachment on channelization lines.

The retroreflective pavement marking film shall consist of mixture of high quality pigmented polymeric materials, with a reflective layer of ceramic and glass beads, and a layer of skid resistant ceramic ' particles bonded to the top urethane wear surface. The film shall have a pre-coated pressure sensitive adhesive. The edges of the preformed tape shall be clear cut and true.

### 608.4.2 Colour

The daytime colour of the white film shall provide a minimum initial Luminance factor, Y, of 80, and shall conform to the following chromaticity requirements:  $X = 0.290$ ,  $Y = 0.315$ ;  $X = (Y.491$ ,  $Y = 0.435$ ;  $X = 0.512$ ,  $Y=0.486$ ;  $X = 0536$ ,  $Y = 0.463$ .

Measurements shall be made in accordance with ASTM E 1349, using illuminate "C" and 0145 (4510) geometry. Calculations shall be in accordance with ASTM E 308 for the 20 standard observer.

### 608.4.3 Reflectance

The white and yellow films shall have the following initial minimum reflectance values as measured in accordance with the testing procedures of ASTM D 4061. The photometric quantity to be measured shall be specific luminance (SQ, and shall be expressed as millicandals per square foot per foot-candle (mcd. ft<sup>2</sup>) ft<sup>-1</sup>). The metric ' equivalent shall be expressed as millicandals per square meter per lux (mcd. M<sup>-2</sup>). 1X<sup>-1</sup>)

	<b>White</b>	<b>Yellow</b>
Entrance Angle 86.00°	86.5 °	86.5 °
Observation Angle	1.0 °	1.0 °
Specific Luminance SL [(mcd. ft <sup>-2</sup> ). ft <sup>-1</sup> ]	300	175

### 608.4.4 Skid Resistance

The surface of the retroreflective films shall provide an initial minimum skid resistance values of 55 BPN as measured by the British Portable Skid Tester in accordance with ASTM E 303.

### 608.4.5 Patchability

The pavement marking film shall be capable of use for patching worn areas of the same type of film in accordance with the manufacturer's instructions.

### 608.4.6 Reflectance Retention

To have a good, effective performance life, the ceramic and glass beads must be strongly bonded and not be easily removed by traffic wear. The following test shall be employed to measure reflectivity retention.

#### 608.4.6.1 Taber Abraser Simulation Test

Using a Taber Abraser with an H-1 8 wheel and a 125 gram load, the sample shall be inspected at 200 cycles, under a microscope, to observed the extent and type of bead failure. No more than 15% of the beads shall be lost due to popout and the predominant mode of failure shall be "wear down" on the beads.

#### 608.4.7 Beads

The size, quality and refractive index of the ceramic and glass beads shall be such that the performance requirements for the marking shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched.

#### 608.4.8 Bead Retention

The film shall be ceramic and glass bead retention qualities such that when a 2 in x 6 in. (5.08 cm x 15.24 cm) sample is bent over a 112 in. (1.27 cm) diameter-mandrel, with the 2 M. dimension perpendicular to the mandrel axis, microscopic examination of the area on the mandrel shall show no more than 10% of the beads with entrapment by the binder of less than 40%.

#### 608.4.9 Thickness

The film without adhesive, shall have a minimum thickness of 0.030 in (0.76mm).

#### 608.4.10 Effective Performance Life

The film, when applied according to the recommendations of the manufacturer, shall provide neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. The film shall be weather resistant and through normal traffic wear shall show no fading, lifting or shrinkage which will significantly impair the intended usage of the marking throughout its useful life and shall show no significant tearing, roll back or other signs of poor adhesion.

#### 608.4.11 Installation

The markings shall be applied in accordance with the manufacturer's instructions.

### 608.5 CEMENTATIONS MARKING COMPOUND

Cementitious marking compound shall be used for Concrete, Surface Dressing and Bitumen to provide enhanced night and wet, weather visibility. This compound will be applied at following locations:

- Kerbs - Pavements and car park areas.
- Roundabout - vertical and sloping faces.
- Traffic Islands - vertical edges and bull noses, etc.
- Traffic Dividers - black and white chevrons.
- Concrete wall and faces - on high speed intersections and traffic merging.

## 608.5 MEASUREMENT AND PAYMENT

### 608.5.1 Measurement

The quantity of non-reflective or reflective chlorinated rubber based or thermoplastic pavement marking paint, shall be the no. of linear meters of painted traffic line for the specified width as indicated in BOQ. The retroreflective preformed pavement markings (tape) shall be measured in square meters. The arrows shall be measured in number.

The measurement shall be made of painted areas, completed and accepted. No measurement shall be made of unauthorized areas. Paint that is applied in un-authorized areas shall be completely removed from the surface of the road to the satisfaction of the Engineer and at Contractor's expense.

### 608.5.2 Payment

The quantities measured as determined above shall be paid for at the Contract unit price respectively for the pay items listed below, which price and payment shall constitute full compensation for furnishing and placing all materials including sampling, packing and testing at approved laboratory. The cost shall also include the preparation of the surface, and for all other costs necessary to complete the work as prescribed in this item.

<u>Pay Item No.</u>	<u>Description</u>	<u>Unit of Measurement</u>
608a	Pavement Marking in non-reflective CR / TP Paint for Lines of 12 cm width	M
608b	Pavement Marking in non-reflective CR / TP Paint for Lines of 15 cm width	M
608c	Pavement Marking in non-reflective CR / TP Paint for Lines of 20 cm width	M
608d	Pavement Marking in non-reflective CR / TP Paint for 4.0 M arrows	Each
608e	Pavement Marking in non-reflective CR / TP Paint for 6.0 M arrows	Each
608f	Pavement Marking in non-reflective CR / TP Paint for various signs	SM
608g	Pavement Marking in reflective CR/TP Paint for Line of 12cm width	M
608h	Pavement Marking in reflective CR/TP Paint for Line of 15cm width	M
608i	Pavement Marking in reflective CR/TP Paint for Line of 20cm width	M
608j	Pavement Marking in reflective CR/TP Paint for 4M arrows	Each

608k	Pavement Marking in reflective CR/TP Paint for various signs	Each
608l	Pavement Marking in reflective CR/TP Paint for various signs	SM
608m	Pavement Marking by retro reflective performed pavement markings (Tape)	SM



# REFLECTORIZED PAVEMENT STUDS

## 609.1 DESCRIPTION

This item shall consist of furnishing and installing reflectorized pavement studs set into the travelled way of the type in accordance with the specifications and at the locations shown on the Drawings or as directed by the Engineer.

## 609.2 MATERIAL REQUIREMENTS

### 609.2.1 Reflectorized Studs

Reflectorized Studs shall be "cat-eyes" either the 'Flush Surface' type or 'Raised Profile' type having the following characteristics.

#### **a) 'Flush Surface' Type**

The 'Flush Surface' reflector shall be the short base type having a maximum base area of 18 cm x 14 cm or as shown in the Drawings.

The base shall be formed in cast-iron with adequate webbing to ensure a firm key to the road when installed.

The pad shall be highly resilient and durable rubber reinforced with canvas and shall have an anticipated life of at least five (5) years. The pad shall be so designed as to produce a self-whipping action of the reflector when depressed.

The reflectors shall be made of impact and abrasion resisting glass and shall be hermetically sealed into a copper socket.

#### **(b) 'Raised Profile' Type**

The 'Raised Profile' reflectors shall consist of an acrylic plastic shell filled with an adherent epoxy compound molded from methyl methacrylate into the shape of a shallow frustum of a pyramid having base dimension of approximately 10 cm x 10 cm and thickness not more than two (2) cm or as shown on the drawings.

The shell shall contain one or two prismatic reflector each inclined at an angle of thirty (30) degree to the horizontal and having an area not less than twenty (20) square cm or as indicated on the plans.

The reflectors shall attain the following standards for their photometric and physical qualities:

**i) Photometric Requirements**

The reflectors shall have the following minimum Specific Intensity values (S.I) expressed as candle power per foot candle of illumination at the reflector on a plane perpendicular to the incident light.

	Colour		
	Crystal	Yellow	Red
Divergence Angle (in Degree)	0.20 S.I.	0.20 S.I.	0.20 S.I.
Incidence Angle			
0	3.00	1.80	0.75
20	1.20	0.72	0.30

The reflector for testing shall be located with the center of the reflecting face at a distance of one and half (1.5) m from a uniformly bright light source having an effective diameter of half (0.5) centimeter.

The width of the photocell shall be 1.27 cms and shall be shielded from stray light. The distance from the centers of the light source and photocell shall be 0.53 cms.

Failure of more than four (4) % of the reflecting faces shall be cause for rejection of the lot.

**ii) Strength Requirements**

The reflectors shall support a vertical load of 1000 kg when tested in the following manner.

A reflector shall be centered horizontally over the open end of a vertically positioned hollow metal cylinder seventy five (75) mm internal diameter, twenty five (25) mm high and wall thickness of six (6) mm. The load shall be applied to the top of the reflector through a six (6) mm diameter by six (6) mm high metal plug centered on top of the reflector.

Failure shall constitute either breakage or significant deformation of the marker at any load less than one thousand (1000) kg.

### 609.2.2 Adhesive

When 'Raised Profile' type of reflectors are used, a two-part adhesive having the following ingredients shall be applied to the stud for bonding to the pavement surface.

<b>Package A</b>	<b>Kg / Litre</b>
Epoxy Resin	0.9400
Titanium Dioxide	0.0700
Colloidal	0.0500
Talc	0.3450
<b>Package B</b>	<b>Kg / Litre</b>
Modified Asphaltic Amine Hardener (Reinhold 2611)	0.2400
Modified Asphaltic Amine Hardener (Reinhold 2613)	0.4720
Carbon Black	0.0022
Colloidal Silica	0.0400
Talc	0.6500

Equal volumes of Package A & B should be mixed together until a uniform colour is obtained. No more than one quart of adhesive shall be prepared at one time.

### 609.2.3 Cement Mortar

Cement mortar shall consist of one (1) part Portland cement to three (3) parts of fine aggregates.

## 609.3 CONSTRUCTION REQUIREMENTS

### 603.3.1 Flush Surface Type

The stud shall be installed into the pavement in accordance with the manufacturer's instructions but shall also comply with the following requirements:

Cavities in the pavement shall be clearly cut to the dimension of the pavement stud and shall allow a clearance of one (1) cm around the stud base. The longitudinal center line axis of the cavity shall be the same as that required for the pavement stud when laid to correct line and direction.

The walls of the cavity shall be splayed back at an angle of approximately thirty (30) degree to the vertical to facilitate a "dove-tail" joint after the mortar has set.

The bottom of the cavity shall be leveled with asphalt concrete prior to placing the stud base, which shall be pounded into position with Pounder Foot attached to a pneumatic drill.

The depth of the cavity shall be such that when the stud base and reflectors have been installed the elevation of the floor of the lens socket shall not be greater than two (2) mm or less than one (1) mm above the pavement surface.

The stud shall be grouted into position with asphalt concrete containing fine aggregate only or with a cement mortar as described in Item 609.2.3 above when the studs are installed into a cement concrete pavement.

### 609.3.2 Raised Profile Type

The pavement studs shall be installed in accordance with the manufacturer's instructions or to the requirements of the Engineer.

## 609.4 MEASUREMENT AND PAYMENT

### 609.4.1 Measurement

The quantity of reflectorized pavement studs to be paid for shall be the number of 'Flushed Surface' or 'Raised Profile' type provided and installed as mentioned above.

### 609.4.2 Payment

The quantities measured as described above shall be paid for at the contract unit price respectively for the pay items listed below and shown in the Bill of Quantities, which payment shall constitute full compensation for furnishing and placing all materials, excavating cavities, preparation of surfaces, applying adhesive and mortar, for all labour, equipment, tools and incidentals necessary to complete the item.

<u>Pay Item No.</u>	<u>Description</u>	<u>Unit of Measurement</u>
609a	Reflectorised Pavement Stud (Flush Surface Type – Single)	Each
609b	Reflectorised Pavement Stud (Flush Surface Type – Double)	Each
609c	Reflectorised Pavement Stud (Raised Surface Type – Single)	M
609d	Reflectorised Pavement Stud (Raised Surface Type – Double)	Each

# PRECAST CONCRETE POSTS AND MARKERS

## 610.1 DESCRIPTION

The work shall consist of furnishing and placing precast concrete Kilometer, Ten Kilometer, Guide Posts and Right of Way Markers, complete including painting and lettering in accordance with the Drawings and specifications or as directed by the Engineer.

## 610.2 MATERIAL REQUIREMENT

### 610.2.1 Concrete

Precast concrete post and markers shall consist of Class A Concrete conforming to the requirements of Item 401 and to the lengths, shapes and other details shown on the Drawings.

### 610.2.2 Reinforcing Steel

Reinforcing steel shall conform to item 404.

## 610.3 CONSTRUCTION REQUIREMENTS

### **(a) Excavation and Bedding**

Excavation shall be made to the required depth as shown on the Drawings. All soft and unsuitable material shall be removed and replaced with suitable material acceptable to the Engineer.

Bedding shall be to section and dimension shown on the Drawings or as directed by the Engineer.

### **(b) Placing**

The precast concrete posts and markers shall be set in two (2) cm of cement mortar to the level and grade as shown on the Drawings or as directed by the Engineer.

### **(c) Backfilling**

After the placing of precast concrete posts and markers in the excavated areas and subsequent setting in with cement mortar, the same will be refilled to the required elevation with suitable earth or granular material, which shall be tamped in layers of not more than fifteen (15) centimeters each until firm and solid.

## 610.4 MEASUREMENT AND PAYMENT

### **610.4.1 Measurement**

The quantity of each element to be paid for shall be the number of post and marker furnished and installed in place as per drawing or as directed by the Engineer.

### **610.4.2 Payment**

The accepted quantities of posts and markers shall be paid for at the contract unit price per unit of measurement for the pay items listed below and shown in Bill of Quantities which price shall be compensation for furnishing, excavation, placing, erection, painting, lettering and for all costs including labour, tools, and incidentals necessary to complete the work prescribed in these items:

Pay Item No.	Description	Unit of Measurement
610a	Gudie Post	Each
610b	Right of Way Marker	Each
610c	Kilometer Post	Each
610d	Ten Kilometer Post	Each

# PLUMBING WORKS

## PART-1 GENERAL

### 1.01 SCOPE

The work under this section consists of providing all material and equipment and performing all the work necessary for the complete execution (jointing, clamping, cleaning, painting etc. both above and underground and embedded in walls) and completion, including testing and commissioning of all systems of plumbing works as shown on the Drawings and/or as specified herein and/or as directed by the Engineer. The system include plumbing works as follows:

- i) Cold and Hot Water Supply
- ii) Building Sewerage & Drainage
- iii) Roof Drainage

All the above systems shall be completed in all respects including extension of these internal systems up to the specified limits outside the building as indicated on the drawings.

### 1.02 APPLICABLE STANDARDS

PPR Pipes	DIN 8077-8078, PN-20 and DIN 16962,PN-25 for fittings
G. I. Pipes	BS- 1387
C. I. Pipes	BS- 416 & 2494
uPVC Pipes	ISO- 3633 (Type B) SN-08, EN-1401 (For External) & BS- 4514/ 5255

## PART-2PRODUCTS

### 2.01 SUBMITTALS & SHOP DRAWINGS

All the materials and equipment shall be of the specifications mentioned herein and the Contractor shall submit the sample, necessary catalogues, sketches, the name of manufacturer and guarantee if necessary, before installation. The system shall be installed after the Engineer approves it. All material and equipment shall be new and unused.

It is specifically intended and must be agreed to by each Contractor submitting a bid, that any material or labor which is usually furnished as a part of such equipment and which is necessary for its proper completion and best operation shall be furnished as a part of this Contract without any additional cost whether or not shown in detail on the drawings or described in detail, in the specifications.

Approval of material and equipment by the Engineer shall not absolve the Contractor of the responsibility of furnishing the same of proper size, quantity, quality and all performance characteristics to efficiently fulfill the requirements and intent of the Contract Documents.

Prior to commencement of works on site and at least 3 weeks in advance of all the drawing being required for actual execution the Contractor shall submit on larger scale as approved by Engineer, shop drawings in triplicate for approval to the Engineer. The Engineer shall review the drawing and (i) approve the drawing or, (ii) approve the drawing with comments or, (iii) disapproved the drawings with comments for rectification/revision of the drawing and resubmit 3 copies to the Consultant for approval. On a drawing being approved, the Contractor shall submit 6 copies for formal approval and distribution to relevant offices.

All drawings shall have plan and section and with sufficient details to clearly reflect the installation of the system. All material specifications shall be provided on the drawings. All information required for preparing suitable foundation, for providing suitable access to the system, for making openings in building structure, for coordination with electrical, air-conditioning and other designs etc., shall be clearly provided.

Installation shall not be allowed to commence unless approved shop drawings are in possession of the Contractor, for which purpose shop drawings shall be submitted by the Contractor to the Engineer sufficiently in advance of actual requirements to allow for ample time in checking and approval and no claim for extension of the contract time will be considered by reason of the Contractor's failure to submit the drawings on time.

Each shop drawing submitted by the Contractor shall include a certificate by the Contractor that all related conditions on site relevant to that particular installation have been checked and that no conflict exists.

Any expenses resulting from an error mistake or omission in or delay in delivery of the drawings and information mentioned above shall be borne by the Contractor.

Drawings approved shall not be departed from except on the instructions of the Engineer.

The approval by the Engineer for any submitted data, working drawings, performance curves, test certificates for any items, arrangements and/or layout shall not relieve the Contractor from any responsibility regarding the performance of the Contract. Such approval shall not also relieve the Contractor from responsibility of any error in the submitted data and workings, brought to light at any time subsequent to any approvals.

Relevant specified imported item, model cuts will be available with the authority concern for execution of work for contractor to check the models for fabrication or import.



## 2.02 MATERIAL & EQUIPMENT

### 2.02.1 PIPE MATERIALS

Polypropylene Random (PPR), Galvanized Iron (G.I), Unplasticised polyvinyl chloride (PVC-U) & C.I Pipes.

#### 2.2.1.1 POLYPROPYLENE RANDOM PIPES AND PIPE FITTINGS

Providing, fixing, jointing and testing Polypropylene Random (PPR) pipes of approved make pressure pipe for cold and hot water as per DIN 8077-8078, PN-20 for pipes and DIN 16962, PN-25 for fittings (polyfusion welded joints) inside building including fittings and specials (sockets, tees, elbows, bends, crosses, reducers, adaptor, plugs and union etc.) supported on walls or suspended from roof slab or run in chases including pipe hangers, supports, cutting and making good the chases and holes, complete in all respects.

#### 2.2.1.2 G.I. COLD, HOT WATER PIPES AND FITTINGS

The galvanized pipes shall be of medium grade and conform to British Standard Specifications 1387 for "Steel Tubes and Tubular suitable for screwing to BS 21 pipe threads".

All screwed tubes and sockets shall have BS pipes thread in accordance with BS 21. In order to prevent damage to the leading thread, the ends of the sockets shall be chamfered internally. A complete and uniform adherent coating of zinc will be provided for galvanized pipes.

Every tube shall be tested at the manufacturer's works to a hydraulic test pressure of 4.90 MPa and shall be maintained at the test pressure sufficiently long for proof and inspection. Tubes which are bundled shall be secured together by rope or soft iron or other suitable material.

The threads of all tubes shall be effectively covered with a good quality grease or other suitable compound, and each tube above 50 mm nominal bore shall have a protecting ring affixed to the unsocketed screwed end.

All pipe fittings upto 75 mm dia. shall conform to BS 21 and shall be of malleable cast iron. Pipe fittings above 75 mm dia. shall be of approved material and specifications as decided by the Engineer.

### 2.2.1.3 UPVC SOIL, WASTE, VENT & RAIN WATER DRAINAGE PIPES & PIPE FITTING

The material shall substantially consist of poly (vinyl chloride) (PVC) as per the requirements of aforesaid standard. Pipes and fittings shall be sufficiently stabilized against thermal ageing and ultraviolet (UV) light.

#### PIPES

There are two types of pipes and fittings (type A and type B) as per ISO 3633 for drainage systems.

- Type A, which shall be used only for primary and secondary ventilation pipe work and internal rainwater applications.
- Type B, which shall be used for soil and waste discharge systems and may also be used for any type A application.

Unplasticised polyvinyl chloride (PVC-U) pipes and fittings for soil and waste discharge (low and high temperature) systems inside the buildings shall confirm to *ISO: 3633: (1991(E)) type B*.

#### FITTINGS

There are two types of fittings available as per ISO 3633:

- uPVC fittings with Solvent Cement (SC) socket joint conforming to ISO 3633:1991.
- uPVC fittings with rubber ring socket joint conforming to DIN 19560, which is compatible with ISO 3633/PS 3214.

#### RUBBER RINGS

The rubber rings may either be Synthetic or natural conforming to PS 1915:1987 & ISO 4633/1983 (E).UPVC pipes shall be used for domestic installation inside the buildings for soil and waste discharge, ventilation and drainage of rain water.

The material shall consist substantially of poly-vinyl chloride (PVC) to which may be added only those additives that are needed to facilitate the manufacture of pipes and fittings having good mechanical strength and opacity.

The pipes and fittings shall be tested mechanically and physically in accordance with the relevant Standards as and when directed by the Engineer, before and during installation.

#### **2.2.1.4 CAST IRON SOIL, WASTE, VENT & RAIN WATER DRAINAGE PIPES & FITTING**

The cast iron pipe shall conform to British Standard Specifications No.416 for "Cast Iron spigot and socket soil, waste and vent pipes and fittings with spigot and socket or hubless ends. The joint shall be lead caulked or elastomeric (Rubber rings) to BS- 2494. Cast iron pipes shall be centrifugally (SPUN) cast.

The quality of material shall be according to B.S.S. No.1452 for Grade 10. The contractor shall supply coated pipes and fittings. The coating composition shall be of tar basis or a mixture of natural bitumen with a suitable hardener and natural asphalt. The coatings shall be smooth, tenacious, sufficiently hard, not to flow when exposed to a temperature of 63 Degrees Celsius and not so brittle at zero degrees Celsius that it chips soft when scribed lightly with the point of a pen knife.

Every pipe shall be tested at the manufacturer's work to a hydraulic test pressure of 0.07 MPa. Every pipe and fitting shall ring clearly when tested for soundness by being struck all over with a light hammer.

### **2.2.2 PLUMBING FIXTURES**

#### **2.2.2.1 General Requirements**

Materials shall conform to the latest referenced standard specifications and other provisions stipulated herein and shall be new and unused. All fixtures shall be of the best quality and finish.

Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer for his approval, a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams, drawings and such other technical data as may be required by the Engineer to satisfy himself as to the suitability, durability, quality and usefulness of the material to be purchased.

Approval of the schedule shall not be construed as authorizing any deviations from the specifications unless the attention of the Engineer has been invited to the specific changes. If the material or equipment offered under this provision is, in the opinion of the Engineer, equal to or better than specified, it will be given consideration.

Plumbing fixtures shall have smooth impervious surfaces, be free from defects and concealed fouling surface. They shall be true to line, angles, curves and colour etc. Normally they shall be of local make and of the best quality available, provided.

All taps and cocks to be installed with plumbing fixtures shall be chrome plated (CP) and shall be of appropriate class to work without damage or leakage on the specified pressure of potable water system, which is 0.88 MPa (128 psi). The taps and cocks shall be of the best quality locally manufactured.

When any fixture is provided with an overflow, the waste shall be so arranged that the standing water in the fixture cannot rise in the over flow when the stopper is closed or remain in the overflow when the fixture is empty.

Plumbing fixtures shall be installed in a manner to afford easy access for cleaning. The space between the fixture and the wall shall be closely fitted and pointed so that there is no chance for dirt or vermin to collect.

When practical, all pipes from fixtures shall be run to the nearest wall. where fixture comes in contact with wall and floors, the joint shall be watertight.

Wall hung fixtures shall be rigidly supported by metal supporting members so that no strain is transmitted to the connections. Flush tanks and similar appurtenances shall be secured by approved non-corrosive screws or bolts.

Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet shall be set closer than 400 mm from its centre to any side wall. No urinal shall be set closer than 300 mm from its centre to any side wall or partition nor closer than 600 mm centre to centre. The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow. All cuttings, making holes etc. and making it good shall be included in the work.

Other physical/chemical properties of the fixtures are as below:

<b>S. No.</b>	<b>Physical/Chemical Properties</b>	<b>Pakistan Standards</b>	<b>European Standards</b>
1	Water absorption	Less than 0.50%	Maximum 0.50%
2	Scratch Resistance	Maximum 5.5 MOH's scale	Maximum 5 MOH's scale
3	Resistance to Chemicals	Resistant to acids, alkalies, bases & other household cleaning chemicals	Resistant to chemicals.
4	Crazing Resistance	Crazing "NIL"	Crazing "NIL"
5	Warpage	Maximum 5.5-6mm	Maximum 6mm
6	Strength against bending	More than 700 kg/cm	450kg/cm - 700 kg/cm
7	Thermal shock	More than 10 cycles of thermal shock from hot to cold water 15°C-200°C	More than 2 cycles of thermal shock from hot to cold water 20°C-110°C
8	Durability	Permanently durable	Durable for ever

#### 2.2.2.2 Vanity Wash Basins

Vanity Wash basin shall be vitreous China, best quality, of color, size and type as approved by the Engineer. It shall be installed as a complete unit including 15 mm mixer for hot and cold water supply (unless mentioned separate in BOQ), 15 mm stop-cocks, C.P brass chain with 32 mm rubber plug, C.P brass bottle trap for individual wash basin and C.P brass P trap for battery of wash basins as applicable, C.P brass strainer, heavy cast iron brackets with bolts, screws etc. approved water inlet connection pipe, waste pipe, joints jointing and sealing material, etc., with all other minor accessories required to complete the job in all respect.

#### 2.2.2.3 Water Closets (European type)

European type water closet shall be best quality, of color, size and type as approved by the Engineer. It shall be installed as a complete unit including all accessories. Flush tank shall be of low level type - it shall be fitted with either single push button or double push button type. Double push button type flushing system is fitted with one 3 liter small button and one 6 liter large button. Trap shall be cast integral with pan. The seat shall be of smooth non-combustible non-absorbent materials like Bakelite and of the open front type fixed to the pan with hinges. The fittings shall also include approved water inlet connection pipe, nuts bolts, 15mm dia stop cock etc. required for complete installation.

#### 2.2.2.4 Water Closets (Orissa)

Squatting (Asian/Orissa) type water closet shall be vitreous China, best quality, of color, size and type approved by the Engineer. It shall be installed as a complete unit including, 15 mm CP stop cock, approved water inlet connection pipe, low level or high level Flush tank, as required. All fittings shall be installed at low level, or high level as required including interconnecting flush piping. Foot rests, cast iron P trap, joints, jointing and sealing materials, etc. with all other minor accessories for complete installation.

#### 2.2.2.5 Kitchen Sink

Kitchen sink shall be stainless steel of best quality, of color, and type as approved by the Engineer, double deep-bowl with integral drain board, of at least 1800 X 600 mm size. It shall be installed as a complete unit with arrangement for both cold and hot water supply, 15 mm C.P. mixer for cold and hot water, approved water inlet connection C.P. brass strainer, waste outlet pipe, heavy cast iron brackets with bolts screws etc., joints jointing & sealing material etc., with all other minor accessories required for complete installation.

#### 2.2.2.6 Urinals

Urinals shall be vitreous China of approved make and size and of wall hung type either with integral water seal trap or with separate brass P-Trap. The complete unit shall be installed including 15mm Tee-stop cock, plastic water inlet/outlet connections, cast Iron enamel painted flush tank of 4 liters capacity fitted with heavy duty CI brackets, bolts, screws, and all internal accessories or CP Flush Valve; CP steel flush pipe. CP steel waste pipe, joints, jointing and sealing materials etc. with all other minor accessories.

## 2.2.3 MISCELLANEOUS ITEMS

### 2.2.3.1 Taps, Cocks and Double Bib Cocks with Muslim Shower

All taps, cocks and double bib cocks with Muslim Shower shall be of brass, gun metal or other equally suitable corrosion resisting alloy conforming to BS 1010 and shall be of best quality. The nominal size specified shall be the nominal bore of the seating. Washers for cold water cocks shall be of specially selected leather, rubber asbestos composition or other equally suitable material. Washers for hot water cocks shall be of good quality fiber, rubber - asbestos composition or other equally suitable material. The muslim shower shall be connected to the double bib cock by means of a flexible connecting pipe. Every tap/cock shall be tested; complete with its component parts, to a hydraulic pressure of at least 1.96 MPa (284.4 psi). During tests it shall neither leak nor sweat.

### 2.2.3.2 Floor trap/MFT

Floor trap/MFT shall be of uPVC or of other anti-corrosive material, compatible with the material of pipe. They shall have minimum water seal of 40 mm and shall be provided with removable metal/uPVC strainers. The traps shall be of self-clearing type. The open area of the strainer shall be greater than the cross section area of the drain line to which it connects. Floor traps shall be well set in position so that there is no leakage at the joint between trap and the floor.

### 2.2.3.3 Shower Rose

Shower Rose shall be of brass, gun metal or other equally suitable corrosion resisting alloy conforming to BS 1010 and shall be of best quality including C.P. mixer for cold and hot water.

### 2.2.3.4 Roof Drains

Roof drains shall be of bitumen coated cast iron/ brass or uPVC or of other anti-corrosive material, compatible with the material of pipe. They shall have strainers extending at least 15 mm above the roof surface immediately adjacent to them, when installed on flat part. Bottom of strainer shall be flush with the roof surface, when installed on vertical part. Strainer shall have an available inlet area, above roof level, of not less than 1-1/2 times the area of the down-pipe to which the drain is connected.

The connection between roof and roof drain shall be made watertight by the use of proper flashing material.

### 2.2.3.5 Cleanouts

Cleanout shall be of the same nominal size as that of the pipe on which it is installed. Cast Iron Cleanout shall consist of tapped heavy duty cast iron ferrule caulked into cast iron fitting and heavy duty brass tapered even plug. UPVC cleanout shall consist of either two 45o bends or one long radius bend both with an removable end cap and other necessary fittings/material for complete installation in floor Cleanouts shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of cleanout shall be flush with the floor by means of finished metal plate secured in position and screwed firmly to the plug. Cleanout shall be so installed that there is a clearance of at least 300 mm for pipes less than 75 mm diameter and at least 457 mm for pipes of 75 mm and larger diameter, for the purpose of Roding.

Pipe used with cleanout shall be measured and paid under pipe item. All other work of ferrule, plug, concrete work, frame and cover etc. shall be measured and paid under cleanout item.

### 2.2.3.6 Vent Cowel

All vent pipe terminating above the building shall be provided with best quality cast iron cowel and a stainless clamp for clamping of water proofing membrane as approved by the Engineer.

### 2.2.3.7 Ferrule Assembly

Ferrule assembly shall consist of brass ferrule assembly including corporation cock for disconnection of approved quality including C.I saddle, M.S strap and all other items related to make complete house connection.

### 2.2.3.8 Bronze Gate Valve/ Sluice Valve

All valves of 100 mm diameter and smaller shall be of bronze unless otherwise specified conforming to BS 5154 and shall be of appropriate class for the working pressure of the system on which they are installed. Open and shut indicators shall be marked on the handle. The ends may be screwed or flanged.

### 2.2.3.9 Bronze Check Valve

Bronze check valves shall be swing type conforming to B.S. 5154. The direction of flow shall be permanently marked on the body of the valve. The end of valves shall be either screwed or flanged, as specified. Threads shall conform to B.S.21. Flanges shall conform to B.S. 4504. Valves and flanges unless otherwise shall be rated for a working pressure of 10 bars for potable water and 16 bars for fire water and shall be tested to 1-1/2 times the working pressure. Check valves shall be installed on horizontal or vertical pipes in the direction of flow.

### 2.2.3.10 Cast Iron Gate Valve/ Sluice Valve

All gate valves shall be of cast iron body and shall conform to B.S.5163 "Specifications for Double Flanged Cast Iron Wedge Gate Valves for Waterworks purposes". Body of the valve shall be tested to 1-1/2 times the service pressure and the seat shall be tested at maximum service pressure. No leakage shall be observed under the above tests. The material used shall be corrosion resisting, free

from toxic substances and shall not foster microbiological growth or give rise to taste, odour, cloudiness or discolouration of water. Two sets of valves key suitable for opening all valves shall be provided to the Owner free of cost. The external surface of the valves shall be painted with a minimum of two coats of black bituminous enamel paint.

#### 2.2.3.11 Cast Iron Check Valve

Check Valves shall conform to B.S. 5153 "Specifications for Cast Iron Check Valves for general purposes" the service rating shall be 10 bars for potable water and 16 bars for fire water. The direction of flow shall be permanently marked on the body of the valve. Body of the valve shall be tested to 1-1/2 times the service rating and seat shall be tested at the pressure of service rating. No leakage shall be permitted under the above tests. The check valves shall be swing type.

Ends of the valves shall be flanged to join with the standard fittings. Flanges shall be of appropriate class and material.

Valves shall be installed at positions shown on the detail drawings. The interior shall be cleaned of all foreign matter before installation. They shall be inspected to ensure that all the components are sound and in working condition. Valves shall be adequately supported, wherever required.

#### 2.2.3.12 Air Relief Valves

These shall be designed to carry out the function described in 10.14.1 above. Each valve shall be provided with only a small orifice which shall operate in the same manner as that in a double acting air valve.

Valves with air intake or exhaust facilities shall have approved screening arrangements to prevent the ingress of air borne sand.

The nominal pressure shall be NP 10 for air valves on potable water lines and NP-16 for air valves on fire water lines.

Body ends shall be flanged with raised faces and drilled according to BS 10 for the nominal pressure specified or indicated in the Drawings.

The materials for the valves shall be as follows:

Cast iron body cover and bowl for small orifice, cast iron with gunmetal seat with rubber covered ball or other approved; for large orifice, cast iron with rubber seat and vulcanite covered ball or other approved.



### 2.2.3.13 Grease Trap / Interceptor

a. The grease trap shall be of stainless steel of specified capacity with cover, baffles and strainers to separate grease from water effectively. The grease trap shall be of approved make or equivalent and installed in the position as shown on drawings or as specified by the Engineer.

Or

b. The grease interceptor shall be built in masonry or reinforced cement concrete as per relevant drawings including excavation, RCC class "C", steel reinforcement, PCC class "E", 15mm thick cement sand plaster in 1:3 c/s, 15mm thick C.I. trap & plate having holes (screen) 25mm c/c of standard diameter, 20mm G.I. pipe for lifting trap, inlet & outlet connections, 600x600 mm C.I. cover with frame, 25mm legs for supporting screen system, painting three coats to steel works with synthetic enamel paint, nuts, bolts etc. complete in all respects as desired by the engineer.

### 2.2.3.14 Glass Mirror

The glass mirror shall be of specified size, 5 mm thick, securely fixed on hard board packing and of best quality Belgium make. The mirror shall be fixed on wall as shown on the drawing or as directed by the Engineer. All accessories required for complete fixing of mirror on wall shall be included in Contractor's scope of work.

### 2.2.3.15 Towel Rail, Toilet Paper Holder, Soap Trays, Mirror Trays

The towel rail, toilet paper holder, soap trays & mirror trays shall be of best quality. All accessories for complete installation of towel rail, toilet paper holder, soap tray and mirror tray shall be included in the Contractor's scope of work.

### 2.2.3.16 Gully Trap

Gully trap shall be of cast iron with specified size outlet. The inlet shall be provided with cast iron, medium duty grating. The open area of the grating shall be at least 1-1/2 times the area of the outlet. The trap shall be of P-Type with a minimum water seal of 50 mm.

### 2.2.3.17 Cast Iron Grating

Cast iron grating shall be of the specified size. The specified size shall mean the clear span. Cast iron grating shall be complete with frame. They shall be of Light/medium duty type to resist normal traffic loads, the casting shall be sound and free from all defects. The frame shall be set in place at the time of pouring of concrete. Openings in grating shall be in approved pattern.

## PART-3 EXECUTION

### 3.1 GENERAL

The Contractor shall be responsible for his work until its completion and final acceptance, and shall replace any of those that may be damaged, lost or stolen without any additional cost. All openings left in floor for passage of lines of water supply, soil, waste, vent, etc. shall be covered and protected.

All open ends of pipes shall be properly plugged to prevent any foreign material from entering the pipe. Misuse of plumbing fixtures to be installed under this Contract is prohibited during the currency of the contract.

All metal fixture trimmings shall be thoroughly covered with non-corrosive grease which shall be maintained until all work is completed.

Upon the completion of work, all fixtures and trimmings shall be thoroughly cleaned, polished and left in first class condition.

Before erection, all pipes, valves, fittings, etc. shall be thoroughly cleaned of oil, grease or other material.

All special tools for proper operation and maintenance of the equipment provided under this Contract shall be delivered at no additional cost.

The Contractor shall allow in his bid for cost of all cutting, making holes and subsequent making it good to the desired finish as per approval of the Engineer. No separate payment shall be made for this item.

The Contractor shall allow in his bid for the cost of providing protective painting or coating as specified in the relevant sections and no claim shall be entertained for this item.

All pipes shall be properly installed as shown on the drawings and/or as directed by the Engineer, and shall be as straight as possible forming right angles and parallel lines with the walls and other pipelines. The position, gradients, alignment and inverts shall be as shown on the drawings and/or as directed in writing and set out by the Engineer.

The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings. The Engineer reserves the right to change the location etc. Special precautions shall be taken for the installation of concealed pipes as shown on the drawings and/or as required. Should it be necessary to correct piping so installed, the Contractor shall be held liable for any injury caused to other works in the correction of piping? The Contractor shall closely coordinate with other works during the entire stage of execution.

A minimum distance between different services shall be maintained as shown on the Drawings and/or as approved by the Engineer.

Pipes should be installed in such a manner that minimum distance should always be maintained between pipe and wall, beams, columns, etc. Pipes shall be supported on hangers and brackets as shown on the drawings or as directed by the Engineer.

Waste-water outlet from each fixture shall be individually trapped. Each vent terminal shall extend to the outer air and be so installed as to minimize the possibilities of clogging and the return of foul air to the building.

When the roughing-in is completed, the plumbing system shall be subjected to test prior to concealing the roughing-in, in order to ascertain that all threads and connections are watertight.

Cast iron soil and drainage fittings for change in direction shall be used as follows:-

\*Vertical to horizontal: short sweep or long-turn for diameter 75 mm and larger; long sweep or extra-long-turn for less than 75 mm. dia.

\*Horizontal to vertical: quarter bend or short turn.

All fittings with hubs shall be aligned so that the hub faces upstream. No drainage or vent piping shall be drilled.

All exterior openings provided for the passage of piping shall be properly sealed with snugly fitting collars of metal or other approved rodent-proof material securely fastened into place.

Joints at the roof, around vent pipes, shall be made water-tight by the use of lead, copper, galvanized iron, or other approved flashing or flashing material. Exterior wall openings shall be made watertight.

Each length of pipe & each pipe fitting, trap, fixture, & device used in a plumbing system shall have cast, stamped or indelibly marked on it the maker's mark or name, the weight, type & classes of the product, when such marking is required by the approved standard that applies.

Where different sizes of pipes, or pipes and fittings are to be connected, the proper size increasers or reducers or reduced fittings shall be used between the two sizes.

Any fitting or connection which has an enlargement, chamber, or recess with a ledge, shoulder, or reduction of pipe area that offers an obstruction to flow through the drain pipe is prohibited. The vertical distance from the fixture outlet to the trap weir shall not exceed 600 mm. Each fixture trap shall have a water seal of not less than 50 mm and not more than 100 mm.

Full S, bell, crown vented traps and traps/depending for their seal upon the action of movable parts are prohibited. No fixture shall be double trapped. Where fixture comes in contact with wall and floors, the joint shall be water-tight. Piping in ground shall be laid on a firm bed for its entire length.

Piping in the plumbing system shall be installed without undue strains and stresses. Vertical piping shall be securely held to keep the pipe in alignment and carry the weight of the pipe and contents. Horizontal piping shall be supported to keep it in alignment and prevent sagging. Hangers and anchors shall be of metal of sufficient strength to maintain their proportional share of pipe

alignments and prevent rattling. Hangers and anchors shall be securely attached to the building under construction. It must be clearly understood that the Contractor shall be fully responsible for hangers and supports and shall obtain prior approval of design as to the shape, material, dimensions, spacing etc.

Piping in concrete or masonry walls or footings shall be placed or installed in sleeves which will permit access to the piping for repair or replacement.

## 3.2 POLYPROPYLENE RANDOM PIPES AND PIPE FITTINGS

The run and arrangement of all pipes shall be as shown on the Drawings and as directed during installation. All vertical pipes shall be erected plumb and shall be parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls. If required to change the location etc. during the currency of the work, the Contractor will do so at no additional cost.

Joints in PPR pipes shall be made perfectly tight, without the use of any filler except approved jointing compound or tape.

Furnish and install all pipe passing through floors and walls with sleeves of G.I. sheet, 18 gauge, the inside dia. of which shall be at least 12mm greater than the outside of the pipe passing through it. Sleeves in exterior walls and pits shall have anchor flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

All embedded cold water supply piping shall be wrapped with approved anti-corrosion polyethylene tape. All exposed piping shall be painted with two coats of enamel paint over a coat of red oxide.

### 3.2.1 Pipework Supports

All supports, clips, steels rods and hangers shall be of mild steel painted with two coats of approved metallic zinc primer.

All clips and brackets shall be equipped with 9 mm sectional rubber liners

Pipe work supports shall be installed in order to allow free movement due to expansions and contraction. Supports shall be arranged adjacent to joints, changes of direction and branches.

Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle form shall be fitted to the underside of slab by two hangers and the pipes shall be supported from the channel iron by rod hangers and flat iron bands.

All hanger rods shall have double nuts and bevelled washers to allow the hanger rod to swing.

Multiple pipe runs along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

Exposed pipe work shall be supported on channel, angle iron or with U-bolts to form a rigid guide.

All U-bolts, except used as anchors, shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide and allowing the pipe to slide axially,. U- bolts shall be provided on alternate pipe bracket.

Small pipework running along skirting shall be supported by standard built-in or screw-on type clips.

Pipes shall be individually supported. Pipes shall not hang from other pipes.

Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means-of support for the riser.

Vibration isolators to be provided with the hangers as approved by the Engineer.

### 3.3 G.I. COLD AND HOT WATER PIPES WITH FITTINGS

The run and arrangement of all pipes shall be as shown on the Drawings and as directed during installation. All vertical pipes shall be erected plumb and shall be parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls. If required to change the location etc. during the currency of the work, the Contractor will do so at no additional cost. Screwed joints in G.I. pipes shall be made perfectly tight, without the use of any filler except approved jointing compound or tape. Wherever required to make flanged joints, they shall conform to BS 10 Table D.

Furnish and install all pipes passing through floors and walls with sleeves of G.I. sheet, 18 gauge, the inside dia. of which shall be at least 1/2" greater than the outside dia of the pipe passing through it. Sleeves in exterior walls and pits shall have anchor flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

All embedded water supply piping shall be wrapped with approved anti-corrosion polyethylene tape. All exposed piping shall be painted with two coats of enamel paint over a coat of red oxide.

#### 3.3.1 Insulation

All hot water supply and return piping shall be insulated as specified herein. Prior to insulation the pipes shall be hydraulically tested and cleaned.

<b>Nominal Pipe Dia. (mm)</b>	<b>Thickness of per-form Fiber glass pipe insulation. (mm)</b>
15 (1/2")	25
20 (3/4")	25
25 ( 1" )	25
32 (1-1/4")	25
40 (1-1/2")	25

Insulation shall consist of pre-formed fiberglass pipe insulation, with factory applied reinforced aluminum vapor barrier, single layer in semi-circular halves, consisting of long, fine glass fibers, bonded with a temperature resistant binder, free from shot or coarse fibers, damage resistant, light in weight, easy to handle, cut and fit. The product shall comply with the requirements of B.S. 3958: Part 4. The insulation shall be rotproof, odorless, non-hygroscopic, and shall not sustain vermin. The fiberglass insulation shall be covered with a layer of approved polyethylene tape in the field. Further reinforcement shall be provided by the use of 20 mm wide soft aluminum bands, generally spaced at 457 mm and on either side of elbows and tees. All butt joints shall be sealed with self-adhesive type of approved quality adhesive tape.

All trimmed sections shall be secured by wrapping of approved type of self adhesive tape to form a complete waterproof seal. All work shall be done in a neat and workmanlike manner, and should reflect recommended practice.

All Hot water and Hot water return lines concealed in walls only, shall be provided with Glass wool blanket insulation.

### 3.3.2 Pipe work Supports

All supports, clips, steel rods and hangers shall be of mild steel painted with two coats of approved metallic zinc primer. All clips and brackets shall be equipped with 9 mm sectional rubber liners (shore-hardness A 40+5°).

Pipe work supports shall be installed in order to allow free movement due to expansions and contraction. Supports shall be arranged adjacent to joints, changes of direction and branches. Each support shall carry the overall weight of pipework and water to be borne by it. The intervals between pipe supports shall not exceed the following.

Dimensions of Support Materials			
Nominal Dia mm	Flat iron bands mm	Support rods mm	U-bolts mm
10	25 x 3	6	6
15	25 x 3	6	6
20	25 x 3	6	6
25	25 x 3	6	6
32	40 x 5	10	10
40	40 x 5	10	10
50	40 x 5	10	10
65	50 x 6	12	12
80	50 x 6	12	12

Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle from shall be fitted to the underside of slab by two hangers and the pipes shall be supported from the channel iron by rod hangers and flat iron hands.

All hanger rods shall have double nuts and beveled washers to allow the hanger rod to swing.

Multiple pipe runs along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

Exposed pipe work shall be supported on channel, angle iron or with U-bolts to form a rigid guide.

All U-bolts, except used as anchors, shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide and allowing the pipe to slide axially,. U- bolts shall be provided on alternate pipe bracket.

Small pipe work running along skirting shall be supported by standard built-in or screw-on type clips.

Pipes shall be individually supported. Pipes shall not hung from other pipes.

Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means-of support for the riser.

Vibration isolators to be provided with the hangers as approved by the Engineer.

### **3.3.3 SOIL, WASTE, VENT & RAIN WATER DRAINAGE PIPES & FITTINGS**

All cast iron soil pipes and fittings shall be installed to the lines and grades shown on the drawings or as directed by the Engineer. When required to be installed above ground floor level, suitable and substantial number of hangers and supports of approved type and make shall be provided. No piping shall be hung from the piping of other systems. Clamps shall be provided on not more than 1.5 meter centres or a minimum of one hanger per each length of pipe whichever is smaller. Where excessive numbers of fittings are installed, additional clamps will be provided.

All steel clamps, hangers and support etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint. All exposed C.I. soil/vent pipes shall be given two coats of synthetic enamel paint. Materials for painting shall be high quality product of well-known manufacturer and will be approved by the Engineer before using. The instructions of the manufacturer regarding all painting work shall strictly be adhered to Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. All vent pipes to be installed in the system shall be provided with approved cowl and will rise at least 0.70 meter above the roof.

Caulked joints for cast iron bell-and-spigot soil pipe shall be firmly packed with oakum or kemp and filled with molten lead not less than 22 mm deep and not to extend more than 3 mm below the rim of the hub. Rubber ring joints shall also be allowed. No paint, varnish, or other coatings shall be permitted on the jointing material unit after the joint has been tested and approved

Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. All vent pipe to the installed in the system shall be provided with approved cowl and will rise at least 0.70 meter above the roof.

Special requirements for uPVC pipes and fittings are as under:

Maximum Interval between Supports (m)  
(Support centers for uPVC pipe work systems) \*

Nominal Diameter, $d_e$	PIPEWORKS	
	Horizontal ( $10 \times d_e$ )	Vertical
(mm)	(m)	(m)
40	0.40	1.2
50	0.50	1.5
80	0.75	2.0
100	1.10	2.0

\* The values shown are for general installations only. Attention is drawn to special requirements that may be needed in more demanding applications.

All steel clamps, hangers, supports etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint.

All exposed uPVC pipes shall be given two coats of approved colour water-based emulsion paint (note that oil based paints must be avoided).

### 3.3.4 PRECAUTIONS

Following points describe how an uPVC must be cared of:

- a. The depth of concrete cover above uPVC pipe depends on the pipe gradient. However, a minimum of 1 (one) inch concrete cover must be provided.
- b. When using cemented joints, the adhesive should be given sufficient opportunity to harden before the pipe is concreted in.
- c. Horizontal lines that are concreted-in should be anchored against upward movement and should be adequately secured while the concrete is being poured.
- d. During the pouring and setting of concrete, necessary care shall be taken to prevent physical damage to the pipes.
- e. When using heated concrete or when steaming the concrete, the sensitivity of uPVC material to temperature changes should be borne in mind.



- f. Concrete mortar that is used before concreting-in shall include no sharp-edged material.
- g. Avoid excessive misalignment of the pipes.
- h. Avoid excessive tightness of joints.
- i. Provide sufficient expansion joints to allow thermal movement or regression.
- j. Use only allowed cleaning & de-scaling techniques for different situations & locations (as described in ISO/TR 7024-1985E) when a pipeline gets choked or blocked.

### 3.3.5 DELIVERY CONDITIONS

The internal and external surfaces of pipes and fittings shall be smooth and free from grooving, blistering and any other surface defect. The materials shall not contain visible impurities or pores. Pipe ends shall be cleanly cut, and the ends of pipes and fittings shall be square with the axis of the pipe

### 3.3.6 MARKINGS

Pipes, fittings and sealing rings shall be marked clearly and indelibly so that legibility is maintained for the life of products under normal conditions of storage, weather and use.

The markings may be integral with the product or on a label. The markings shall not damage the product.

### 3.3.7 PIPES

Pipes shall be marked with at least the following information:

- a. Manufacturer's name or trade mark;
- b. Pipe material;
- c. Nominal diameter of pipe;
- d. Nominal wall thickness of pipe
- e. Manufacturing information, in plain text or in code, providing tractability of the production period to within the year and month and the production site if the manufacturer is producing at several national or international sites.
- f. The number of this International Standard.

Pipes with a nominal laying length up to and including  $z_2$  meters shall be marked with at least once. Pipes with a nominal laying length greater than  $z_2$  meters shall be marked at intervals of  $z_3$  meters at the most. The values of  $z_2$  and  $z_3$  shall be as specified by the authorities in each country.

### 3.3.8 FITTINGS

Fittings shall be marked with at least the following information:

- a) Manufacturer's name or trade mark;
- b) Fitting material (may be given on packing only in the case of PVC, provided this information is not required on each article by national authorities);
- c) Nominal diameter of fitting;
- d) Classification (where applicable)
- e) Values of angles, if any;
- f) Manufacturing information, in plain text or in code, providing tractability of the production period to within the year and month and the production site if the manufacturer is producing at several national or international sites (may be given on packing only, provided this information is not required on each article by national authorities);
- g) The number of this International Standard (may be given on packing only, provided this information is not required on each article by national authorities).

### 3.3.9 SEALING RINGS

Sealing rings shall be marked with at least the following information:

- a. Manufacturer's name or trade mark;
- b. Nominal diameter of ring;
- c. Manufacturing information, in plain text or in code, providing traceability of the production period to within the year and month and the production site if the manufacturer is producing at several national or international sites.

## 3.4 TESTING AND COMMISSIONING

### 3.4.1 POLYPROPYLENE RANDOM PIPES AND PIPE FITTINGS

All water distribution system shall be tested whole or in part to 1 1/2 times the working pressure. The contractor shall pay for all device, materials, supplies, labour and power required for the test. The test will be run for two hours at the specified pressure and there should be no leakage in the system. Defects revealed by the test shall be repaired and the whole test rerun until the system proves to be satisfactory.

After all the pipes and fixtures have been properly laid and tested, they shall be flushed clean with water and then disinfected with water solution of chlorine of at least 50 ppm strength for a contact period of 6 hours. The system will be finally flushed with clean water.

### 3.4.2 G.I COLD AND HOT WATER PIPES

All water distribution system shall be tested whole or in part to 2 times the working pressure with a minimum test pressure of 0.69 MPa (100psi). The contractor shall pay for all device, materials, supplies, labor and power required for the test. The test will be run for two hours at the specified pressure and there should be no leakage in the system. Defects revealed by the test shall be repaired and the whole test rerun until the system proves to be satisfactory.

After all the pipes and fixtures have been properly laid and tested, they shall be flushed clean with water and then disinfected with water solution of chlorine of at least 50 ppm strength for a contact period of 6 hours. The system will be finally flushed with clean water.

### **3.4.3 SOIL, WASTE, VENT & RAIN WATER DRAINAGE PIPES & PIPE FITTINGS**

The entire system of drains, waste, and vent piping inside the building shall be tested by this Contractor under a water test. Every portion of the system shall be tested to a hydrostatic pressure equivalent to at least 3-meter head of water. After filling this Contractor shall shut off water supply and shall allow it to stand two hours, under test during which time there shall be no loss or leakage.

The Contractor shall furnish and pay for all devices, materials, supplies, labor and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

The Contractor shall also be responsible for the repair of this work & other trades work that may be damaged or disturbed by the tests. Defects disclosed by the tests repaired. Work shall be replaced with new work without extra cost to the Employer. Tests shall be repeated as directed, until all work is proven satisfactory.

All fixtures shall be tested for soundness, stability, support and satisfactory operation.

## **PART-4 METHOD OF MEASUREMENT**

### **4.1 PPR COLD & HOT WATER PIPES**

#### **4.1.1 Measurement**

Measurement for acceptably completed works of PPR cold and hot water pipes shall be made in running feet length. including earthworks, pipe fittings, jointing, hangers, clamps and brackets, sleeves, cutting and breaking concrete and then making it good, applying protective painting, coating, cleaning, testing and disinfecting etc. and the measurement will be for the full work specified herein.

### **4.2 G.I COLD & HOT WATER PIPE**

#### **4.2.1 Measurement**

Measurement for acceptably completed works of supply and installation of G.I. cold and hot water pipes shall be in running feet length. No measurement shall be made for pipe fittings, jointing, hangers, clamps, brackets, sleeves, insulation, cutting and breaking concrete and then making it good, applying protective painting, coating, cleaning, testing and disinfecting etc. and the measurement will be for the full work specified herein.

### 4.3 uPVC and C.I. SOIL, WASTE & VENT PIPES

#### 4.3.1 Measurement

Measurement for acceptably completed works of supply and installation of uPVC & C.I. pipes, will be in running feet length and the work to be done shall include all pipe fittings, jointing, hangers, clamps, brackets, sleeves, cutting and breaking concrete and then making it good, applying protective painting, coating, cleaning and testing.

### 4.4 VALVES

#### 4.4.1 Measurement

Measurement of acceptably completed work of gate and check valves will be made on the basis of actual number of valves provided and installed in position as shown on the drawing or as directed by the Engineer.

### 4.5 PLUMBING FIXTURES

#### 4.5.1 Measurement

Measurement for plumbing fixtures will be made as per actual number acceptably installed. The Contractor's bid against these items shall include installation of complete unit as specified herein, inclusive of all work from inlet connection of water supply to outlet connection with the sanitary system, complete as per Contract Documents and/or as directed by the Engineer.

### 4.6 MISCELLANEOUS ITEMS

#### 4.6.1 Measurement

Measurement for acceptably completed works of floor traps & floor drains, roof drains, cleanouts, glass mirror, towel rail, toilet paper holder, soap trays, mirror trays, water coolers, electric water heaters, gully trap, grease interceptor, hot water boilers etc. shall be made on the basis of actual number acceptably installed in position. The Contractor's bid against these items shall include installation complete as specified herein and/or as shown on the Drawings.

## PART-5 BASIS OF PAYMENT

### 5.1 PPR COLD & HOT WATER PIPES

#### 5.1.1 Payment

Payment for acceptably measured quantity of works will be made at the unit rate per running feet length of PPR cold and hot water pipes as quoted in the Bill of Quantities. and shall constitute full compensation for all the works related to the item.

### 5.2 G.I COLD & HOT WATER PIPE

#### 5.2.1 PAYMENT

Payment for acceptable measured quantity will be made at the unit rate per running feet length of G.I. cold and hot water pipes quoted in the Bill of Quantities. The amount bid shall be the full payment for completion of the work in all respects as specified herein.

### 5.3 uPVC and C.I. SOIL, WASTE & VENT PIPES

#### 5.3.1 Payment

Payment will be made at the unit rate of bid per running feet length of pipe acceptably supplied and installed. The amount bid shall be full payment for the work specified herein.

### 5.4 VALVES

#### 5.4.1 Payment

Payment will be made for acceptable measured quantity of gate, check, air relief valves on the basis of unit rate per number quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

### 5.5 PLUMBING FIXTURES

#### 5.5.1 Payment

Payment for plumbing fixtures shall be made at the applicable unit price per number bid for the respective item in the Bill of Quantities. The amount bid shall be full payment for the work specified herein.

### 5.6 MISCELLANEOUS ITEMS

#### 5.6.1 Payment

Payment for acceptably measured quantity of floor traps & floor drains, roof drains, cleanouts, glass mirror, towel rail, toilet paper holder, soap trays, mirror trays, water coolers, electric water heaters,

gully trap, grease interceptor, hot water boiler etc. shall be made at the applicable unit rate per number quoted in the Bill of Quantities. The bid amount shall be full payment for the works specified herein and as shown on the Drawing.

## ELECTRICAL WORKS

### 1. SCOPE OF WORK:

The Electrical Contractor shall supply all labour, materials and equipment necessary for the complete installation, testing and commissioning of the entire electrical works which shall broadly include but not limited to the following as per specifications, drawings and bill of quantities.

- a. LV Main/Sub-main distribution boards, MCB DB's disconnect switches/circuit breakers, motor starters etc.
- b. LV Main/Sub-main cables
- c. Wiring for light, fan and socket outlets
- d. Wiring accessories. (Switches, sockets, computer, telephone outlets etc.)
- e. Earthing system.
- f. Lighting fixtures. (Normal + Emergency)
- g. Uninterrupted Power Supply System
- h. Fire Alarm System.
- i. Closed Circuit TV System
- j. Telephone and Data (Structured Cabling) System
- k. Public Address System
- l. Access Control System
- m. Community Access Television System

**2. GENERAL:**

The entire electrical installation shall be carried out by an approved licensed Electrical Contractor authorized to undertake such works.

All works are to comply with the latest Edition of the IEE Regulations for Electrical Installations UK, the Electricity Act 1910, the Electricity Rules 1937, EIA/TIA and in accordance with the requirements of the local inspector, the utility supply authorities (K.E.S.C. / WAPDA / Pakistan Telecommunication Corporation), Contract Drawings / specifications, BOQ and to the satisfaction of the Consultant/Owner.

**3. APPROVAL FROM ELECTRICAL INSPECTOR:**

The Contractor shall be responsible for completing all formalities such as serving notices, submitting drawings / documents and obtaining all permits, sanctions, connections and having the installation passed and commissioned by the relevant authorities and obtain an approval certificate from the concerned Electrical Inspector's Office for the total load of the premises including the load of HVAC machines elevators, pumps, etc. All costs involved in obtaining such permits, sanctions, approvals from the concerned authorities are deemed to be included in the contract price and no extra payment shall be made to the Contractor.

**4. STANDARDS:**

All materials and equipment such as distribution boards, cables/wires, conduits, conduit accessories, wiring accessories (switches, sockets, dimmers etc.), Circuit breakers, switch boxes lighting fixtures, lamps etc. are to comply with the specifications, the relevant British Standards, Pakistan Standards Institute and underwriters laboratories requirements or equivalent IEC, DIN Standards & NEC Standard. In general, following standards & codes of practices shall be followed.

All works, equipment and materials shall conform to:

On the one hand:

The specification recommended practices, official standards and codes the non - restrictive List of which is given below.

International Electro-technical Commission (IEC)

British Standards (BS) [BS 6346 | BS 7671 Latest Edition | BS 5839]

NFPA / National Electric Code (NEC)

National Standards [Electricity ACT 1910 | Electricity Rules 1937]

EIA / TIA

In the event of conflict between standards, the most stringent shall prevail.



Whenever the electrical equipment to be installed, does not hold national standards, the Contractor shall take into account the specific standards chosen by the Owner and make sure that the equipment he has to install, meets these standards.

In addition, even if no mention is stipulated in this specification, it is implied that the equipment be tropicalized, if required, by the conditions of the site of installation.

In any case, the standards and codes to be taken into consideration are those in force at the date of delivery. Samples of all materials / equipment are to be submitted to the Project Manager/ Owner for approval before purchase or fabrication / installation.

## 5. SHOP DRAWINGS:

The locations, routings, and installation heights of electrical equipment, conduits cable trays etc. given on the design drawings are approximate. Based on site conditions and in coordination with civil and mechanical drawings the contractor shall prepare shop drawings showing proposed routes of conduits and positions of equipment, including mounting and fixing details and submit the same to Owner/ Construction Manager for approval. 3 sets of drawings (hard & soft copy) and technical literature/ brochures for all the electrical equipment / systems are to be submitted in advance of the execution of the works and approval obtained before execution / installation of works.

## 6. DRAWINGS OF LV SWITCHGEAR/DISTRIBUTION BOARDS

The Contractor is required to submit the preliminary drawings of Main Distribution Board, and associated Distribution / Computer Distribution Panels from one of the approved manufacturer, to the Project Manager/ Owner for approval. These drawings will be issued for construction after getting written approval from them.

## 7. CLIMATIC CONDITIONS:

Equipment and materials supplied shall withstand under all conditions of continuous operation and without developing any defects, the following environmental conditions.

Maximum temperature	:	45 deg. C
Minimum temperature	:	00 deg. C
Relative humidity	:	80 %
Altitude	:	186 m

**7a. EQUIPMENT PROTECTION:**

Unless otherwise stated all equipment supplied shall conform as a minimum to the following protection classes:

Indoor I.P. 23

Outdoor I.P. 54 or 65 as applicable

Certification from manufacturer is required / to be submitted.

**8. FACTORY INSPECTION OF LV SWITCHGEAR/ PANELS**

A visit of the Electrical Consultant / Construction Manager shall be arranged, for the Inspection/ testing of LV Switchgear. Distribution / Computer distribution boards, etc. at the Manufacturer's premises before delivery the items to site. The Consultant will have the right to object/ reject any substandard material/ panel found to be unsuitable or not in accordance with the specifications. The Contractor will be required to replace the substandard material and rectify the defect / objection by the Consultant at his own cost.

**8a. TESTING AND COMMISSIONING:**

During execution and on completion of the works, (as required by Owner / Project Manager / Consultant the following tests shall be performed and a satisfactory performance certificate in respect of each test shall be submitted with the final bill. All equipment / instruments for the tests are to be provided by the Contractor at no extra cost. All tests shall be performed in the presence of Consultant / Owner or its representative Engineer.

- a) Earth Resistance test and earth loop impedance test.
- b) Insulation resistance / Megger test of the entire electrical installation, between phases, phase to earth and phase to neutral.
- c) Polarity tests on switches, MCB's, fuses, etc.
- d) Operation tests and commissioning of the entire electrical installation including all equipment.
- e) Illumination (Lux) level measurement of each area.
- f) Fluke Test for I.T Systems.

Certificates of Test shall be compiled, for each section of the installation. A master set of these documents shall be kept as the original of the Test Dossier. This dossier will bear the signature of Owner witnessing the tests.

**9. AS-BUILT DRAWINGS:**

On completion of the works the contractor shall supply one reproducible and one hard copy of as-built drawings along with the soft copy of the drawings in AutoCAD format on non-erasable media. The drawings

should clearly indicate all amendments, junction boxes, pull boxes, etc. These shall be provided at no extra cost. The as-built drawings shall indicate the entire electrical installation as actually carried out on site including telephone, fire alarm, sound system, computer system, electrical wiring, LV switchgear panels, distribution panels, & electrical works of building etc and schematic diagrams.

#### **10. OPERATION AND MAINTENANCE MANUALS:**

The contractor shall submit 2 sets of manuals & wall mounted charts for all the electrical equipment supplied and installed by him which shall include detailed operation and maintenance instructions for each item as recommended by the manufacturer. These manuals shall be submitted on completion of the works.

#### **11. ASSOCIATED CIVIL WORKS:**

The cost of any civil works, (cutting, chiselling, excavation, backfilling, grouting, drilling etc. and making good) associated with any item of the electrical works shall be included in the quoted price for the item. The Contractor shall be responsible for carrying out these civil works and making good and the cost shall be deemed to be included in the quoted price.

Care shall be taken so as not to damage the structure during execution of his work. If so done, the contractor shall be responsible for necessary repairs and make good all losses at his own cost.

#### **12. CONDUIT AND CONDUIT ACCESSORIES:**

Wiring shall generally be in PVC conduit for electrical use minimum 20mm diameter, minimum wall thickness 1.25mm, concealed in structural slab, wall or screed with at least 50mm cover or clipped to the surfaces with PVC saddles, as required. All conduit accessories shall be of the same quality as the conduit. Saddles for fixing conduit on surface shall be provided at maximum 1000 mm spacing.

No conduit shall be laid in the light-weight concrete over the sunken slabs of bathrooms/ toilets.

Manufactured smooth bends shall be used where conduits change directions. Sharp 90 degrees bends and tees shall not be allowed. Round PVC junction boxes for ceiling points shall have adequate capacity for wires and connectors.

The drawings are schematic and do not generally indicate pull boxes, however, these shall be installed in conduit runs to limit the pulling lengths as required.

Where indicated heavy gauge (1.6mm minimum wall thickness) steel conduit, minimum 20mm dia. with appropriate accessories shall be used for wiring. These shall be protected with two coats of red oxide anti-corrosion primer and two coats of black enamel inside and outside. All conduit accessories shall also be treated as above.

Where indicated hot-dip galvanized steel conduit minimum 20mm dia. shall be used for wiring. All accessories shall also be galvanized.

Final connection to motors and other equipment shall be in flexible steel conduit encased in weather-proof plastic.

### **13. OUTLET BOXES PULL BOXES ETC.**

The outlet boxes for installing switches, sockets, dimmers, etc. shall be of 16 SWG sheet steel de-rusted, degreased, rust-proofed and powder coated. These boxes shall be of suitable dimensions to receive the conduits and the accessories and have ample wiring space. A suitable brass earth terminal shall be provided for connecting the earth continuity conductor in the outlet box. Pull boxes shall generally be of the same specifications as the outlet boxes. All boxes shall have adequate number of knock-outs and have a minimum depth of 50mm.

### **14. SWITCHES, SOCKETS, CEILING ROSES ETC.**

These shall be of white moulded plastic suitable for flush mounting in sheet steel outlet boxes. Lighting switches shall be single pole rated for 10 Amps, 250 volts AC. The switches shall operate with snap action. 3-Pin switch socket outlets shall be rated for 15 amps, 250 volts AC. Ceiling roses shall be suitable for 5 amps. 250 volts AC and shall have white plastic moulded base plate with copper terminals. The cover of the ceiling rose shall have a suitable cable inlet hole. All other outlets (Computer, telephone etc.) shall have face plates that match the design of the face plates of switches and sockets. All external switches, sockets and accessories shall be of heavy duty, cast construction, weatherproof type. 5 Amps socket outlets shall be of 3-pin type with integral switch. Power outlets for computers shall be 13A, 250V switch socket 3-Pin with flat terminals. 16A, 2-Pin + Earth Schuko socket outlets to DIN standards shall be provided as indicated on the drawings.

All outdoor switches and sockets shall be of the weather proof type.

### **15. LV CABLES AND WIRES**

In general LV cables and wires shall be with stranded copper conductors PVC insulated, PVC sheathed/unsheathed, single/multi-core, armoured/un-armoured. For lighting and socket outlet circuits they shall be 450/750 volts grade to BS 6004.

All power cables for main, sub-main feeders and power equipment etc. shall be of 600/1000 volts grade to BS-6346 Phase, neutral and grounding conductors shall be color coded red/yellow/blue, black and green. Each circuit shall have its own neutral and grounding conductor. The looping-in system shall be used throughout the installation. Any joint in wires shall not be permitted.

Final connection to lighting fixtures from ceiling rose/outlet box shall be made with 3-core 1.0 sq.mm PVC/PVC cable in flexible PVC conduit. Copper lugs shall be used for termination of cables. All multi-core cables shall be provided with glands of suitable size at entry to the panels.

Power cables shall be clipped to the surface by means of heavy duty spacer saddles and clamps. The saddles and clamps shall be made of cast-iron or steel. Alternatively power cables shall be installed on cable trays or in cable trunking including all installation materials and fixing accessories as specified. All installation materials and fixing accessories such as glands, lugs, saddles, clamps, brackets etc. shall be provided without any additional cost.

Cables installed in under floor trenches shall be laid in single tier when laid on the bed of the trench. Cables may also be clamped on the walls of the trench by means of heavy duty spacer saddles and clamps of insulated material or fixed on brackets grouted into the side of the trench at a maximum of 600mm intervals. The centre to centre distance between cables shall be equal to twice the diameter of the cable. Cable terminations and joints shall be as per manufacturer's recommendations. Conductor connections and terminations shall be made with compression ferrules and lugs. Cable entry into panels shall be made with brass cable glands. Cable terminal lugs/ wire pins shall be of the mechanical compression type, soldered type lugs shall not be used.

The routing and general arrangement of all cables i.e. power, instrumentation, voice and data should be planned concurrently with main pipe racks and wheel access ways etc. to provide unimpeded direct routes wherever possible. Power cable shall be segregated from instrumentation, voice and data cables to eliminate any possibility of electrical interference with voice, data/ control circuitry.

Cable shall be run in continuous unbroken lengths and joints will not be permitted. Unless the route length exceeds the maximum manufactured drum length, or there is specific authorization for jointing of the cable by consultant/construction manager/ owner.

Each cable shall be subjected to an insulation resistance and continuity test after installation and prior to final dressing in to position and termination. Results shall be recorded and approved by consultant/ construction manager/ owner.

All cables including lighting and small power sub-circuits shall be identified and tagged at each end adjacent to their termination point with approved markers on carrier strip. In addition, all underground cables shall be fitted with non-corrodible identification bands at all points where they enter or leave the area, cable ducts, trench ducts or similar. Lighting and power sub-circuits cable shall be identified at each luminaries/ socket outlet.

Underground cables shall be laid in trenches 1000mm deep, Cables shall be laid at the bottom on a 150mm layer of sand. The cables shall then be covered by another 150mm layer of sand. Concrete tiles shall cover the entire length and width of the cable trench on top of the sand layer, caution tape is placed on the top of concrete tiles. The trench shall then be filled with earth. Concrete cable route markers shall be provided at every 20 meter interval and at change of direction.

All jointing and termination work shall be carried out by practicing, fully trained tradesmen, qualified in such a work for the operating voltage concerned.

Brass glands shall be used which are of the thread fixing, hexagon bodied displacement seal type or equal. They shall be compatible with associated cable and maintain the degree of protection of the equipment enclosure. All glands shall be fitted with PVC or PVC shrouds.

The entire body of the cable must enter the gland. The cable shall be on a straight axis from a point at least six diameter before entering the gland. Seals shall be checked for correct size at the point of application.

Care shall be taken to ensure that creepage and clearance distances are maintained e.g. no washers or loose stands.

In addition to cable identification cable cores shall be positively identified at every terminal point, in accordance with the drawings.

Ferrules used for identification shall be of the interlocking permanently engraved type, designed to encircle the core completely. Markers of the adhesive type will not be permitted. Ferrules shall be correctly sized. There shall be no improvisation and engravings must not be altered.

## 16. TELEPHONE SYSTEM

Telephone cables shall be based on VOIP i.e. through structured cabling system. It shall be covered under this contract. However under this contract outlet boxes, conduit / trunking etc. with pull wires and main Tel. Cable shall be executed.

The outlet back boxes shall be of appropriate size. The minimum size of conduit used for the telephone system shall be 25mm in diameter.

Telephone junction boxes shall be fabricated from 16 gauge sheet steel, de-rusted, de-greased, primed with zinc chromate and painted with two coats of enamel with hinged covers. IDC 110 tag blocks will be used on both sides with ample space for wiring shall be installed. Outdoor Telephone junction boxes and Main Distribution Frame shall be floor mounted in sheet steel cabinets to IP-54 grade of protection on a concrete base (where required).

**17. EARTHING:**

The earthing system shall comprise of copper earthing plates or rod as specified, of 600 x 600 x 5 (mm) buried at a depth of 25 feet or as per site requirement as advised by Project Manager, from ground level in a 250 Kg mixture of salt and charcoal. This work includes excavation, perfect back filling and all necessary materials as per drawing and as per standard practice according to the satisfaction of Consultant. Two earthing leads of PVC insulated copper wires of specified size in PVC conduit shall be used to connect the earth plate(s) to the equipment. Piping for watering of earth plates shall be provided. The earth resistance test shall be performed as per the Electrical Inspectors requirements. Earth resistance shall not exceed one ohm for each earthpit. If the required earth resistance is not achieved, additional earthing set shall be provided and connected in parallel until the specified resistance is achieved (without any extra cost).

Concrete Inspection Chamber(s), heavy duty C.I. covers, fixing clamps all accessories etc. are deemed to be included in the Electrical Contract.

**18. LIGHTING FIXTURES AND FANS:**

The lighting fixtures shall be as specified in the lighting fixtures schedule. The determination of quality is based on construction material, shape, finish, operation etc. The Contractor shall submit sample of each lighting fixture specified for the approval of the architect / consultant / owner.

**18.1 Fluorescent Lighting Fixtures**

The Fluorescent Lighting fixtures shall be complete with lamps. The ballast shall be low loss Electronic type, totally enclosed and suitable to operate on 230 V. A wiring diagram, wattage, voltage and current ratings shall be printed on the body of the ballast.

The starter shall be glow type with radio interference suppressor/by-pass capacitor. All lighting fixtures shall be provided with power factor improvement capacitors to give power factor of 0.90. The internal wiring of the fixture shall be done with heat resistant wires and provided with a suitable connector. The body of the fixtures shall be minimum 22 SWG sheet steel, de-rusted, degreased, finished in heat resistant paint, stove enamelled or alternatively powder coated. Appropriate size bushed wire entry holes, fixing holes and earth terminal shall be provided. The design of recess mounting light fixtures shall be co-ordinated with the design of the false ceiling. The installation method/detail of recess mounting fixtures shall be submitted to the architect / consultant for approval. Recess mounting fixtures shall be supported by hangers from the slab above to prevent the weight of the fixtures from being transmitted to the false ceiling. For fixing surface mounted fixtures, nylon plugs and galvanized steel bolts or screws shall be used. The pendant type fixtures shall be hung by two 20mm dia. 16 SWG white enamelled tubes having swivel joint type hanger at the top for fixing directly on to the recessed outlet or on the ceiling.

## 18.2 LED Light Fixtures

### **a) Housing**

The fixture shall have a die cast/ Extruded aluminum housing providing adequate rigidity, strength and heat dissipation.

The housing shall have integrated driver and LED compartments (as applicable) for better heat dissipation and both LED module & driver compartment must separate for convenience in maintenance at the site and to avoid Driver and LED Compartments thermal effect to each other.

The optical LED component shall have thermally hardened glass cover and high quality silicon gaskets. The glass shall be extra white for maximum light transmission. The glass cover shall be lightly secured with the housing.

The housing shall feature highly reflective components and films to increase light output.

Below mentioned test reports shall be submitted by the manufacturer.

Corrosion tests in artificial atmospheres (Salt Spray tests)

### **b) Optics**

The light output ratio (LOR) shall not be less than 85%.

The luminaries shall offer a composite system efficacy of minimum 110 lumen/watt.

Ensure maximum spread of light by using any efficient technique, shall carry defined inner and outer profile for high efficiency LED to ensure maximum spacing between the road lighting poles and coverage of wider roads (according to center/ pole distance in meter and pole height).

The multilayer optics design will be preferred for adequate luminance and luminance uniformity in the unlikely event of an individual LED failure.

The optical (lens/ glass) system shall feature long life with no discoloration, highest possible light transmission and white painted circuit board for high reflectivity for maximum light output.

Diffuser (plastic/acrylic) should not pale within warranty time.

### **c) Surge Protection**

The lighting fixture shall have external surge protection to protect the electronic driver ; minimum surge protection shall be 10KV

### **d) IP Protection / Impact Resistance**

The led compartment of luminaire shall have ingress protection class IP23 (indoor) and IP66 (outdoor) for long reliable performance and minimal maintenance requirements, and impact resistance of IK08 or



above. No chemical glue shall be used as that may cause breakdown of water proof, dust proof and corrosion proof.

Below mentioned test reports shall be submitted by the manufacturer;

EN 60529(IP)

EN 50102(IK)

IEC 60068-2-68 ed 1.0 Environmental Testing Part 2; Tests –Test L: Dust And Sand

**e) Maintenance**

LED and drivers must be in separate compartments, with easy access to drivers for maintenance & services. Access to drivers must not compromise the IP 66 ratings and shall be easy to open with tool less or simple locking mechanism.

Gaskets are to be properly secured in special grooves made for the same and must not be fixed to the body by any adhesive material.

The components like LED drivers, terminal blocks etc. must be easily detached by using plug and play connectors/terminals also to ensure ease of replacement at site and to be secured the body of fixture making special mounting arrangements so that the same or not dislodged from their designated position.

**f) Mounting**

Supporting mounting suitable as per application & design, Nuts and bolts should be rust proof, Grippers should be robust and rust proof.

**g) Future Compatibility**

The fixture shall be fully compatible with future LED upgrades and/or drivers at site conveniently with minimum effort.

LED component shall have an easy access for opening the glass cover and shall be separate from the control gear compartment.

The LED Light manufacturing company / Assembler / vendor should have local technical backup support facility with necessary machines, tools and measuring/testing instruments.

Vendor must have basic testing facility, housed in local production unit, mandatory for production and batch testing or collaboration with local facility. Vendor shall, at a minimum, have the facility to carry out illumination level testing of the facility, to be carried out after installation of light fixtures, and map the resulting levels on AutoCad (2010) drawings for submission with as-built drawings of the facility by the main Contractor

Contract shall comply with Engineer In-charge/ Management of procuring agency's request for visiting the facility of manufacturer/ assembler/ supplier claiming for local backup support for future up gradation and resolving warrantees issues

#### **h) LED Driver / Electronic Control Gear**

100 V to 270 V AC with 50 Hz (+ or – 10 % tolerance) Power Factor more than 0.9 Driver Efficiency 85 % or more. The LED driver may have energy saving, dimming options as per the project requirement (optional) so that the luminaire can be operated at various reduced wattages as per traffic conditions to have an energy efficient use.

The LED driver shall confirm to following latest standards and codes;

EN 61347-1 LED control gear general and safety requirements.

EN 61347-2-13: particular requirements for DC or AC supplied electronic control gear for LED modules.

EN 62384: DC or AC supplied electronic control gear for LED modules performance requirements.

#### **i) LED Chip**

100 V to 270 V AC with 50 hz (+ or – 10 % tolerance) Power Factor more than 0.9 Driver Efficiency 85 equivalent (duly typed tested as specified and in full conformance to the technical requirements/ specifications)

The LED shall;

- Be designed for lumen maintenance of L70 or 70% at the end of useful life at ambient temperature of 35 °C.
- Have a useful life of 40,000 burning hours.
- Have a minimum color rendering index of 70 +10/-10 and a color temperature range from 3000K-6500K as per the requirement.
- The LED shall confirm to following latest standards and codes detailed report.
- LM 79 for LED chips being used.
- LM 82-12-Approved method of measuring LPW@50°C.
- IEC 62471 (Photo biological safety test for the LED chips being used)

#### **j) Thermal Management**

There should be proper contact between the body heat sink and LED chip ensuring proper thermal dissipation mechanism for heat generated by LED lights. PCBs for LED should be metal contact with body sink should be highly efficient thermal conductance material.

**k) Photometric**

Light distribution should be symmetric. Product must have photometric data file (IES, IES; EULUMDAT or TM-14) file for simulation on Dialux, Relux or any other lighting design renowned illumination simulation software.

**l) Applicable Standards & Codes**

Verifiable detail test reports and certificates with model number and pictures of product are required. In case of equaling, supported documents must be provided.

- IEC/EN 60598-1
- IEC/EN 650598-2-3 ( For Road Lighting)
- IEC/EN 650598-2-5 ( For Flood Lighting)
- IEC/EN 62471 (Photo biological safety test for the complete fixtures being offered as well as for the LED chips).
- EN 55015:2006 and 2007 Limits and methods of measurement of radio disturbance characteristics of electrical lighting.
- EN 61547 1995/ +A1:2000 Equipment for the general lighting purpose EMC immunity requirements.
- EN 61000-3-2:2006 Limitations of harmonic current emission.
- EN 61000-3-3:2008 Limitation of voltage fluctuation and maker.
- EN 62493 Assessment of lighting Equipment related to human exposure to electromagnetic field (Environmental Friendly).

**m) Independent Laboratories**

The luminarie should confirm to the above standards & codes. If required, the supplier shall submit detailed type test reports from certified international testing agency /laboratory with complete report that includes model number and picture.

Cross verification should be possible, for the specified requirement of type test and type test report by an independent authority/ independent laboratory (specific to their status/ approval for performance of specific tests) on the luminaire as defined in project.

The following associated laboratories shall be considered as independent laboratories;

- Any Laboratory accredited by EA (European Co- operation for Accreditation)
- Any Laboratory accredited by ILAC( International Laboratory Accreditation Co-operation)
- Any Laboratory accredited by IAF( International Accreditation Forum).
- Any Laboratory accredited by STL(Short Circuit Testing Liaison)

**18.3 Ceiling Fans**

Ceiling fans shall be of capacitor type of sizes as indicated in BOQ. They shall be complete with appropriate sized down rod, canopies, mounting brackets dimmer/regulator, blades etc.

## 18.4 Exhaust Fans/Wall Fans

Exhaust fans shall be wall/window mounting type as required of sizes as indicated in the BOQ, complete with louvers, shutters, and all fixing accessories.

Wall Fans shall be bracket mounting type of sizes as indicated in the BOQ complete with all mounting accessories.

## 19. L.V. SWITCHGEAR

Main, Sub-main Distribution Boards and MCB DBs shall be of the totally enclosed type, dust proof, damp proof and be suitable for floor/surface/flush mounting, and comply with IEC 157, IEC 158, IEC 439, BS 4752.

They shall be suitable for 400/230 volts 3 phase, 4 wires, 50 Hz system and shall have all components rated for insulation class 600 volts minimum.

All main, sub-main and MCB distribution boards shall be factory assembled. Main and Sub-main distribution boards shall be fabricated with 14SWG and MCB DBs with 16 SWG sheet steel, de-rusted, degreased, rust proofed with two base coats of anti-corrosive paint and painted with two coats of heavy enamel paint in approved color or powder coated. Indoor distribution boards shall have enclosures of IP-40 grade. All distribution boards shall be complete with adequately rated electrolytic tinned copper phase, neutral and earth bus bars and be complete with incoming and outgoing cable terminations arrangement, terminal block/line up terminals and shall be suitable for flush mounting of all instruments. The cabling inside the panels shall be suitably numbered and harnessed by means of straps or cords. Cable entries shall be through removable gland plates.

All components shall be installed on mounting brackets inside the enclosure and protected from the front with screwed sheet steel safety plate. The enclosure shall be provided with rubber gasketing and a lockable hinged door with cam fastener. All distribution boards shall be front access type.

The front side of the distribution boards shall be provided with a name plate designating the board. The inside of the door shall have a chart clearly indicating the circuits with their designations. The door is to be grounded by flexible copper cable. This also applies to the common and front plate.

Miniature circuit breakers (MCB's) and moulded case circuit breakers (MCCBs) shall be of the moulded pattern and their switching levers shall be such that they are accessible through the safety plate for operation. The short circuit rating of the circuit breakers shall be as indicated on the drawing. They shall comply to IEC Standards 947-2 and 898.

Load Break Switches and Contactors shall be of AC3 type for motor loads.

Outdoor feeder pillar shall be housed in weather proof sheet steel cabinets to IP54 or IP65 as applicable, grade fabricated with 14 SWG sheet steel, de-rusted, degreased, rust-proofed with two coats of anticorrosive paint or powder coated. They shall be floor mounted on concrete bases of required dimensions.

The minimum clearances of the equipment shall be in accordance with the manufacturer's recommendations but not less than the following criteria.

Vertical, from highest equipment to bottom of roof beam: 500mm

Operation side of 400V switch gear: 1500mm

Operation side of distribution panels: 1500 mm

All distribution boards and isolators shall be identified with circuit designations and source of incoming supply. Lighting switches shall also be identified.

Labels for indoor or weather protected areas shall be white-black (or red wire), laminated plastic with lettering engraved to show the middle layer. Identification and instructions shall be in black lettering. Warning or danger shall be in red.

### 19.1. Circuit Identification

In addition to cable identification, cable cores shall be positively identified at every terminal point, in accordance with the drawings.

The cores of non-flexible cable shall be identified in accordance with the "IEE Wiring Regulations" with the addition of polarity markings for D.C. circuits.

Ferrules used for identification shall be of interlocking permanently engraved type, designed to encircle the core completely. Markers of the adhesive type will not be permitted. Ferrules shall be correctly sized. There shall be no improvisation and engravings must not be altered. Core markings shall be strictly in accordance with the drawings.

## 20. CABLE TRUNKING

Cable trunking shall be fabricated from sheet steel having a minimum thickness of 1.6mm and having a galvanized finish, and shall include all covers, accessories, supports, etc.

The trunking shall be of such a design that the lid is secured by mushroom headed screws having threads.

Copper links shall be provided on all the trunking interconnection to ensure that the electrical continuity is maintained throughout the trunking runs.

These copper links are to be fitted on the exterior of the trunking where they are readily visible at all times.

The inside surfaces of all trunking and trunking accessories should be smooth and free from burrs and other defects.

Slotted entries into distribution boards shall be suitably bushed by means of a non-ferrous insulating material securely fixed between the trunking at the distribution boards

Cable retaining clips shall be installed at not greater than 900mm centres within the trunking to prevent damage to cables when the covers are replaced. Cables within the trunking shall be taped together in groups to denote circuits common to individual pieces of equipment.

The segregation of compartments in trunking shall be maintained at all cross over positions and metal separators shall be fixed to keep the wiring in each compartment completely isolated from the remainder.

The cable capacity of the trunking is to be strictly in accordance with the current edition of the I.E.E.E regulations and the stipulated spare space shall be left in all cable trunking.

When trunking passes through a floor, wall, partition or ceiling which constitutes a fire barrier all orifices are to be effectively sealed to restrict the spread of fire.

Generally trunking is to be fixed at not more than 1.8m centre with additional fixing at not more than 150mm on either side of any fitting such as bends and tees. The trunking shall be suspended from structure with steel hangers or supported on walls by angle iron brackets.

## 21. CABLE TRAY

The Contractor shall supply and install all cable trays with covers, accessories, supports and fixing. Cable trays shall have a minimum thickness of 1.6mm up to 450mm width and 2.0mm thick over 450mm width and shall be heavy duty of the perforated pattern and made from galvanized sheet steel. All cables in any one layer are to be run in flat formation on the cable tray. Cable saddles for securing the cables shall be confined to within the width of the tray and all cable saddle fixing shall be accessible from the front of the cable tray. Cable trays shall have return flange edges.

All cable trays shall be spaced a minimum of distance of 20mm from any surface upon which they are run. All purpose made saddles supporting the cable tray must be supplied by the Contractor and must be painted with one coat of red oxide before erection.

All cable trays shall be fixed at intervals of not more than 1.2m for runs in both horizontal and vertical planes. The Contractor is to ensure that no sagging of the tray occurs. If this is apparent additional supports must be inserted to prevent the cable tray from sagging and to present a neat and workmanlike appearance.

Horizontal runs are to be hung from the ceiling with GI rods and supported on GI channels of appropriate sizes.

Cable trenches and cable trays/ ladder racks/ pipes shall be designed to allow for 25% spare space capacity for future installation.

## **22. UNDER FLOOR BOXES**

The under floor pull boxes for power, data and telephone cables shall be of galvanized sheet steel construction (minimum 16 SWG thickness). The boxes shall be installed in floor screed. The height of the boxes shall be between 65mm to 70mm or as required. Suitable arrangement of knock outs for conduit and trunking entry into the boxes is to be provided.

Metal adaptors forming barriers / crossovers / tees, etc. shall be provided within the boxes as required for segregation of power cables from data and telephone cables.

The cover together with the frame is to incorporate vertical adjustment. The cover is to be of minimum 14 SWG thick galvanized sheet steel.

Alternatively the frame and the cover may be of sheet steel de-rusted, de-greased, rust proofed and powder coated with the box in the screed remaining of galvanized sheet steel construction. The boxes shall include a brass earth terminal.

## **23. CCTV SYSTEM**

All the equipment of CCTV System shall be UL LISTED. The Contractor shall furnish with the tender bid, complete details of equipment, materials. All products shall be made by one manufacturer and shall be supplied by the authorized sole agent of the manufacturer.

The CCTV system shall consist of COLOR CAMERAS and COLOR P.C. MONITOR, DVR, wall bracket assembly, Power Supply & required cabling, etc.

All allied and small works and materials, even if not specifically mentioned in the specifications, but required for completion of the job shall be deemed to have been included in the contract sum.

## 24. FIRE ALARM SYSTEM (ADDRESSABLE)

All the equipment shall be as per British Standards based and designed on BS 5839 Part I. The Contractor shall furnish with the tender bid, complete details of equipment, materials etc. All products shall be made by one manufacturer and shall be supplied by the authorized sole agent of the manufacturer.

The Fire Alarm System shall be of addressable type and consist of Addressable Manual Call Points, Addressable Photoelectric Smoke Detectors, Addressable Heat Detector, Bells / Sounders with strobe, Addressable Fire Alarm Control Panel. The Fire Alarm Control Panel shall be compatible with any existing Fire Alarm Panel of either the building / facility and be capable with integrating with the existing panel.

### 24.1 Fire Alarm Control Panel (FACP)

The Fire Alarm Control panel (FACP) shall be 16 bit microprocessor and have the ability to indicate the exact location of the fire to enable fast response to any fire calls. It shall have flash ROM to provide comprehensive zoning facilities and fully programmable user display using relevant software. Internal facilities shall include:

- a. A 3 Amp charger and two rechargeable 7 A hr batteries or as per battery sizing calculations
- b. The principal function of the system shall be surveillance for up to 200 field sensors on 8 Zone Modular design.
- c. 80 Character LCD status display.
- d. Operator commands and system interrogation via keypad,
- e. Digital Signalling detectors with parity error detection.
- f. PC Programmable according to site specific requirement.
- g. A watchdog facility to test microprocessor integrity.
- h. Additional protection circuitry for immunity to transients and EMI.
- i. A 2-Zone Programmable Sounder Module and 2-Zone Relay Module.
- j. The control panel shall be Ethernet connectivity thru RS232 port.
- k. Mains supply shall be 230 VAC 50Hz.
- l. The system shall operate on 24V DC.



- m. The FACP shall utilize the Smoke Detectors, Heat Detectors, Manual Call Points, Sounders, Relay and their communication shall be by means of pulse position modulation from the control unit.
- n. The protocol shall enable other devices such as line powered sounders, beacons and other input/output devices to be added to the line.
- o. A maximum of 63 devices may be connected to each loop.
- p. The control panel shall include an integral buzzer.
- q. The enclosure shall be fabricated from 14 SWG mild steel sheet, anti-rust treated and shall be finished in two toned grey to approval.
- r. The door shall be hinged on the left hand side and have a window to house the Perspex facia which shall accommodate the display and control.
- s. Access to interiors shall be via a key operated lock situated on the front..
- t. Modules for auto shutdown of HVAC & other equipment.
- u. Interfacing with other systems like Emergency Evacuation System.

The front panel shall include following controls and display:

- Fire, Pre-Alarm and Fault Indictors.
- Programmable LCD Status display with full menu reporting options.
- Sounder Mute, System Reset, Buzzer Mute, Lamp Test and Evacuate push button controls.
- Status Indicators for Isolate, Test, Sounder Fault, Output Fault, Software Fault, Power Fail and Supply Healthy.

## 24.2 Manual Call Point

Manual Call Point shall be of rugged ABS plastic construction designed for recess, semi-recess or surface mounting on a standard socket outlet box. The break glass design shall be with a frangible element. The frangible element shall consist of a glass blank with a thin plastic film laminated to its surface, avoiding injury to the thumb and confining the glass pieces within the call point, when operated. A single key shall be used for opening, testing and resetting of call point. A20% spare quantity of glass pieces are to be provided at no extra cost.

## 24.3 Sounder with strobe

The electronic sounder shall provide high efficiency tones and high outputs. It shall be set to provide up to 5 different tones. It shall be designed to operate on very low current rating and shall operate continuously for 02 hours. Operating voltage shall be 9 – 28 Volt. It shall be made of ABS Plastic case in Red or While Color. It shall be small and compact in design and weight. The output shall be 100 dB at 1 meter.

#### 24.4 Smoke Detector

Smoke Detector shall be housed in off white self-extinguishing Plastic. It shall have Red LED which flashes periodically in the Quiescent mode and flashes continuously in Fire, Alert or Fault mode. Smoke Detectors shall be optical type. Operating voltage shall be 10V to 30V DC.

#### 24.5 Heat Detector:

The Heat Detector shall be constructed of self Extinguishing plastic and protected against moisture and corrosion. Base unit shall have a red LED which flashes periodically in quiescent mode and flashes continuously in Fire Alert or Fault mode. It shall have a sensing unit to detect a change in temperature and incorporate an electronic control circuit. When the ambient temperature changes by a predetermined amount, the sensing unit shall activate and initiate the integral LED. It shall operate on 55 degree C. Operating voltage shall be 10V to 30V DC.

##### **Notes:**

- PVC conduit may be used if embedded in concrete / building fabric. All exposed and surface installed conduits shall be minimum 18 SWG mild steel anticorrosive painted.
- Any item not mentioned in BOQ, but required to complete the system as described in specifications for successful commissioning & operation shall be deemed to be built in the quoted prices.

#### 24.6 Testing & Commissioning

The system shall be tested and commissioned by the manufacturer's representative and witnessed by Owner / Construction Manager / Consultant.

Inspection, testing and commissioning shall be carried out in accordance with a field testing inspection and commissioning specifications to be issued by the contractor. The specification shall be subject to approval by Construction Manager / Consultant / Owner.

Certificates of tests shall be complied, for each section of the installation. A master set of these documents shall be kept as the original of the test dossier.

## 25. ACCESS CONTROL SYSTEM

Card Access System shall be microprocessor base, with LED display and integral backlight keypad and memory potential for 1000 cards. System shall be programmable through keypad system shall be consist of two components: An encoded, personal ID card and card-reader at each protected door. The system shall be completed with individual controller, central control software and event server and other components as required. Each cardholder's identification shall be store within the systems memory. Card capacity of the system shall be 1000 cards. System shall be consisting of 4-access level by assigning various combinations of doors to each level. The system shall have the facility to allow the cardholder access only through those doors, which are within the holder assign access level. The system shall have facility to interface a printer for maintaining the date, time, location, card number and transaction records of the cardholder. System shall be 2Aux. Timer Outputs to control external equipment such as VCR, CCTV, LIGHT, etc.A battery backup system tobe used to maintain memory during a power failure. Software of the system shall be the facilities of Security with & w/o delay, Window text based software, 1000 Transactions on board each door, Time expire card, System tampered, Card lockout, Check card information, Alarm monitoring function, and View 20 use definable fields for high security. Power consumption of the system shall not more than 200mA at 14 VDC and power supply shall be 1Amp/220 VAC at 50/60 Hz.

### 25.1 Card Reader

Card Reader shall be of electrostatic proximity type. Card holders shall not have to insert or swipe cards through Reader. Reader shall be able to read cards through a purse or wallet up-to a range of 6" from the reader.

CARD READER shall be a facility to search a valid card with its internal memory & after verification to allow access of valid card holder and door lock shall be release. Card Reader shall have a facility of AntiPass back, using separate entry and exit reader denies two consecutive "in" or "out" transactions.

### 25.2 Proximity Card

Proximity Cards shall have two facilities, a facility code unique to client specific installation site and an individual card number buried inside each card. Facility codes shall never be duplicated. Infrared card encoding technology shall be utilized for the highest and most accurate technological approach to Access Control Card Security.