



**NED UNIVERSITY OF ENGINEERING & TECHNOLOGY  
PROCUREMENT CELL**

Phone # 99261261-68, (Ext. 2471 & 2501) Fax # 99261255, e-mail: [dp@neduet.edu.pk](mailto:dp@neduet.edu.pk)

**“Say No to Corruption”**



**Director Procurement**

No. DP/PHD-116812/6663-B/ **2131**  
October 12, 2021

**Notice Inviting Tender**

NED University of Engineering and Technology invites sealed bids on Single Stage One Envelope procedure from Reputable and Well Experienced Firms/Companies to carry out following works:

| Sr.<br># | Tender / Number  | Tender Schedule – Date and Time |            |                          |                          | Estimated<br>Cost (Rs.<br>In Million) | Tender<br>Fee Rs. | Time of<br>Completion |
|----------|--|---------------------------------|------------|--------------------------|--------------------------|---------------------------------------|-------------------|-----------------------|
|          |  | Issue / Sale                    |            | Submission               | Opening                  |                                       |                   |                       |
|          |  | From                            | To         |                          |                          |                                       |                   |                       |
| 1        | Construction of 03<br>Laboratories for Department<br>of Physics & Chemistry at<br>NEDUET.<br>Tender No. PC/NED/DWS<br>Construction/6663-B/2021 | 18.10.2021                      | 03.11.2021 | 04.11.2021<br>10:30 A.M. | 04.11.2021<br>11:00 A.M. | 19.905                                | 5,000/-           | 13 Months             |

**Eligibility Criteria**

1. Registered with Sindh Revenue Board and FBR
2. Documentary evidence of similar work executed and works in progress
3. Financial statement (Summary) and Income tax returns for the last 03 Years
4. Valid Registration with Pakistan Engineering Council (PEC) in category C-4 and above, specialization code CE-10.
5. Affidavit that firm has not been blacklisted or involved in any litigation by any government, Semi-government or autonomous bodies on Non-Judicial Stamp Paper.

**Method of Procurement:** Single Stage, One Envelope Procedure

**Terms & Condition**

- a) Under following conditions bid shall be rejected:
  - i. Blacklisted Firm/ Companies
  - ii. Bid received after specified time and date
  - iii. Incomplete, conditional, Electronic and Telegraphic Bid/Tender
  - iv. Bids not accompanied by Bid Security of required amount and form.
- b) **Bid Validity Period:** (90) days from the date of opening of tender
- c) **Bid Security:** 2% of bid cost in the form of Deposit at Call or Pay Order or Demand Draft or a Bank guarantee issued by a schedule bank in Pakistan in Favor of Director Finance NED UET, Karachi

Tender Fee in shape of Pay Order/ Bank Draft should be in favor of Director Finance NEDUET, Bidding Documents can be obtained and shall be submitted in the office of ADP – II In the University as per above schedule. Bidders are requested to give their best and Final Price as “No Negotiations” is permitted. Bidding Documents containing detailed terms and conditions are available at Websites [www.neduet.edu.pk](http://www.neduet.edu.pk) and [www.ppm.spprasindh.gov.pk](http://www.ppm.spprasindh.gov.pk). In case of public holiday or any holiday or non-working day due to Force Majeure, the next official working day shall be deemed to be date for issuance, submission and opening of tenders. NEDUET shall not be responsible for any cost or expenses incurred by bidders. Procuring Agency reserves the right to reject all or any bid subject to the relevant provision of Sindh Public Procurement Rules 2010 (Amended up to date).

**Director Procurement**

*g/cor* *12/12/21*  
*Dr*



**N.E.D. UNIVERSITY OF ENGINEERING & TECHNOLOGY,  
KARACHI**

**CONSTRUCTION OF 03 LABORATORIES  
FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

**CONDITIONS OF CONTRACT**

**VOLUME 1**

**Consult-Tech** (Since 1970)

11-C, 3<sup>rd</sup> Floor, Shahbaz Commercial Line No. 2,  
Phase-VI, Defence Housing Authority, Karachi  
Tel +92 21 35847692 – 3, Fax +92 21 35847688

# **TABLE OF CONTENTS**

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

|           |  |    |
|-----------|--|----|
| <b>E.</b> | <b>Bid Opening and Evaluation</b>  |    |
|           | IB.23 Bid Opening  | 15 |
|           | IB.24 Process to be Confidential   | 15 |
|           | IB.25 Clarification of Bids  | 16 |
|           | IB.26 Examination of Bids and Determination of Responsiveness                | 16 |
|           | IB.27 Correction of Errors   | 16 |
|           | IB.28 Evaluation and Comparison of Bids                                      | 17 |
| <b>F.</b> | <b>Award of Contract</b>   |    |
|           | IB.29 Award  | 17 |
|           | IB.30 Employer's Right to Accept any Bid and to Reject any or all Bids       | 18 |
|           | IB.31 Notification of Award  | 18 |
|           | IB.32 Performance Security   | 18 |
|           | IB.33 Signing of Contract Agreement  | 19 |
|           | IB.34 General Performance of the Bidders                                     | 19 |
|           | IB.35 Integrity Pact   | 19 |
|           | IB.36 Instructions Not Part of Contract                                      | 19 |
|           | <b>BIDDING DATA</b>  | 20 |
|           | <b>FORM OF BID AND APPENDICES TO BID</b>                                     | 24 |
|           | <b>FORM OF BID</b>   | 25 |
|           | Appendix-A to Bid : Special Stipulations                                     | 27 |
|           | Appendix-C to Bid : Price Adjustment (Under Clause 70)                       | 28 |
|           | Appendix-D to Bid : Bill of Quantities                                       | 29 |
|           | Appendix-E to Bid : Proposed Construction Schedule                           | 35 |
|           | Appendix-F to Bid : Method of Performing the Work                            | 36 |
|           | Appendix-G to Bid : List of Major Equipment – Related Items                  | 37 |
|           | Appendix-H to Bid : Construction Camp and Housing Facilities                 | 39 |
|           | Appendix-J to Bid : Estimated Progress Payments                              | 40 |
|           | Appendix-K to Bid : Organization Chart of the Supervisory<br>Staff and Labor | 41 |
|           | Appendix-L to Bid : Integrity Pact   | 42 |
|           | <b>FORMS</b>   | 43 |
|           | BID SECURITY   | 44 |
|           | PERFORMANCE SECURITY   | 46 |
|           | CONTRACT AGREEMENT   | 48 |
|           | MOBILIZATION ADVANCE GUARANTEE/BOND  | 50 |



**SPECIAL PROVISIONS**

|   |            |
|---|------------|
| <b>PART-I: GENERAL CONDITIONS OF CONTRACT</b>     | <b>55</b>  |
| <b>PART-II: PARTICULAR CONDITIONS OF CONTRACT</b> | <b>128</b> |

# **INVITATION FOR BIDS**



Director Procurement

**NED University of Engineering & Technology**  
**University Road, Karachi-75270, Pakistan**  
**Tel #: 92-21-99261261-8 (Ext: 2291), Fax #: 92-21-99261255**  
**E-mail: dp@neduet.edu.pk Website: http://www.neduet.edu.pk**

**"SAY NO TO CORRUPTION"**

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY**

**NOTICE INVITING TENDERS**

NED University of Engineering & Technology invites sealed Bids from  
 Reputable and Well Experienced Firms/ Companies for the Work detailed below:

| <b>Name of Work</b>   | <b>Estimated Cost</b> | <b>Bid Security</b> | <b>Tender Fee (Rs.)</b> | <b>Time of Completion</b> |
|---|-----------------------|---------------------|-------------------------|---------------------------|
| CONSTRUCTION OF<br>03 LABORATORIES<br>FOR DEPARTMENT<br>OF PHYSICS AND<br>CHEMISTRY | 19.905 million        | 2 %                 | 5,000                   | 13 Months                 |

**ELIGIBILITY:**

- i. Valid Registration with Pakistan Engineering Council (PEC) in category C-4 and above, Specialization code CE-10
- ii. Registered with Sindh Revenue Board and FBR.
- iii. Financial Statement (Summary) and Income Tax Return for the Last 3 Years.
- iv. Documentary evidence of similar works executed and works in progress.
- v. Affidavit that firm has not been black listed by any Government, Semi Government or Autonomous bodies on non-judicial stamp paper.

**METHOD OF PROCUREMENT:** Single Stage, One Envelope procedure.

**BIDDING/ TENDER DOCUMENTS:**

- i. Issuance: Documents will be issued from \_\_\_\_\_ to \_\_\_\_\_  
 Last Date of Submission of Bids is \_\_\_\_\_ at \_\_\_\_\_
- ii. Submission: \_\_\_\_\_ am
- iii. Opening: Bids will be open on \_\_\_\_\_ at \_\_\_\_\_ am
- iv. Place Address: Directorate of Procurement, NED University, Main Campus,  
 Tel: 021-99261261-68 (Ext. 2291)

**TERMS & CONDITIONS:**

- a) Under the following conditions, bid can be rejected:
  - i. Incomplete, Conditioned, Electronic and Telegraphic Bids/Tenders
  - ii. Bids not accompanied by Bid Security of required amount & Form
  - iii. Bids received after specified Date & time
  - iv. Black Listed Firms/ Companies
- b) Bid Validity Period: **90 days**
- c) The Procuring Agency reserves the right to reject all or any Bid subject to the relevant provisions of Sindh Public Procurement Rules 2010 amended up to date.

**Director Procurement**

# **INSTRUCTIONS TO BIDDERS**

## INSTRUCTION TO BIDDERS

### A. GENERAL

#### IB.1 Scope of Bid

- 1.1 The Employer as defined below hereinafter called “the Employer” wishes to receive bids for the construction and completion works as described below and summarized referred to as the “Works”.

Name and Address of the Employer:

The Employer is “NED University of Engineering & Technology, University Road, Karachi- 75270”

Phone: (9221) 9926-1261-68 EXT: 2291 Fax No. (9221) 9926-1255

Name of the Project & Summary of the Works:

**“Construction of 03 Laboratories for Department of Physics and Chemistry”**

The work involves Construction of 03 Laboratories for Department of Physics and Chemistry including execution of Civil, Electrical, and Plumbing and allied Works in accordance with the design, Drawings, Technical Specifications, Bill of Quantities and Instructions of the Client/ Consultant with special emphasis on Quantity and Quality control ethics.

- 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 Employer has arranged funds from Government of Sindh and it is intended that part of the proceeds of this will be applied to eligible payments under the Contract for which these Bidding Documents are issued.

#### IB.3 Eligible Bidders

- 3.1 This invitation for Bids is open to all Bidders meeting the following requirements:
- a. Duly licensed by the Pakistan Engineering Council (PEC) in the category C-04 and their license should be valid for the current calendar year.
  - b. Technically and Financially capable firm having adequate managerial capacity.
  - c. Valid Registration with FBR, SRB and NTN.

#### 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 Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

## **B. BIDDING DOCUMENTS**

### **IB.7 Contents of Bidding Documents**

- 7.1 The Bidding Documents, in addition to invitation for bids, are those stated below and should be read in conjunction with any Addenda issued in accordance with Clause IB.9.
1. Instructions to Bidders.
  2. Bidding Data.
  3. 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.
- 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**

- 8.1 Any prospective bidder requiring any clarification (s) in respect of the Bidding Documents may notify the Employer in writing at the Employer's address indicated in the Invitation for Bids. The Employer will respond to any request for clarification which he receives earlier than (07) Seven days prior to the deadline for submission of bids.
- Copies of the Employer's response will be forwarded to all purchasers of the Bidding Documents, including a description of the enquiry but without identifying its source.



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

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

## **C. PREPARATION OF BIDS**

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

- 10.1 The bid and all correspondence and documents related to the bid exchanged by a bidder and the Employer shall be in the bid language stipulated in the Bidding Data (English) 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 and previously submitted with the application for prequalification, and continue to meet the minimum criteria set out in the prequalification documents which as a minimum, would include the following:
    - (i) Evidence of access to financial resources along with average annual construction turnover;
    - (ii) Financial predictions for the current year and the two following years including the effect of known commitments;
    - (iii) Work commitments since prequalification;
    - (iv) Current litigation information; and
    - (v) Availability of critical equipment.

- (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  
and other pertinent information such as mobilization programme etc.

11.2 Bids submitted by a joint venture of two (2) or more firms shall comply with the following requirements:

- (a) the bid and in case of a successful bid, the Form of Contract Agreement shall be signed so as to be legally binding on all partners;
- (b) one of the joint venture partners shall be nominated as being in charge; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the joint venture partners;
- (c) the partner-in-charge shall always be duly authorized to deal with the Employer regarding all matters related with and/or incidental to the execution of Works as per the terms and Conditions of Contract and in this regard to incur any and all liabilities, receive instructions, give binding undertakings and receive payments on behalf of the joint venture;
- (d) all partners of the joint venture shall at all times and under all circumstances be liable jointly and severally for the execution of the Contract in accordance with the Contract terms and a statement to this effect shall be included in the authorization mentioned under Sub-Para(b) above as well as in the Form of Bid and in the Form of Contract Agreement (in case of a successful bid); and
- (e) a copy of the agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly responsible for due performance of the Contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partner without prior written consent of the Employer.

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 Sub-Clause 1.1 hereof, based on the unit rates and / or prices submitted by the bidder.
- 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 Employer when executed and shall be deemed covered by rates and prices for other items in the Bill of Quantities.

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

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

- General Condition refer to page # 19-A

- 12.4 The rates and prices quoted by the bidders are subject to adjustment during the performance of the Contract in accordance with the provisions of Clause 70 of the Conditions of Contract. The bidders shall furnish the prescribed information for the price adjustment formulae in Appendix-C to Bid, and shall submit with their bids such other supporting information as required under the said Clause.

### **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. The Employer shall make payment only in Pak Rupees and no foreign currency payments are admissible. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country shall bear all the costs and risks for arranging the requirements of such currencies through his own resources.

### **IB.14 Bid Validity**

- 14.1 Bids shall remain valid for the **90 Days** 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 Employer may request that the bidders extend the period of validity for a specified additional period which shall in no case be more than the original bid validity period. The request and the responses thereto shall be made in writing. A bidder may refuse the request without forfeiting his Bid Security. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his Bid Security for the period of the extension, and in compliance with Clause IB.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 (2% of Bid Price in the form of Pay Order/ Bank Draft).
- 15.2 The Pay order shall be, at the option of the bidder, in the form of Deposit at Call 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 Employer valid for a period 28 days beyond the Bid Validity date.

- 15.3 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Employer as non-responsive.
- 15.4 The bid securities of unsuccessful bidders will be returned as promptly as possible, but not later than 28 days after the expiration of the period of Bid Validity.
- 15.5 The Bid Security of the successful bidder will be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.
- 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 Alternate Proposals by bidder are not invited. Bidder will only quote for the drawings and Design as provided in the Bidding Documents

#### **IB.17 ERRORS, OMISSIONS & QUERIES:**

- 17.2 (a) The bidder shall notify “the Employer” of any inconsistencies, errors and omissions found in the Bid Documents, prior to the Bid Opening Date. Withholding of any such information which will later materially affect the contract price during construction may be considered as sufficient grounds for rejection of the Bid. All queries shall be directed to The CIVIL ENGINEER, Construction of 03 Laboratories for Department of Physics and Chemistry, NED UET, Karachi.
- 17.2 (b) The NED UET, Karachi is not responsible for any verbal communications or instructions to the bidders or Acceptable of the Bid Documents.

#### **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 and stamped.

- 18.3 No alteration is to be made in the Form of Bid nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.
- 18.4 Each bidder shall prepare by filling out the forms completely and without alterations one (1) original and two copies, specified in the Bidding Data, of the documents comprising the bid as described in Clause IB.7 and clearly mark them “ORIGINAL” and ‘COPY” as appropriate. In the event of discrepancy between them, the original shall prevail.
- 18.5 The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person or persons duly authorized to sign on behalf of the bidder pursuant to Sub- Clause 11.1(a) hereof. All pages of the bid shall be initialed and stamped by the person or persons signing the bid.
- 18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the Employer, 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. Bids shall be prepared and submitted on the form of “the Bid “provided. All blank spaces must be filled in and completed form must be without interlineations or literation of the original wording. Bids with incomplete and /or unsigned Form of Bid may be rejected/ considered Non Responsive. The bidder shall stamp and sign each page of Bid Documents for the purpose of identification and acknowledgement of acceptance thereof.  
The bids must Conform in all respects to the Bid Documents.
- 18.8 Bidders should retain a copy of the Bidding Documents as their file copy.

#### **D. SUBMISSION OF BIDS**

##### **IB.19 Sealing and Marking of Bids**

- 19.1 Each bidder shall submit his bid as under:
- (a) ORIGINAL and each 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 will be put in one sealed envelope and addressed / identified as given in Sub- Clause 19.2 hereof.
- 19.2 The inner and outer envelopes shall:
- (a) be addressed to the Director Procurement at NED UET, Karachi- 75270; Phone: (92-21)9926-1261-8 (Ext: 2291) FAX 9926-1255
  - (b) bear the name and identification number of the contract as defined in the Bidding Data; and “Construction of 03 Laboratories for Department of Physics and Chemistry”

- (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 **Single Stage- One Envelope Procedure**
  - a) Notice inviting tenders and bidding documents of this method shall contain the following eligibility criteria:
    - i. Relevant experience;
    - ii. Turn-over of at least three years;
    - iii. Registration with Income Tax, Sales Tax, SRB and Pakistan Engineering Council (where applicable);
    - iv. Any other factor deemed to be relevant by the procuring agency subject to provision of Rule 44;
  - b) Each bid shall comprise one single envelope containing the financial proposal and required information mentioned at clause (a) above;
  - c) All bids received shall be opened and evaluated in the manner prescribed in the Notice Inviting Tenders or bidding Document

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

- 20.1 (a) Bids must be received by the Employer 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 Employer 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 Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

#### **IB.21 Late Bids**

- 21.1 (a) Any bid received by the Employer after the deadline for submission of bids prescribed in Clause IB.20 will be returned unopened to such bidder.
- (b) Delays in the mail, delays of person in transit, or delivery of a bid to the wrong office shall not be accepted as an excuse for failure to deliver a bid at the proper place and time. It shall be the bidder’s responsibility to determine the manner in which timely delivery of his bid will be accomplished either in person, by messenger or by mail.



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

- 22.1 Any bidder may modify, substitute or withdraw his bid after bid submission provided that the modification, substitution or written notice of withdrawal is received by the Employer 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 bids except in accordance with Sub-Clauses 22.1 and 27.2.
- 22.4 Withdrawal of a bid during the interval between the deadline for submission of bids and the expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the Bid Security in pursuance to Clause IB.15.

## **E. BID OPENING AND**

### **EVALUATION IB.23 Bid Opening**

- 23.1 The Employer 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 present shall sign a register evidencing their attendance.
- 23.2 Envelopes marked “MODIFICATION”, “SUBSTITUTION” or “WITHDRAWAL” shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause IB.22 shall not be opened.
- 23.3 The bidder’s name, total Bid Price and price of any Alternate Proposal(s), any discounts, bid modifications, substitution and withdrawals, the presence or absence of Bid Security, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening of bids.
- 23.4 The Consultant on behalf of Employer shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with the Sub-Clause 23.3.

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

- 24.1 Information relating to the examination, clarification, evaluation and comparison of bid and recommendations for the award of a contract shall not be disclosed to bidders or any other person not officially concerned with such

process Any effort by a bidder to influence the Employer's processing of bids or award decisions may result in the rejection of such bidder's bid.

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

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

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

- 26.1 Prior to the detailed evaluation of bids, the Employer will determine whether each bid is substantially responsive to the requirements of the Bidding Documents.
- 26.2 A substantially responsive bid is one which (i) meets the eligibility criteria; (ii) has been properly signed; (iii) is accompanied by the required Bid Security; and (iv) conforms to all the terms, conditions and specifications of the Bidding Documents, without material deviation or reservation. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the Works; (ii) which limits in any substantial way, inconsistent with the Bidding Documents, the Employer'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.
- 26.3 If a bid is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

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

- 27.1 Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:
- (a) where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; and
  - (b) where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern, unless in the opinion of the Employer there is an obviously gross misplacement of the decimal point in the unit rate, in which case the line item total as quoted will govern and the unit rate will be corrected.

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

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

- 28.1 The Consultant on behalf of Employer 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 Employer will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:
- (a) making any correction for errors pursuant to Clause IB.27;
  - (b) excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including competitively priced Day work; and
  - (c) making an appropriate adjustment for any other acceptable variation or deviation.
- 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 Employer's estimate of the cost of work to be performed under the Contract, the Employer may require the bidder to produce detailed price analyses for any or all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the Performance Security set forth in Clause IB.32 be increased at the expense of the successful bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful bidder under the Contract.
- 28.5 A bid with highly inflated or unworkable rates of any BOQ items may be considered non-conforming and rejected. The Employer may also disqualify such bidder from participating in the subsequent bids who submits such unbalanced and/or unworkable rates of major items of work.

## **F. AWARD OF CONTRACT**

### **IB.29 Award**

- 29.1 Subject to Clauses IB.30 and IB.34, the Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid Price,

provided that such bidder has been determined to be eligible in accordance with the provisions of Clause IB.3 and qualify pursuant to Sub-Clause IB 29.2.

- 29.2 The Employer, at any stage of the bid evaluation, having credible reasons for or *prima facie* evidence of any defect in supplier's or contractor's capacities, may require the suppliers or contractors to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not:

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

### **IB.30 Employer's Right to Accept any Bid and to Reject any or all Bids**

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

### **IB.31 Notification of Award**

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

### **IB.32 Performance Security**

- 32.1 The performance security shall be equal to an amount of 10% of the contract Price stated in the Letter of Acceptance. Such Security shall be in the Form of unconditional, irrevocable Bank Guarantee from any scheduled Bank of Pakistan acceptable to the Employer in favor of NED University of

Engineering & Technology, Karachi or an insurance company having at least AA rating from PACRA/JCR. The performance security will be valid for a period (up to the completion of the Project) after the date of issue of Defect Liability Certificate.

- .32.2 Failure of the successful bidder to comply with the requirements of Sub-Clause IB.32.1 or Clauses IB.33 or IB.35 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.

### **IB.33 Signing of Contract Agreement**

- 33.1 Within 14 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Employer will send the successful bidder the Contract Agreement in the form provided in the Bidding Documents, incorporating all agreements between the parties.
- 33.2 The formal Agreement between the Employer and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the successful bidder from the Employer.

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

The Employer reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts/works. The Employer may in case of consistent poor performance of any Bidder as reported by the employers of the previously awarded contracts, interilic, 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 debarring him from participation in future bidding for similar works.

### **IB.35 Integrity Pact**

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

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

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

# **BIDDING DATA**



**[NOTES ON BIDDING DATA]**

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

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

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

**BIDDING DATA****1.1 Name and address of the Employer:**

The Employer is NED University of Engineering & Technology, Karachi-75270 Phone: (9221) 9926-1261-8 EXT: 2291 FAX no.: (9221) 9926-1255

**Name of the Project & Summary of the Works:****Construction of 03 Laboratories for Department of Physics and Chemistry**

The work involves Construction of 03 Laboratories for Department of Physics and Chemistry including execution of Civil, Electrical, Plumbing and allied Works in accordance with the design, Drawings, Technical Specifications, Bill of Quantities and Instructions of the Client/ Consultant with special emphasis on Quantity and Quality control ethics.

**IB.2 Source of Funds:**

The Employer has arranged funds from Government of Sindh and it is intended that part of the proceeds of this will be applied to eligible payments under the Contract for which these Bidding Documents are issued.

**IB.3 Eligible Bidders**

As notified in NIT

**IB.8.1 Time limit for clarification:**

The Employer will respond to any request for clarification which he receives earlier than (07) Seven Days prior to the deadline for submission of bids

**IB.10 Bid language:**

The bid and all correspondence and documents related to the bid exchanged by a bidder and the Employer shall be in the English Language.

**IB.11.1(c) Furnish Technical Proposal:**

The bidder to submit a technical proposal in sufficient detail to demonstrate the adequacy of the bid in meeting requirements for timely completion of the Works and taking into account the various appendices to Bid specified into instructions to Bidder.

**IB.13.1 Currencies of Bid and Payment**

The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. The Employer shall make payment only in Pak Rupees and no foreign currency payments are admissible. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country shall bear all the costs and risks for arranging the requirements of such currencies through his own resources.

**IB.14.1 Period of Bid Validity:**

Bids shall remain valid for the 90 Days after the date of bid opening.

**IB.15.1 Amount of Bid Security:**

Minimum 2% of Bid Price in the form of Pay Order/ Bank Draft

**IB.18.4 Number of copies of the Bid to be completed and submitted:**

One (1) original and two copies.

**IB.19 Sealing and Marking of Bids****19.2(a) Employer's address for the purpose of Bid Submission**

The Director Procurement at NED UET, Karachi- 75270; Phone: (92-21)9926-1261-8 FAX 9926-1255

**19.2 (a) (b) Name and number of the Contract**

bear the contract name "Construction of 03 Laboratories for Department of Physics and Chemistry"

**IB. 20.1(a)Deadline for submission of bids:**

As notified in "Invitation to Bids"

**IB. 23.1 Venue, Time and Date of Bid opening:**

As notified in "Invitation to Bids"

**I.B.32.1 Standard form and amount of Performance Security acceptable to the Employer:**

The performance security shall be equal to an amount of 10% of the contract Price stated in the Letter of Acceptance. Such Security shall be in the Form of unconditional, irrevocable Bank Guarantee from any scheduled Bank of Pakistan acceptable to the Employer in favor of NED University of Engineering & Technology, Karachi or an insurance company having at least AA rating from PACRA/JCR. The performance security will be valid for a period (up to the completion of the Project) after the date of issue of Defect Liability Certificate.

**FORM OF BID  
AND  
APPENDICES TO BID**

**FORM OF BID**

Bid Reference No. \_\_\_\_\_  
 (Name of Contract/Works)

To:

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

Gentleman,

1. Having examined the Bidding Documents including Instructions to Bidders, Bidding Data, 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 any time 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

\_\_\_\_\_  
Bidder in Block Capitals) (Seal) (Name of

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

Witness:

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

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

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

Occupation \_\_\_\_\_  
\_\_\_\_\_



### SPECIAL STIPULATIONS

#### Clause

#### Conditions of Contract

|     |  |               |  |
|-----|--|---------------|--|
| 1.  | Engineer's Authority to issue Variation in emergency                                     | 2.1           | The variation amount shall not exceed overall 2% of the Contract Price during the currency of the Contract   |
| 2.  | Amount of Performance Security   | 10.1          | 10% of Contract Price stated in the Letter of Acceptance in the form of bank guarantee issued by a Scheduled Bank of Pakistan or Insurance companies having at least AA Rating from PACRA/ JCR |
| 3.  | Time for Furnishing Programme  | 14.1          | Within 7 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.  |
| 6.  | Time for Completion  | 43.1,<br>48.2 | 13 months from the date of receipt of Engineer's Notice to Commence.   |
| 7.  | Amount of Liquidated Damages   | 47.1          | One tenth of one percent (0.10%) for each day of delay in completion of the Works subject to a maximum of 10% of Contract Price stated in the Letter of Acceptance.                            |
| 8.  | Defects Liability Period   | 49.1          | 180 days from the effective date of Taking Over Certificate.   |
| 9.  | Percentage of Retention Money  | 60.2          | 5 % of the amount of Interim Payment Certificate.  |
| 10. | Limit of Retention Money   | 60.2          | 10 % of Contract Price stated in the Letter of Acceptance.   |
| 11. | Minimum amount of Interim Payment Certificates (Running Bills)                           | 60.2          | Rs. (05) Five Million  |
| 12. | Time of Payment from delivery of Engineer's Interim Payment Certificate to the Employer. | 60.10         | (28) Twenty Eight days(No interest shall be paid in case of any delay in payment).   |
| 13. | Mobilization Advance * (Interest Free)   | 60.12         | 10 % of Contract Price stated in the Letter of Acceptance against unconditional and irrevocable bank guarantee from a scheduled bank of Pakistan   |

**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:

(To be filled by the Employer)

| Cost Element | Description             | Weightages | Applicable index   |
|--------------|-------------------------|------------|--|
| 1            | 2                       | 3          | 4  |
| (i)          | Fixed Portion           | 0.60       |  |
| (ii)         | Local Labor             | 0.12       | Government of Pakistan (GP)<br>Federal Bureau of Statistics (FBS)<br>Monthly Statistical Bulletin. |
| (iii)        | Cement – in bags        | 0.06       | “ “ “  |
| (iv)         | Reinforcing Steel       | 0.20       | “ “ “  |
| (v)          | High Speed Diesel (HSD) | 0.02       | “ “ “  |
|              |                         |            | “ “ “  |
|              |                         |            | “ “ “  |
|              |                         |            |  |
|              | Total                   | 1.000      |  |

**Notes:**

- 1) 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.
- 2) Any fluctuation in the indices or prices of materials other than those given above shall not be subject to adjustment of the Contract Price.
- 3) Fixed portion shown here is for typical road project, Employer to determine the weightage of Fixed Portion considering only those cost elements having cost impact of seven (7) percent or more on his specific project.

(Employers using this price adjustment provisions may add or delete any elements as deemed appropriate to the project.)

## **BILL OF QUANTITIES**

### **A. Preamble**

1. The Bill of Quantities shall be read in conjunction with the Conditions of Contract, Specifications and Drawings.
2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work executed and measured by the Contractor and verified by the Engineer and valued at the rates and prices entered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix as per the Contract.
3. The rates and prices entered in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the Contract include all costs of Contractor's plant, labor, supervision, materials, execution, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract. Furthermore, all duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as on the date 28 days prior to deadline for submission of Bids, shall be included in the rates and prices and the total Bid Price submitted by the Bidder.
4. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of items against which the Contractor will have failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
5. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the priced Bill of Quantities, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the Works.
6. General directions and description of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the Bidding Documents shall be made before entering prices against each item in the priced Bill of Quantities.
7. Provisional sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with Sub-Clause 58.2 of Part I, General Conditions of Contract.

**BILL OF QUANTITIES**

**B. Work Items**

1. The Bill of Quantities contains the following Bills and Schedule:  
(by way of example)

|                            |   |
|----------------------------|---|
| Bill No. 1                 | - |
| Bill No. 2                 | - |
| Bill No. 3                 | - |
| Bill No. 4                 | - |
| Bill No. 5                 | - |
| Day work Schedule          |   |
| Summary Bill of Quantities |   |

2. Bidders shall price the Bill of Quantities in Pakistani Rupees only.

### BILL OF QUANTITIES

Bill No.1 \_\_\_\_\_

|   | Description | Unit | Quantity | Rate              |                | Amount |
|---|-------------|------|----------|-------------------|----------------|--------|
|   |             |      |          | Rupees in figures | Rupees in Word |        |
| 1   | 2           | 3    | 4        | 5                 |                | 6      |
| 101   |             |      |          |                   |                |        |
| 102   |             |      |          |                   |                |        |
| 103   |             |      |          |                   |                |        |
| 104   |             |      |          |                   |                |        |
| 105   |             |      |          |                   |                |        |
| 106   |             |      |          |                   |                |        |
| Total for Bill No.1<br>(Carried Forward to Summary Page) _____. |             |      |          |                   |                |        |

## **BILL OF QUANTITIES**

### **C. Day work**

#### **Schedule General**

1. Reference is made to Sub-Clause 52.4 of the General Conditions of Contract Part-I. Work shall not be executed on a day work basis except by written order of the Engineer. Bidders shall enter basic rates for Day work items in the Schedules, which rates shall apply to any quantity of Day work ordered by the Engineer. Nominal quantities have been indicated against each item of Day work, and the extended total for Day work shall be carried forward to the Bid Price.

#### **Day work Labor**

2. In calculating payments due to the Contractor for the execution of Day work, the actual time of classes of labor directly doing the Day work ordered by the Engineer and for which they are competent to perform will be measured excluding meal breaks and rest periods. The time of gangers (charge hands) actually doing work with the gang will also be measured but not the time of foreman or other supervisory personnel.
3. The Contractor shall be entitled to payment in respect of the total time that labor is employed on Day work, calculated at the basic rates entered by him in the Schedule of Day work Rates for labor together with an additional percentage, payment on basic rates representing the Contractor's profit, overheads, etc., as described below:
  - a) the basic rates for labor shall cover all direct costs to the Contractor, including (but not limited to) the amount of wages paid to such labor, transportation time, overtime, subsistence allowances and any sums paid to or on behalf of such labor for social benefits in accordance with Pakistan law. The basic rates will be payable in local currency only; and
  - b) the additional percentage payment to be quoted by the Bidder and applied to costs incurred under (a) above shall be deemed to cover the Contractor's profit, overheads, superintendence, liabilities and insurances and allowances to labor timekeeping and clerical and office work; the use of consumable stores, water, lighting and power; the use and repair of staging, scaffolding, workshops and stores, portable power tools, manual plant and tools; supervision by the Contractor's staff, foremen and other supervisory personnel; and charges incidental to the foregoing.

**Day work Material**

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

**Day work Constructional Plant**

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



**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 Employer'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):

| <u>Description</u>  | <u>Time for Completion</u> |
|---|----------------------------|
| a) Whole Works  | _____ days                 |
| b) Part-A (Structural Work Civil)                             | _____ days                 |
| c) Part-B (Electrical Work & ACMV)                            | _____ days                 |
| d) Part-C (Plumbing Work)                                     | _____ days                 |
| e) Part-D (Finishing Work Civil, Electrical & Plumbing Works) | _____ days                 |

### **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.]

**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

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

## **CONSTRUCTION CAMP AND HOUSING FACILITIES**

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

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

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

1. Site Preparation (clearing, land preparation, etc.).
2. Provision of Services.
  - a) Power (expected power load, etc.).
  - b) Water (required amount and system proposed).
  - c) Sanitation (sewage disposal system, etc.).
3. Construction of Facilities
  - a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type of construction of buildings, etc.).
  - b) Warehouses and Storage Areas (area required, type of construction and layout).
  - c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction, etc.).
4. Construction Equipment Assembly and Preparation (detailed plans for carrying out this activity).
5. Other Items Proposed (Security services, etc.)
6. The Contractor's responsibility to arrange the water for construction work or wherever water require for the execution of work. The client will not provide the water and contractor arrange outside from the university premises on his own basis. Before use water, contractor should submit the test report from PCSIR laboratory.
7. Contractor will arrange electricity source on its own basis or use an alternate of source of electricity (like Generator) or contractor can take temporary connection from university. Connection would be on sub meter. Contractor will liable to pay bill to university for the temporary connection.

### 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<br/>(1000 Rs.)</b> |
|------------------------------|-------------------------------|
| <b>1</b>                     | <b>2</b>                      |
| <b>1st Quarter</b>           |                               |
| <b>2nd Quarter</b>           |                               |
| <b>3rd Quarter</b>           |                               |
| <b>4th Quarter</b>           |                               |
| <b>5th Quarter</b>           |                               |
| <b>6th Quarter</b>           |                               |
|                              |                               |
|                              |                               |
|                              |                               |
| <b>Bid Price</b>             |                               |

**ORGANIZATION CHART  
FOR THE  
SUPERVISORY STAFF**





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

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

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

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

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

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

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

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

|  |  |
|--|--|
| <p>WITNESS:</p> <p>1. _____</p> <p>_____</p> <p>Corporate Secretary (Seal)</p> <p>2. _____</p> <p>_____</p> <p>Name, Title &amp; Address</p> | <p>SURETY (Bank)</p> <p>Signature _____</p> <p>Name _____</p> <p>Title _____</p> <p>Corporate Guarantor (Seal)</p> |
|--|--|

**FORM OF PERFORMANCE SECURITY  
(Bank Guarantee)**

Guarantee No. \_\_\_\_\_  
 Executed on \_\_\_\_\_  
 Expiry date \_\_\_\_\_

[Letter by the Guarantor to the Employer]

Name of Guarantor (Bank) with address: \_\_\_\_\_  
 (Scheduled Bank in Pakistan)

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

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

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

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

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

NOW THEREFORE, if the Principal (Contractor) shall well and truly perform and 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 Employer, 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 defenses under the Contract, do hereby irrevocably and independently guarantee to pay to the Employer without delay upon the Employer's first written demand without cavil or arguments and without requiring the Employer to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Employer's written declaration that the Principal has refused or failed to perform the obligations under the Contract which payment will be effected by the Guarantor to Employer's designated Bank & Account Number.

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

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

|   |  |
|---|--|
| <p>Witness:</p> <p>1. _____</p><br><p>_____</p> <p>Corporate Secretary (Seal)</p><br><p>2. _____</p><br><p>_____</p> <p>Name, Title &amp; Address</p> | <p>_____<br/>Guarantor (Bank)</p><br><p>Signature _____</p><br><p>Name _____</p><br><p>Title _____</p><br><br><p>_____</p> <p>Corporate Guarantor (Seal)</p> |
|---|--|

## FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the \_\_\_\_\_ day of \_\_\_\_\_ (month) 20\_\_\_\_ between \_\_\_\_\_ (hereafter called the "Employer") of the one part and \_\_\_\_\_ (hereafter called the "Contractor") of the other part.

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

NOW this Agreement witnessed 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 Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy defects therein in conformity and in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works as per provisions of the Contract, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

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

Signature of the Contactor

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

Signature of Employer

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

Signed, Sealed and Delivered in the presence of:

Witness:

\_\_\_\_\_

(Name, Title and Address)

Witness:

\_\_\_\_\_

(Name, Title and Address)

**MOBILIZATION ADVANCE GUARANTEE/BOND**

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

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

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

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

AND WHEREAS, \_\_\_\_\_  
 \_\_\_\_\_ (Scheduled Bank in Pakistan or Insurance Company acceptable to the Employer)  
 (hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the Employer agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

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

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

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

(Date)

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

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



GUARANTOR

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

WITNESS

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

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

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

## [Notes on the Conditions of Contract]

The Conditions of Contract comprise two parts:

|                     |  |
|---------------------|--|
| <b>(a) Part I -</b> | <b>General Conditions of Contract</b>    |
| <b>Part II -</b>    | <b>Particular Conditions of Contract</b> |

Over the years, a number of “model” General Conditions of Contract have evolved. The one used in these Standard Bidding Documents was prepared by the International Federation of Consulting Engineers (Federation Internationale des Ingenieurs-Conseils, or FIDIC), and is commonly known as the FIDIC Conditions of Contract. (The used version is the fourth edition, 1987, reprinted in 1992 with further amendments).

The FIDIC Conditions of Contract have been prepared for an ad measurement (unit price or unit rate) type of contract, and cannot be used without major modifications for other types of contract, such as lump sum, turnkey, or target cost contracts.

The standard text of the General Conditions of Contract chosen must be retained intact to facilitate its reading and interpretation by bidders and its review by the Client. Any amendments and additions to the General Conditions, specific to the contract in hand, should be introduced in the Particular Conditions of Contract.

The use of standard conditions of contract for all civil Works will ensure comprehensiveness of coverage, better balance of rights or obligations between Employer and Contractor, general acceptability of its provisions, and savings in time and cost for bid preparation and review, leading to more economic prices.

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

---

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

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

FIDIC Secretariat

P.O. Box 86

1000 Lausanne 12

Switzerland

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



FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS

**CONDITIONS OF CONTRACT**

**FOR WORKS OF CIVIL**

**ENGINEERING CONSTRUCTION**

**PART I GENERAL CONDITIONS**  
**WITH FORMS OF TENDER AND AGREEMENT**

FOURTH EDITION 1987  
Reprinted 1988 with editorial amendments  
Reprinted 1992 with further amendments

**General**

Conditions of Contract

**Definitions and Interpretation**

- 1.1 Definitions
- 1.2 Headings and Marginal Notes
- 1.3 Interpretation
- 1.4 Singular and Plural
- 1.5 Notices, Consents, Approvals, Certificates & Determinations

**Representatives**

- 2.1 Appointment of Engineer's Representative
- 2.2 Duties and Authority of Engineer's Representative
- 2.3 Instructions in Writing
- 2.4 Contractor's Representative
- 2.5 Instructions in Writing
- 2.6 Engineer to Act Impartially

**Sub-Contracting**

- 3.1 Assignment of Contract
- 4.1 Sub-Contracting
- 4.2 Assignment of Sub Contractor's Obligations

**Contract Documents**

- 5.1 Language and Law
- 5.2 Priority of Contract Documents
- 6.1 Custody and supply of Drawings
- 6.2 One Copy of Drawings to be kept on Site
- 6.3 Disruption of Progress
- 6.4 Delays and cost of Delay of drawings
- 6.5 Failure by Contractor to Submit drawings
- 7.1 Supplementary Drawings and Instructions
- 7.2 Permanent Works designated by the Contractor
- 7.3 Responsibility unaffected by Approval

**General Obligations**

- 8.1 Contractor's General Responsibilities
- 8.2 Site Operations and Method of Construction
- 9.1 Contract Agreement
- 10.1 Performance Security

|      |  |
|------|--|
| 10.2 | Period of Validity of Performance Bond                 |
| 10.3 | Claims Under Performance Security                      |
| 11.1 | Inspection of Site                                     |
| 12.1 | Sufficiency of Tender                                  |
| 12.2 | Not Foreseeable Physical Obstructions or Conditions    |
| 13.1 | Work to be in Accordance with Contract                 |
| 14.1 | Program to be Submitted                                |
| 14.2 | Revised Program  |
| 14.3 | Cash Flow Estimate to be Submitted                     |
| 14.4 | Contractor not relieved of duties and responsibilities |
| 15.1 | Contractor's Superintendence                           |
| 16.1 | Contractor's Employees                                 |
| 16.2 | Employer at Liberty to Object                          |
| 17.1 | Setting Out  |
| 18.1 | Bore-holes and Exploratory Excavation                  |
| 19.1 | Safety, Security and Protection of Environment         |
| 19.2 | Employer's Responsibility                              |
| 20.1 | Care of Works  |
| 20.2 | Responsibility to Rectify Loss or Damage               |
| 20.3 | Loss or Damage due to Employer's Risk                  |
| 20.4 | Employer's Risk  |
| 21.1 | Insurance of Works and Contractor's Equipment          |
| 21.2 | Scope of Cover   |
| 21.3 | Responsibility for Amounts not Recovered               |
| 21.4 | Exclusions   |
| 22.1 | Damage to Persons and Property                         |
| 22.2 | Exceptions   |
| 22.3 | Indemnity by Employer                                  |
| 23.1 | Third Party Insurances (including Employer's Property) |
| 23.2 | Minimum Amount of Insurance                            |
| 23.3 | Cross Liabilities                                      |
| 24.1 | Accident or Injury to Workmen                          |
| 24.2 | Insurance against Accident to Workmen                  |
| 25.1 | Evidence and Terms of Insurance                        |
| 25.2 | Adequacy of Insurance                                  |
| 25.3 | Remedy on Contractor's Failure to Insure               |
| 25.4 | Compliance with Policy Conditions                      |
| 26.1 | Compliance with Statutes, Regulations                  |
| 27.1 | Fossils  |
| 28.1 | Patent Rights  |
| 28.2 | Royalties  |
| 29.1 | Interference with Traffic and adjoining Properties     |
| 30.1 | Avoidance of Damage to Roads                           |

- 30.2 Transportation of Contractor's Equipment & Temporary Works
- 30.3 Compliance with Traffic Laws
- 31.1 Opportunities for other Contractors
- 31.2 Facilities for other Contractors
- 32.1 Contractor to keep Site Clear
- 33.1 Clearance of Site on Completion

#### **Labour**

- 34.1 Engagement of Staff and Labour
- 35.1 Returns of Labour and Contractor's Equipment

#### **Materials, Plant and Workmanship**

- 36.1 Quality of Materials, Plant and Workmanship
- 36.2 Cost of Samples
- 36.3 Cost of Tests
- 36.4 Cost of Tests not Provided for
- 36.5 Employer's Determination where Tests not Provided For
- 37.1 Inspection of Operations
- 37.2 Inspection and Testing
- 37.3 Dates for Inspection and Testing
- 37.4 Rejection
- 37.5 Independent Inspection
- 38.1 Examination of Works before Covering Up
- 38.2 Uncovering and Making Openings
- 39.1 Removal of Improper Work, Material or Plant
- 39.2 Default of Contractor in Compliance

#### **Suspension**

- 40.1 Suspension of Work
- 40.2 Employer's Determination following Suspension
- 40.3 Suspension lasting more than 84 days

#### **Commencement and Delays**

- 41.1 Commencement of Works
- 42.1 Possession of Site and Access Thereto
- 42.2 Failure to give Possession
- 42.3 Rights of Way and Facilities
- 43.1 Time for Completion
- 44.1 Extension of Time for Completion
- 44.2 Contractor to provide Notification and detailed Particulars
- 44.3 Interim Determination of Extension
- 45.1 Restriction on Working Hours
- 46.1 Rate of Progress
- 47.1 Liquidated Damages for Delay
- 47.2 Reduction of Liquidated Damages
- 48.1 Taking Over Certificate

- 48.2 Taking Over of Sections or Parts
- 48.3 Substantial Completion of Parts
- 48.4 Surfaces Requiring Reinstatement

#### **Defects Liability**

- 49.1 Defects Liability Period
- 49.2 Completion of Outstanding Works and Remedying Defects
- 49.3 Cost of Remedying Defects
- 49.4 Contractor's Failure to Carry out Instructions
- 50.1 Contractor to Search

#### **Alterations, Additions and Omissions**

- 51.1 Variations
- 51.2 Instructions for Variations
- 52.1 Valuation of Variations
- 52.2 Power of Employer to fix Rates
- 52.3 Variations exceeding 15 percent
- 52.4 Day Work

#### **Procedure for Claims**

- 53.1 Notice of Claims
- 53.2 Contemporary Records
- 53.3 Substantiation of Claims
- 53.4 Failure to Comply
- 53.5 Payment of Claims

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

- 54.1 Contractor's Eqp. Temp. Works & Material; Exclusive use
- 54.2 Employer not Liable for Damage
- 54.3 Customs Clearance
- 54.4 Re-Export of Contractor's Equipment
- 54.5 Conditions of Hire of Contractor's Equipment
- 54.6 Costs for the purpose of Clause 63
- 54.7 Incorporation of Clause in Subcontracts
- 54.8 Approval of Materials not Implied

#### **Measurement**

- 55.1 Quantities
- 56.1 Works to be Measured
- 57.1 Method of Measurement
- 57.2 Breakdown of Lump Sum Items

#### **Provisional Sums**

- 58.1 Definition of Provisional Sum
- 58.2 Use of Provisional Sums
- 58.3 Production of Vouchers

## **Nominated Subcontractors**

- 59.1 Definition of Nominated Subcontractor
- 59.2 Nominated Subcontractors; Objection to Nomination
- 59.3 Design Requirements to be Expressly Stated
- 59.4 Payments to Nominated Subcontractors
- 59.5 Certification of Payments to Nominated Subcontractors

## **Certificates and Payments**

- 60.1 Monthly Statements
- 60.2 Monthly Payments
- 60.3 Payment of Retention Money
- 60.4 Correction of Certificates
- 60.5 Statement of Completion
- 60.6 Final Statement
- 60.7 Discharge
- 60.8 Final Payment Certificate
- 60.9 Cessation of Employer's Liability
- 60.10 Time for Payment
- 61.1 Approval only by Defects Liability Certificate
- 62.1 Defects Liability Certificate
- 62.2 Unfulfilled Obligations

## **Remedies**

- 63.1 Default of Contractor
- 63.2 Valuation at Date of Termination
- 63.3 Payment after Termination
- 63.4 Assignment of Benefit of Agreement
- 64.1 Urgent Remedial Work

## **Special Risks**

- 65.1 No Liability for Special Risks
- 65.2 Special Risks
- 65.3 Damage to Work by Special Risks
- 65.4 Projectile, Missile
- 65.5 Increased Costs arising from Special Risks
- 65.6 Out Break of War
- 65.7 Removal of Contractor's Equipment on Termination
- 65.8 Payment if Contract Terminated

## **Release from Performance**

- 66.1 Payment in event of release from Performance

## **Settlement of Disputes**

- 67.1 Employer's Decision
- 67.2 Amicable Settlement
- 67.3 Arbitration



67.4 Failure to Comply with Engineer's decision

**Notices**

68.1 Notice to Contractor

68.2 Notice to Employer and Engineer

68.3 Change of Address

**Default of Client**

69.1 Default of Employer

69.2 Removal of Contractor's Equipment

69.3 Payment on Termination

69.4 Contractor's Entitlement to Suspend Work

69.5 Resumption of Work

**Changes in Cost and Legislation**

70.1 Increase or Decrease of Cost

70.2 Subsequent Legislation

**Currency and Rates of exchange**

71.1 Currency Restrictions

72.1 Rates of Exchange

72.2 Currency Proportions

72.3 Currencies of Payment for Provisional Sums

## Definitions and Interpretation

### Definitions

1.1 In the Contract (as hereinafter defined) the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

(a) (i) "Employer" means the person named as such in Part II of these Conditions and the legal successors in title to such person, but not (except with the consent of the Contractor) any assignee of such person.

(ii) "Contractor" means the person whose tender has been accepted by the Employer and the legal successors in title to such person, but not (except with the consent of Employer) any assignee of such person.

(iii) "Subcontractor" means any person named in the Contract as a Subcontractor for a part of the Works or any person to whom a part of the Works has been subcontracted with the consent of the Engineer and the legal successors in title to such person, but not any assignee of any such person.

(iv) "Engineer" means the person appointed by the Employer to act as Engineer for the purposes of the Contract and named as such in Part II of these Conditions.

(v) "Engineer's Representative" means a person appointed from time to time by the Engineer under Sub-Clause 2.2.

(b) (i) "Contract" means these Conditions (Parts I and II), the Specification, the Drawings, the Bill of Quantities, the Tender, the Letter of Acceptance, the Contract Agreement (if completed) and such further documents as may be expressly incorporated in the Letter of Acceptance or Contract Agreement (if completed).

(ii) "Specification" means the specification of the Works included in the Contract and any modification thereof or addition thereto made under Clause 51 or submitted by the Contractor and approved by the Engineer.

(iii) "Drawings" means all drawings, calculations and technical information of a like nature provided by the Engineer to the Contractor under the Contract and all

drawings, calculations, samples, patterns, models, operation and maintenance manuals and other technical information of a like nature submitted by the Contractor and approved by the Engineer.

(iv) "Bill of Quantities" means the priced and completed bill of quantities forming part of the Tender.

(v) "Tender" means the Contractor's priced offer to the Employer for the execution and completion of the Works and the remedying of any defects therein in accordance with the provisions of the Contract, as accepted by the Letter of Acceptance.

(vi) "Letter of Acceptance" means the formal acceptance by the Employer of the Tender.

(vii) "Contract Agreement" means the contract agreement (if any) referred to in Sub-Clause 9. 1.

(viii) "Appendix to Tender" means the appendix comprised in the form of Tender annexed to these Conditions.

(c) (i) "Commencement Date" means the date upon which the Contractor receives the notice to commence issued by the Engineer pursuant to Clause 41.

(ii) "Time for Completion" means the time for completing the execution of and passing the Tests on Completion of the Works or any Section or part thereof as stated in the Contract (or as extended under Clause 44) calculated from the Commencement Date.

(d) (i) "Tests on Completion" means the tests specified in the Contract or otherwise agreed by the Engineer and the Contractor which are to be made by the Contractor before the Works or any Section or part thereof are taken over by the Employer.

(ii) "Taking-Over Certificate" means a certificate issued pursuant to Clause 48.

(e) (i) "Contract Price" means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works and the remedying of any defects therein in accordance with the provisions of the Contract.

(ii) "Retention Money" means the aggregate of all monies

retained by the Employer pursuant to Sub-Clause 60.2(a).

(iii) "Interim Payment Certificate" means any certificate of payment issued by the Engineer other than the Final Payment Certificate.

(iv) "Final Payment Certificate" means the certificate of payment issued by the Engineer pursuant to Sub-Clause 60.8.

(f) (i) "Works" means the Permanent Works and the Temporary Works or either of them as appropriate.

(ii) "Permanent Works" means the permanent works to be executed (including Plant) in accordance with the Contract.

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

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

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

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

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

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

(ii) "day" means calendar day.

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

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

|   |  |
|---|--|
| Headings and Marginal Notes                                   | <b>1.2</b> The headings and marginal notes in these Conditions shall not be deemed part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.   |
| Interpretation  | <b>1.3</b> Words importing persons or parties shall include firms and corporations and any organization having legal capacity.   |
| Singular and Plural   | <b>1.4</b> Words importing the singular only also include the plural and vice versa where the context requires.  |
| Notices, Consents, Approvals, Certificates and Determinations | <b>1.5</b> Wherever in the Contract provision is made for the giving or issue of any notice, consent, approval, certificate or determination by any person, unless otherwise specified such notice, consent, approval, certificate or determination shall be in writing and the words “notify”, “certify” or “determine” shall be construed accordingly. Any such consent, approval, certificate or determination shall not unreasonably be withheld or delayed. |

### **Engineer and Engineer’s Representative**

|                                  |   |
|----------------------------------|---|
| Engineer's Duties and Authority  | <p><b>2.1</b> (a) The Engineer shall carry out the duties in the specified Contract.</p> <p>(b) The Engineer may exercise the authority specified in or necessarily to be implied from the Contract, provided, however, that if the Engineer is required, under the terms of his appointment by the Employer, to obtain the specific approval of the Employer before exercising any such authority, particulars of such requirements shall be set out in Part II of these Conditions. Provided further that any requisite approval shall be deemed to have been given by the Employer for any such authority exercised by the Engineer.</p> <p>(c) Except as expressly stated in the Contract, the Engineer shall have no authority to relieve the Contractor of any of his obligations under the Contract.</p> |
| Engineer's Representative        | <b>2.2</b> The Engineer's Representative shall be appointed by and be responsible to the Engineer and shall carry out such duties and exercise such authority as may be delegated to him by the Engineer under Sub-Clause 2.3.  |
| Engineer's Authority to Delegate | <p><b>2.3</b> The Engineer may from time to time delegate to the Engineer's Representative any of the duties and authorities vested in the Engineer and he may at any time revoke such delegation. Any such delegation or revocation shall be in writing and shall not take effect until a copy thereof has been delivered to the Employer and the Contractor.</p> <p>Any communication given by the Engineer's Representative to</p>   |

the Contractor in accordance with such delegation shall have the same effect as though it had been given by the Engineer. Provided that:

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

(b) if the Contractor questions any communication of the Engineer's Representative he may refer the matter to the Engineer who shall confirm, reverse or vary the contents of such communication.

Appointment of  
Assistants

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

Instructions in  
Writing

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

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

Engineer to Act  
Impartially

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

(a) giving his decision, opinion or consent,

(b) expressing his satisfaction or approval,

(c) determining value, or

(d) otherwise taking action which may affect the rights and obligations of the Employer or the Contractor he shall exercise such discretion impartially within the terms of the Contract and having regard to all the circumstances. Any such decision, opinion, consent, expression of satisfaction, or approval, determination of value or action may be opened up, reviewed or revised as provided in Clause 67.

### **Assignment and Subcontracting**

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

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

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

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

(a) the provision of labor,

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

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

Assignment of Subcontractors' Obligations      **4.2** In the event of a Subcontractor having undertaken towards the Contractor in respect of the work executed, or the goods, materials, Plant or services supplied by such Subcontractor, any continuing obligation extending for a period exceeding that of the Defects Liability Period under the Contract, the Contractor

shall at any time, after the expiration of such Period, assign to the Employer, at the Employer's request and cost, the benefit of such obligation for the unexpired duration thereof.

#### **Contract Documents**

Language/s and  
Law

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

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

(b) the country or state the law of which shall apply to the Contract and according to which the Contract shall be construed. If the said documents are written in more than one language, the language according to which the Contract shall be construed and interpreted is also stated in Part II of these Conditions, being therein designated the "Ruling Language".

Priority of  
Contract  
Documents

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

(1) The Contract Agreement (if completed);

(2) The Letter of Acceptance.

(3) The Tender,

(4) Part II of these Conditions;

(5) Part I of these Conditions; and

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

Custody and  
Supply of  
Drawings and  
Documents

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

The Contractor shall supply to the Engineer four copies of all Drawings, Specification and other documents submitted by the



Contractor and approved by the Engineer in accordance with Clause 7, together with a reproducible copy of any material which cannot be reproduced to an equal standard by photocopying. In addition, the Contractor shall supply such further copies of such Drawings, Specification and other documents as the Engineer may request in writing for the use of the Employer, who shall pay the cost thereof.

One Copy of Drawings to be Kept on site

**6.2** One copy of the Drawings, provided to or supplied by the Contractor as aforesaid, shall be kept by the Contractor on the Site and the same shall at all reasonable times be available for inspection and use by the Engineer and by any other person authorized by the Engineer in writing.

Disruption of Progress

**6.3** The Contractor shall give notice to the Engineer, with a copy to the Employer, whenever planning or execution of the Works is likely to be delayed or disrupted unless any further drawing or instruction is issued by the Engineer within a reasonable time. The notice shall include details of the drawing or instruction required and of why and by when it is required and of any delay or disruption likely to be suffered if it is late.

Delays and Cost of delay of Drawings

**6.4** If, by reason of any failure or inability of the Engineer to issue, within a time reasonable [ maximum 7 days] in all the circumstances, any drawing or instruction for which notice has been given by the Contractor in accordance with Sub-Clause 6.3, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Employer and the Contractor, determine:

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

(b) the amount of such costs, which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Employer.

Failure by Contractor to submit Drawings

**6.5** If the failure or inability of the Engineer to issue any drawings or instructions is caused in whole or in Part by the failure of the Contractor to submit Drawings, Specification or other documents which he is required to submit under the Contract, the Engineer shall take such failure by the Contractor into account when making his determination pursuant to Sub-Clause 6.4.

Supplementary Drawings and Instructions

**7.1** The Engineer shall have authority to issue to the Contractor, from time to time, such supplementary Drawings and instructions as shall be necessary for the purpose of the proper and adequate execution and completion of the Works and the remedying of any defects therein. The Contractor shall carry out

and be bound by the same.

Permanent  
Works Designed  
by Contractor

**7.2** Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall submit to the Engineer, for approval:

(a) such drawings, specifications, calculations and other information as shall be necessary to satisfy the Engineer as to the suitability and adequacy of that design, and

(b) operation and maintenance manuals together with drawings of the Permanent Works as completed, in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust the Permanent Works incorporating that design. The Works shall not be considered to be completed for the purposes of taking over in accordance with Clause 48 until such operation and maintenance manuals, together with drawing on completion, have been submitted to and approved by the Engineer.

Responsibility  
Unaffected by  
Approval

**7.3** Approval by the Engineer, in accordance with Sub-Clause 7.2, shall not relieve the Contractor of any of his responsibilities under the Contract.

### **General Obligations**

Contractor's  
General  
Responsibilities

**8.1** The Contractor shall, with due care and diligence, design (to the extent provided for by the Contract), execute and complete the Works and remedy any defects therein in accordance with the provisions of the Contract. The Contractor shall provide all superintendence, labor, materials, Plant, Contractor's Equipment and all other things, whether of a temporary or permanent nature, required in and for such design, execution, completion and remedying of any defects, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract.

The Contractor shall give prompt notice to the Engineer, with a copy to the Employer, of any error, omission, fault or other defect in the design of or Specification for the Works which he discovers when reviewing the Contract or executing the Works.

Site Operations  
and Method of  
Construction

**8.2** The Contractor shall take full responsibility for the adequacy, stability and safety of all Site operations and methods of construction. Provided that the Contractor shall not be responsible (except as stated hereunder or as may be otherwise agreed) for the design or specification of Permanent Works, or for the design or specification of any Temporary Works not prepared by the Contractor. Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall be fully responsible for that part of such Works, notwithstanding any approval by the Engineer.

|  |             |  |
|--|-------------|--|
| Contract Agreement                         | <b>9.1</b>  | The Contractor shall, if called upon so to do, enter into and execute the Contract Agreement, to be prepared and completed at the cost of the Employer, in the form annexed to these Conditions with such modification, as may be necessary.   |
| Performance Security                       | <b>10.1</b> | If the Contract requires the Contractor to obtain security for his proper performance of the Contract, he shall obtain and provide to the Employer such security within 15 days after the receipt of the Letter of Acceptance, in the sum stated in the Appendix to Tender. When providing such security to the Employer, the Contractor shall notify the Engineer of so doing. Such security shall be in the form annexed to these Conditions or in such other form as may be agreed between the Employer and the Contractor. The institution providing such security shall be subject to the approval of the Employer. The cost of complying with the requirements of this Clause shall be borne by the Contractor, unless the Contract otherwise provides.  |
| Period of Validity of Performance Security | <b>10.2</b> | The performance security shall be valid until the Contractor has executed and completed the Works and remedied any defects therein in accordance with the Contract. No claim shall be made against such security after the issue of the Defects Liability Certificate in accordance with Sub-Clause 62.1 and such security shall be returned to the Contractor within 14 days of the issue of the said Defects Liability Certificate.  |
| Claims Under Performance Security          | <b>10.3</b> | Prior to making a claim under the performance security the Employer shall, in every case, notify the Contractor stating the nature of the default in respect of which the claim is to be made.   |
| Inspection of Site                         | <b>11.1</b> | <p>The Employer shall have made available to the Contractor, before the submission by the Contractor of the Tender, such data on hydrological and sub-surface conditions as have been obtained by or on behalf of the Employer from investigations undertaken relevant to the Works but the Contractor shall be responsible for his own interpretation thereof.</p> <p>The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself (so far as is practicable, having regard to considerations of cost and time) before submitting his Tender, as to:</p> <p>(a) the form and nature thereof, including the sub-surface conditions,</p> <p>(b) the hydrological and climatic conditions,</p> <p>(c) the extent and nature of work and materials necessary for the execution and completion of the Works and the remedying of any defects therein, and</p> |

(d) the means of access to the Site and the accommodation he may require, and, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

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

Sufficiency  
of Tender

**12.1** The Contractor shall be deemed to have satisfied himself as to the correctness and sufficiency of the Tender and of the rates and prices stated in the Bill of Quantities, all of which shall, except insofar as it is otherwise provided in the Contract, cover all his obligations under the Contract (including those in respect of the supply of goods, materials, Plant or services or of contingencies for which there is a Provisional Sum) and all matters and things necessary for the proper execution and completion of the Works and the remedying of any defects therein.

Not Foreseeable  
Physical  
Obstructions or  
Conditions

**12.2** If, however, during the execution of the Works the Contractor encounters physical obstructions or physical conditions, other than climatic conditions on the Site, which obstructions or conditions were, in his opinion, not foreseeable by an experienced contractor, the Contractor shall forthwith give notice thereof to the Engineer, with a copy to the Employer. On receipt of such notice, the Engineer shall, if in his opinion such obstructions or conditions could not have been reasonably foreseen by an experienced contractor, after due consultation with the Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 44, and (b) the amount of any costs which may have been incurred by the Contractor by reason of such obstructions or conditions having been encountered, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer. Such determination shall take account of any instruction, which the Engineer may issue to the Contractor in connection therewith, and any proper and reasonable measures acceptable to the Engineer, which the Contractor may take in the absence of specific instructions from the Engineer.

Work to be in  
Accordance with  
Contract

**13.1** Unless it is legally or physically impossible, the Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the Contract to the satisfaction of the Engineer. The Contractor shall comply with and adhere strictly

to the Engineer's instructions on any matter, whether mentioned in the Contract or not, touching or concerning the Works. The Contractor shall take instructions only from the Engineer (or his delegate).

Programme to be Submitted

**14.1** The Contractor shall, within the time stated in Part II of these Conditions after the date of the Letter of Acceptance, submit to the Engineer for his consent a programme, in such form and detail as the Engineer shall reasonably prescribe, for the execution of the Works. The Contractor shall, whenever required by the Engineer, also provide in writing for his information a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works.

Revised Programme

**14.2** If at any time it should appear to the Engineer that the actual progress of the Works does not conform to the programme to which consent has been given under Sub-Clause 14.1, the Contractor shall produce, at the request of the Engineer, a revised programme showing the modifications to such programme necessary to ensure completion of the Works within the Time for Completion.

Cash Flow Estimate to be Submitted

**14.3** The Contractor shall, within the time stated in Part II of these Conditions after the date of the Letter of Acceptance, provide to the Engineer for his information a detailed cash flow estimate, in quarterly periods, of all payments to which the Contractor will be entitled under the Contract and the Contractor shall subsequently supply revised cash flow estimates at quarterly intervals, if required to do so by the Engineer.

Contractor not Relieved of Duties or Responsibilities

**14.4** The submission to and consent by the Engineer of such programmes or the provision of such general descriptions or cash flow estimates shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

Contractor's Superintendence

**15.1** The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorized representative approved of by the Engineer, which approval may at any time be withdrawn, shall give his whole time to the superintendence of the Works. Such authorized representative shall receive, on behalf of the Contractor, instructions from the Engineer.  
If approval of the representative is withdrawn by the Engineer, the Contractor shall, as soon as is practicable, having regard to the requirement of replacing him as hereinafter mentioned, after receiving notice of such withdrawal, remove the representative from the Works and shall not thereafter employ him again on the Works in any capacity and shall replace him by another

representative approved by the Engineer.

Contractor's  
Employees

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

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

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

Engineer at Liberty  
to Object

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

Setting-out

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

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

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

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

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

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

Boreholes  
and  
Exploratory  
Excavation

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

Safety, Security  
and Protection of  
the Environment

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

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

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

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

Employer's  
Responsibilities

**19.2** If under Clause 31 the Employer shall carry out work on the Site with his own workmen he shall, in respect of such work:

(a) have full regard to the safety of all persons entitled to be upon the Site, and

(b) keep the Site in an orderly state appropriate to the avoidance of danger to such persons.

If under Clause 31 the Employer shall employ other contractors on the Site he shall require them to have the same regard for safety and avoidance of danger.

Care of Works

**20.1** The Contractor shall take full responsibility for the care of the Works and materials and Plant for incorporation therein from the Commencement Date until the date of issue of the Taking-Over Certificate for the whole of the Works, when the responsibility for the said care shall pass to the Employer. Provided that:

(a) if the Engineer issues a Taking-Over Certificate for any Section or part of the Permanent Works the Contractor shall

cease to be liable for the care of that Section or part from the date of issue of the Taking-Over Certificate. When the responsibility for the care of that section or part shall pass to the Employer. and

(b) the Contractor shall take full responsibility for the care of any outstanding Works and materials and Plant for incorporation therein which he undertakes to finish during the Defects Liability Period until such outstanding Works have been completed pursuant to Clause 49.

Responsibility to Rectify Loss or Damage

**20.2.** If any loss or damage happens to the Works, or any part thereof, or materials or Plant for incorporation therein, during the period for which the Contractor is responsible for the care thereof, from any cause whatsoever, other than the risks defined in Sub-Clause 20.4, the Contractor shall, at his own cost, rectify such loss or damage so that the Permanent Works conform in every respect with the provisions of the Contract to the satisfaction of the Engineer. The Contractor shall also be liable for any loss or damage to the Works occasioned by him in the course of any operations carried out by him for the purpose of complying with his obligations under Clauses 49 and 50.

Loss or Damage due to Employer's Risks

**20.3.** In the event of any such loss or damage happening from any of the risks defined in Sub-Clause 20.4, or in combination with other risks, the Contractor shall, if and to the extent required by the Engineer, rectify the loss or damage and the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer. In the case of a combination of risks causing loss or damage any such determination shall take into account the proportional responsibility of the Contractor and the Employer.

Employer's Risks

**20.4** The Employer's risks are:

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

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

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



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

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

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

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

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

Insurance of  
Works and  
Contractor's  
Equipment

**21.1** The Contractor shall, without limiting his or the Employer's obligations and responsibilities under Clause 20, insure:

(a) the Works, together with materials and Plant for incorporation therein, to the full replacement cost (the term "cost" in this context shall include profit).

(b) an additional sum of 15 per cent of such replacement cost, or as may be specified in Part II of these Conditions, to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature, and

(c) the Contractor's Equipment and other things brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.

Scope of Cover

**21 21.2** The insurance in paragraphs (a) and (b) of Sub-Clause 21.1 shall be in the joint names of the Contractor and the Employer and shall cover:

(a) the Employer and the Contractor against all loss or damage from whatsoever cause arising, other than as provided in Sub-Clause 21.4, from the start of Work at the Site until the date of issue of the relevant Taking-Over Certificate in respect of the Works or any Section or part thereof as the case may be, and

(b) the Contractor for his liability:

(i) during the Defects Liability Period for loss or damage, arising from a cause occurring prior to the commencement of the Defects Liability Period, and

(ii) for loss or damage occasioned by the Contractor in the course of any operations carried out by him for the purpose of complying with his obligations under Clauses 49 and 50.

Responsibility  
for amounts not  
Recovered

**21.3** Any amounts not insured or not recovered from the insurers shall be borne by the Employer or the Contractor in accordance with their responsibilities under Clause 20.

Exclusions

**21.4** There shall be no obligation for the insurances in Sub-Clause 21.1 to include loss or damage caused by:

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

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

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

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

Damages to  
Persons and  
Property

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

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

(b) loss of or damage to any property (other than the Works), which may arise out of or in consequence of the execution and completion of the Works and the remedying of any defects therein, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, subject to the exceptions defined in Sub-Clause 22.2.

Exceptions

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

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

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

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

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

|                       |   |
|-----------------------|---|
| Indemnity by Employer | <b>22.3</b> The Employer shall indemnify the Contractor against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the exceptions defined in Sub-Clause 22.2. |
|-----------------------|---|

|   |   |
|---|---|
| Third Party Insurance (including Employer's Property) | <b>23.1</b> The Contractor shall, without limiting his or the Employer's obligations and responsibilities under Clause 22, insure, in the joint names of the Contractor and the Employer, against liabilities for death of or injury to any person (other than as provided in Clause 24) or loss of or damage to any property (other than the Works) arising out of the performance of the Contract, other than the exceptions defined in paragraphs (a), (b) and (c) of Sub-Clause 22.2. |
|---|---|

|                             |   |
|-----------------------------|---|
| Minimum amount of Insurance | <b>23.2</b> Such insurance shall be for at least the amount stated in the Appendix to Tender. |
|-----------------------------|---|

|                   |  |
|-------------------|--|
| Cross Liabilities | <b>23.3</b> The insurance policy shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Employer as separate insured. |
|-------------------|--|

|                               |   |
|-------------------------------|---|
| Accident or Injury to Workmen | <b>24.1</b> The Employer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any Subcontractor, other than death or injury resulting from any act or default of the Employer, his agents or servants. The Contractor shall indemnify and keep indemnified the Employer against all such damages and compensation, other than those for which the Employer is liable as aforesaid, and against all claims, proceedings, damages, costs, charges, and expenses whatsoever in respect thereof or in relation thereto. |
|-------------------------------|---|

|                   |  |
|-------------------|--|
| Insurance against | <b>24.2</b> The Contractor shall insure against such liability and shall |
|-------------------|--|

|  |             |  |
|--|-------------|--|
| Accident to Workmen                      |             | continue such insurance during the whole of the time that any persons are employed by him on the Works. Provided that, in respect of any persons employed by any Subcontractor, the Contractor's obligations to insure as aforesaid under this Sub-Clause shall be satisfied if the Subcontractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy, but the Contractor shall require such Subcontractor to produce to the Employer, when required, such policy of insurance and the receipt for the payment of the current premium.                          |
| Evidence and terms of Insurances         | <b>25.1</b> | The Contractor shall provide evidence to the Employer prior to the start of work at the Site that the insurances required under the Contract have been effected and shall, within 84 days of the Commencement Date, provide the insurance policies to the Employer. When, providing such evidence and such policies to the Employer, the Contractor shall notify the Engineer of so doing. Such insurance policies shall be consistent with the general terms agreed prior to the issue of the Letter of Acceptance. The Contractor shall effect all insurances for which he is responsible with insurers and in terms approved by the Employer. |
| Adequacy of Insurances                   | <b>25.2</b> | The Contractor shall notify the insurers of changes in the nature, extent or programme for the execution of the Works and ensure the adequacy of the insurances at all times in accordance with the terms of the Contract and shall, when required, produce to the Employer the insurance policies in force and the receipts for payment of the current premiums.  |
| Remedy on Contractor's Failure to Insure | <b>25.3</b> | If the Contractor fails to effect and keep in force any of the insurances required under the Contract or fails to provide the policies to the Employer within the period required by Sub-Clause 25. 1, then and in any such case the Employer may effect and keep in force any such insurances and pay any premium as may be necessary for that purpose and from time to time deduct the amount so paid from any monies due or to become due to the Contractor, or recover the same as a debt due from the Contractor.   |
| Compliance with Policy conditions        | <b>25.4</b> | In the event that the Contractor or the Employer fails to comply with conditions imposed by the insurance policies effected pursuant to the Contract, each shall indemnify the other against all losses and claims arising from such failure.  |
| Compliance with Statutes, Regulations    | <b>26.1</b> | The Contractor shall conform in all respects, including by the giving of all notices and the paying of all fees, with the provisions of: <p>(a) any National or State Statute, Ordinance or other Law, or</p>  |

any regulation, or bye-law of any local or other duly constituted authority in relation to the execution and completion of the Works and the remedying of any defects therein, and

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

#### Fossils

**27.1** All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall, as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Engineer's instructions for dealing with the same. If, by reason of such instructions, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 44, and (h) the amount of such costs which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

#### Patent Rights

**28.1** The Contractor shall save harmless and indemnify the Employer from and against all claims and proceedings for or on account of infringement of any patent rights, design trademark or name or other protected rights in respect of any Contractor's Equipment, materials or Plant used for or in connection with or for incorporation in the Works and from and against all damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, except where such infringement results from compliance with the design or Specification provided by the Engineer.

#### Royalties

**28.2** Except where otherwise stated, the Contractor shall pay all tonnage and other royalties, rent and other payments or compensation, if any, for getting stone, sand, gravel, clay or other materials required for the Works.

Interference  
with Traffic and  
Adjoining  
Properties

**29.1** All operations necessary for the execution and completion of the Works and the remedying of any defects therein shall, so far as compliance with the requirements of the Contract permits, to be carried on so as not to interfere unnecessarily or improperly with:

(a) the convenience of the public, or

(b) the access to, use and occupation of public or private roads and footpaths to or of properties whether in the possession of the Employer or of any other person.

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

Avoidance of  
Damage to Roads

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

Transport of  
Contractor's  
Equipment or  
Temporary Works

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

Transport of  
Materials or Plant

**30.3** If, notwithstanding Sub-Clause 30.1, any damage occurs to any bridge or road communicating with or on the routes to the Site arising from the transport of materials or Plant, the Contractor shall notify the Engineer with a copy to the Employer, as soon as he becomes aware of such damage or as soon as he receives any claim from the authority entitled to make such claim. Where under any law or regulation the haulier of such materials or Plant is required to indemnify the road authority against damage the Employer shall not be liable for any costs, charges or expenses in respect thereof or in relation thereto. In other cases

the Employer shall negotiate the settlement of and pay all sums due in respect of such claim and shall indemnify the Contractor in respect thereof and in respect of all claims, proceedings, damages, costs, charges and expenses in relation thereto.

Provided that if and so far as any such claim or part thereof is, in the opinion of the Engineer, due to any failure on the part of the Contractor to observe and perform his obligations under Sub-Clause 30.1, then the amount, determined by the Engineer, after due consultation with the Employer and the Contractor, to be due to such failure shall be recoverable from the Contractor by the Employer and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Provided also that the Employer shall notify the Contractor whenever a settlement is to be negotiated and, where any amount may be due from the Contractor, the Employer shall consult with the Contractor before such settlement is agreed.

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

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

(a) any other contractors employed by the Employer and their workmen,

(b) the workmen of the Employer, and

(c) the workmen of any duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any contract which the Employer may enter into in connection with or ancillary to the Works.

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

(a) make available to any such other contractor, or to the Employer or any such authority, any roads or ways for the maintenance of which the Contractor is responsible.

(b) permit the use, by any such, of Temporary Works or Contractor’s Equipment on the Site, or

(c) provide any other service of whatsoever nature for any such, the Engineer shall determine an addition to the Contract Price in

accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.

- |   |  |
|---|--|
| Contractor to keep Site Clear materials | <b>32.1</b> During the execution of the Works the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment and surplus and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required.  |
| Clearance of Site on Completion         | <b>33.1</b> Upon the issue of any Taking-Over Certificate the Contractor shall clear away and remove from that part of the Site to which such Taking-Over Certificate relates all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike condition to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period. |

## **Labour**

- |  |  |
|--|--|
| Engagement of Staff and Labour               | <b>34.1</b> The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.  |
| Returns of Labour and Contractor's Equipment | <b>35.1</b> The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and at such intervals as the Engineer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such information respecting Contractor's Equipment as the Engineer may require. |

## **Materials, Plant and Workmanship**

- |   |  |
|---|--|
| Quality of materials, Plant and Workmanship | <b>36.1</b> All materials, Plant and workmanship shall be:<br><br>(a) of the respective kinds described in the Contract and in accordance with the Engineer's instructions, and<br><br>(b) subjected from time to time to such test as the Engineer may require at the place of manufacture, fabrication or preparation, or on the Site or at such other place or places as may be specified in the Contract, or at all or any of such places.<br><br>The Contractor shall provide such assistance, labour, electricity, |
|---|--|



fuels, stores apparatus and instruments as are normally required for examining, measuring and testing any materials or Plant and shall supply samples of materials, before incorporation in the Works, for testing as may be selected and required by the Engineer.

**Cost of Samples**      **36.2** All samples shall be supplied by the Contractor at his own cost if the supply thereof is clearly intended by or provided for in the Contract.

**Cost of Tests**      **36.3** The cost of making any test shall be borne by the Contractor if such test is:

(a) clearly intended by or provided for in the Contract, or

(b) particularised in the Contract (in cases only of a test under load or of a test to ascertain whether the design of any finished or partially finished work is appropriate for the purposes which it was intended to fulfil) in sufficient detail to enable the Contractor to price or allow for the same in his Tender.

**Cost of Tests not Provided for**      **36.4** If any test required by the Engineer which is:

(a) not so intended by or provided for,

(b) (in the cases above mentioned) not so particularised, or

(c) (though so intended or provided for) required by the Engineer to be carried out at any place other than the Site or the place of manufacture, fabrication or preparation of the materials or Plant tested, shows the materials, plant or workmanship not to be in accordance with the provisions of the Contract to the satisfaction of the Engineer, then the cost of such test shall be borne by the Contractor, but in any other case Sub-Clause 36.5 shall apply.

**Engineer's Determination where Tests not Provided for**      **36.5** Where, pursuant to Sub-Clause 36.4, this Sub-Clause applies the Engineer shall, after due consultation with the Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 44, and (b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

**Inspection of Operations**      **37.1** The Engineer, and any person authorised by him, shall at all reasonable times have access to the Site and to all workshops and places where materials or Plant are being manufactured,

fabricated or prepared for the Works and the Contractor shall afford every facility for and every assistance in obtaining the right to such access.

Inspection and  
Testing

**37.2** The Engineer shall be entitled, during manufacture, fabrication or preparation to inspect and test the materials and Plant to be supplied under the Contract. If materials or Plant are being manufactured, fabricated or prepared in workshops or places other than those of the Contractor, the Contractor shall obtain permission for the Engineer to carry out such inspection and testing in those workshops or places. Such inspection or testing shall not release the Contractor from any obligation under the Contract.

Dates for  
Inspection and  
Testing

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

Rejection

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

Independent  
Inspection

**37.5** The Engineer may delegate inspection and testing of materials or Plant to an independent inspector. Any such delegation shall be effected in accordance with Sub-Clause 2.4 and for this

purpose such independent inspector shall be considered as an assistant of the Engineer. Notice of such appointment (not being less than 14 days) shall be given by the Engineer to the Contractor.

Examination  
of Work before  
Covering up

**38.1** No part of the Works shall be covered up or put out of view without the approval of the Engineer and the Contractor shall afford full opportunity for the Engineer to examine and measure any such part of the Works which is about to be covered up or put out of view and to examine foundations before any part of the Works is placed thereon. The Contractor shall give notice to the Engineer whenever any such part of the Works or foundations is or are ready or about to be ready for examination and the Engineer shall, without unreasonable delay, unless he considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such part of the Works or of examining such foundations.

Uncovering and  
Making Openings

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

Removal of  
Improper work,  
Materials or Plant

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

(a) the removal from the Site, within such time or times as may be specified in the instruction, of any materials or Plant which, in the opinion of the Engineer, are not in accordance with the Contract,

(b) the substitution of proper and suitable materials or Plant, and

(c) the removal and proper re-execution, notwithstanding any previous test thereof or interim payment therefore, of any work which, in respect of

(i) materials, Plant or workmanship, or

(ii) design by the Contractor or for which he is responsible, is not, in the opinion of the Engineer, in accordance with the

Contract.

Default of  
Contractor in  
Compliance

**39.2** In case of default on the part of the Contractor in carrying out such instruction within the time specified therein or, if none, within a reasonable time, the Employer shall be entitled to employ and pay other persons to carry out the same and all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

### **Suspension**

Suspension of  
Work

**40.1** The Contractor shall, on the instructions of the Engineer, suspend the progress of the Works or any part thereof for such time and in such manner as the Engineer may consider necessary and shall, during such suspension, properly protect and secure the Works or such part thereof so far as is necessary in the opinion of the Engineer. Unless such suspension is:

(a) otherwise provided for in the Contract,

(b) necessary by reason of some default of or breach of contract by the contractor or for which he is responsible,

(c) necessary by reason of climatic conditions on the Site, or

(d) necessary for the proper execution of the Works or for the safety of the Works or any part thereof (save to the extent that such necessity arises from any act or default by the Engineer or the Employer or from any of risks defined in Sub-Clause 20.4), Sub-Clause 40.2 shall apply.

Engineer's  
Determination  
following  
Suspension

**40.2** Where, pursuant to Sub-Clause 40.1, this Sub-Clause applies the Engineer shall, after due consultation with the Employer and the Contractor, determine:

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

(b) the amount, which shall be added to the Contract Price, in respect of the cost incurred by the Contractor by reason of such suspension, and shall notify the Contractor accordingly, with a copy to the Employer.

Suspension lasting  
more than 84 Days

**40.3** If the progress of the Works or any part thereof is suspended on the instructions of the Engineer and if permission to resume work is not given by the Engineer within a period of 84 days

from the date of suspension then, unless such suspension is within paragraph (a), (b), (c) or (d) of Sub-Clause 40.1, the Contractor may give notice to the Engineer requiring permission, within 28 days from the receipt thereof, to proceed with the Works or that part thereof in regard to which progress is suspended. If, within the said time, such permission is not granted, the Contractor may, but is not bound to elect to treat the suspension, where it affects part only of the Works, as an omission of such part under Clause 51 by giving a further notice to the Engineer to that effect, or, where it affects the whole of the Works, treat the suspension as an event of default by the Employer and terminate his employment under the Contract in accordance with the provisions of Sub-Clause 69.1, whereupon the provisions of Sub-Clauses 69.2 and 69.3 shall apply.

### **Commencement and Delays**

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

|   |  |
|---|--|
| Failure to Give Possession                                  | <p><b>42.2</b> If the Contractor suffers delay and/or incurs costs from failure on the part of the Employer to give position in accordance with the terms of Sub-Clauses 42.1, the Engineer shall, after due consultation with the Employer and the Contractor determine:</p> <p>(a) an extension of time to which the Contractor is entitled under Clause 44, and</p> <p>(b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly with a copy to the Employer.</p>   |
| Rights of way and facilities                                | <p><b>42.3</b> The Contractor shall bear all costs and charges for special or temporary rights of way required by him in connection with access to the Site. The Contractor shall also provide at his own cost any additional facilities outside the Site required by him for the purposes of the Works.</p>   |
| Time for Completion   | <p><b>43.1</b> The whole of the Works and, if applicable any Section required to be completed within a particular time as stated in the Appendix to Tender, shall be completed, in accordance with the provisions of Clause 48, within the time stated in the Appendix to Tender for the whole of the Works or the Section (as the case may be), calculated from the Commencement Date, or such extended time as may be allowed under Clause 44.</p>   |
| Extension of Time for Completion                            | <p><b>44.1</b> in the event of:</p> <p>(a) the amount or nature of extra or additional work.</p> <p>(b) any cause of delay referred to in these Conditions,</p> <p>(c) exceptionally adverse climatic conditions,</p> <p>(d) any delay, impediment or prevention by the Employer, or</p> <p>(e) other special circumstances which may occur, other than through a default of or breach of contract by the Contractor or for which he is responsible, being such as fairly to entitle the Contractor to an extension of the Time for completion of the Works, - or any Section or part thereof, the Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of such extension and shall notify the Contractor accordingly, with a copy to the Employer.</p> |
| Contractor to Provide Notification and Detailed Particulars | <p><b>44.2</b> Provided that the Engineer is not bound to make any determination unless the Contractor has</p> <p>(a) within 28 days after such event has first arisen notified the Engineer with a copy to the Employer, and</p>  |

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

Interim  
Determination of  
Extension

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

Restriction on  
Working Hours

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

Rate of Progress

**46.1** If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the Works or any Section is at any time, in the opinion of the Engineer, too slow to comply with the Time for Completion, the Engineer shall so notify the Contractor who shall thereupon take such steps as are necessary, subject to the consent of the Engineer, to expedite progress so as to comply with the Time for Completion. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a result of any notice given by the Engineer under this Clause, the Contractor considers that it is necessary to do any work at night or on locally recognised days of rest, he shall be entitled to seek the consent of the Engineer so to do. Provided that if any steps, taken by the Contractor in meeting his obligations under this Clause, involve the Employer

in additional supervision costs, such costs shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

Liquidated  
Damages for Delay

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

Reduction of  
liquidated  
Damages

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

Taking-Over  
Certificate

**48.1** When the whole of the Works have been substantially completed and have satisfactorily passed any Tests on Completion prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer, with a copy to the Employer, accompanied by a written undertaking to finish with due expedition any outstanding work during the Defects Liability Period. Such notice and undertaking shall be deemed to be a request by the Contractor for the Engineer to issue a Taking-Over Certificate in respect of the Works. The Engineer shall, within 21 days of the date of delivery of such notice, either issue to the Contractor, with a copy to the Employer, a Taking-Over Certificate, stating the date on which, in his



opinion, the Works were substantially completed in accordance with the Contract, or give instructions in writing to the Contractor specifying all the work which, in the Engineer's opinion, is required to be done by the Contractor before the issue of such Certificate. The Engineer shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the Works specified therein. The Contractor shall be entitled to receive such Taking-Over Certificate within 21 days of completion, to the satisfaction of the Engineer, of the Works so specified and remedying any defects so notified.

Taking-Over of  
Section of Part

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

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

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

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

Substantial  
Completion of  
Parts

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

Surfaces Requiring  
Reinstatement

**48.4** Provided that a Taking-Over Certificate given in respect of any Section or part of the Permanent Works before completion of the whole of the Works, shall not be deemed to certify completion of any ground or surfaces requiring reinstatement unless such Taking-Over Certificate shall expressly so state.

### **Defects Liability**

Defects Liability  
Period

**49.1** In these Conditions the expression "Defects Liability Period" shall mean the defects liability period named in the Appendix to Tender, calculated from:

(a) the date of completion of the Works certified by the Engineer in accordance with Clause 48, or

(b) in the event of more than one certificate having been issued by the Engineer under Clause 48, the respective dates so certified, and in relation to the Defects Liability Period the expression “the Works” shall be construed accordingly.

Completion of  
Outstanding Work  
and remedying  
Defects

**49.2** To the intent that the Works shall, at or as soon as practicable after expiration of the Defects Liability Period, be delivered to the Employer in the condition required by the Contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall:

(a) complete the work, if any, outstanding on the date stated in the Taking-Over Certificate as soon as practicable after such date, and

(b) execute all such work of amendment, reconstruction, and remedying defects, shrinkages or other faults as the Engineer may, during the Defects Liability Period or within 14 days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration, instruct the Contractor to execute.

Cost of Remedying  
Defects

**49.3** All work referred to in Sub-Clause 49.2 (b) shall be executed by the Contractor at his own cost if the necessity thereof is, in the opinion of the Engineer, due to:

(a) the use of materials, Plant or, workmanship not in accordance with the Contract,

(b) where the Contractor is responsible for the design of part of the Permanent Works, any fault in such design, or

(c) the neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the Contract.

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

Contractor's  
failure to carry out  
Instructions

**49.4** In case of default on the part of the Contractor in carrying out such instruction within a reasonable time, the Employer shall be entitled to employ and pay other persons to carry out the same and if such work is work which, in the opinion of the Engineer, the Contractor was liable to do at his own cost under the

Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

Contractor to  
search

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

### **Alterations, Additions and Omissions**

Variations

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

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

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

Instructions for  
Variation

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

Valuation of  
Variations

**52.1** All variations referred to in Clause 51 and any additions to the Contract Price which are required to be determined in accordance with Clause 52 (for the purposes of this Clause referred to as "varied work"), shall be valued at the rates and prices set out in the Contract if, in the opinion of the Engineer, the same shall be applicable. If the Contract does not contain any rates or prices applicable to the varied work, the rates and prices in the Contract shall be used as the basis for valuation so far as may be reasonable, failing which, after due consultation by the Engineer with the Employer and the Contractor, suitable rates or prices shall be agreed upon between the Engineer and the Contractor. In the event of disagreement the Engineer shall fix such rates or prices as are, in his opinion appropriate and shall notify the Contractor accordingly, with a copy to the Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on-account payments to be included in certificates issued in accordance with Clause 60.

Power of Engineer  
to Fix Rates

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

with Clause 60.

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

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

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

Variations  
Exceeding 15  
Percent

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

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

(b) all adjustments upon measurement of the estimated quantities set out in the Bill of Quantities, excluding provisional Sums, dayworks and adjustments of price made under Clause 70, but not from all other cause, there have been additions to or deductions from the Contract Price which taken together are in excess of 15 percent of the "Effective Contract Price" (which for the purposes of this Sub-Clause shall mean the Contract Price, excluding Provisional Sums, and allowance for dayworks, if any) then and in such event (subject to any action already taken under any other Sub-Clause of this Clause), after due consultation by the Engineer with the Employer and the Contractor, there shall be added to or deducted from the Contract Price such further sum as may be agreed between the Contractor and the Engineer or, failing agreement, determined by the Engineer having regard to the Contractor's Site and general overhead costs of the Contract. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer. Such sum shall be based only on the amount by which such additions or deductions shall be in excess of 15 percent of the Effective Contract Price.

Daywork

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

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

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

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

**Procedure for Claims**

Notice of Claims

**53.1** Notwithstanding any other provision of the Contract, if the Contractor intends to claim any additional payment pursuant to any Clause of these Conditions or otherwise, he shall give notice of his intention to the Engineer, with a copy to the Employer, within 28 days after the event giving rise to the claim has first arisen.

Contemporary  
Records  
reasonably

**53.2** Upon the happening of the event referred to in Sub-Clause 53.1, the Contractor shall keep such contemporary records as may be necessary to support any claim he may

subsequently wish to make. Without necessarily admitting the Employer's liability, the Engineer shall, on receipt of a notice under Sub-Clause 53.1, inspect such contemporary records and may instruct the Contractor to keep any further contemporary records as are reasonable and may be material to the claim of which notice has been given. The Contractor shall permit the Engineer to inspect all records kept pursuant to this Sub-Clause and shall supply him with copies thereof as and when the Engineer so instructs.

Substantiation of  
Claims

**53.3** Within 28 days, or such other reasonable time as may agreed by the Engineer of giving notice under Sub-Clause 53.1, the Contractor shall send to the Engineer an account giving detailed particulars of the amount claimed and the grounds upon which the claim is based. Where the event giving rise to the claim has a continuing effect, such account shall be considered to be an interim account and the Contractor shall, at such intervals as the Engineer may reasonably require, send further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. In cases where interim accounts are sent to the Engineer, the Contractor shall send a final account within 28 days of the end of the effects resulting from the event. The Contractor shall, if required by the Engineer so to do, copy to the Employer all accounts sent to the Engineer pursuant to this Sub-Clause.

Failure to Comply

**53.4** If the Contractor fails to comply with any of the provisions of this Clause in respect of any claim which he seeks to make, his entitlement to payment in respect thereof shall not exceed such amount as the Engineer or any arbitrator or arbitrators appointed pursuant to Sub-Clause 67.3 assessing the claims considers to be verified by contemporary records (whether or not such records were brought to the Engineer's notice, as required under Sub-Clauses 53.2 and 53.3).

Payment of Claims

**53.5** The Contractor shall be entitled to have included in any Interim payment certified by the Engineer pursuant to Clause 60 such amount in respect of any claim as the Engineer, after due consultation with the Employer and the Contractor, may consider due to the Contractor provided that the Contractor has supplied sufficient particulars to enable the Engineer to determine the amount due. If such particulars are insufficient to substantiate the whole of the claim, the Contractor shall be entitled to payment in respect of such part of the claim as such particulars may substantiate to the satisfaction of the Engineer. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer.

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

|  |   |
|--|---|
| Contractor's Equipment, Temporary Works and Materials; Exclusive use for the works | <b>54.1</b> All Contractor's Equipment, Temporary Works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof, except for the purpose of moving it from one part of the Site to another, without the consent of the Engineer. Provided that consent shall not be required for vehicles engaged in transporting any staff, labour, Contractor's Equipment, Temporary Works, Plant or materials to or from the Site.  |
| Employer not Liable for Damage   | <b>54.2</b> The Employer shall not at any time to be liable, save as mentioned in Clauses 20 and 65, for the loss of or damage to any of the said Contractor Equipment, Temporary Works or materials.   |
| Customs Clearance  | <b>54.3</b> The Employer will use his best endeavours in assisting the Contractor, where required, in obtaining clearance through the Customs of Contractor's Equipment, materials and other things required for the Works.   |
| Re-exports of Contractor's Equipment   | <b>54.4</b> In respect of any Contractor's Equipment which the Contractor has imported for the purposes of the Works, the Employer will use his best endeavours to assist the Contractor, where required, in procuring any necessary Government consent to the re-export of such Contractor's Equipment by the Contractor upon the removal thereof pursuant to the terms of the Contract.   |
| Conditions of Hire of Contractor's Equipment                                       | <b>54.5</b> With a view to securing, in the event of termination under Clause 63, the continued availability, for the purpose of executing the Works, of any hired Contractor's Equipment, the Contractor shall not bring on to the Site any hired Contractor's Equipment unless there is an agreement for the hire thereof (which agreement shall be deemed not to include an agreement for hire purchase) which contains a provision that the owner thereof will, on request in writing made by the Employer within 7 days after the date on which any termination has become effective, and on the Employer undertaking to pay all hire charges in respect thereof from such date, hire such Contractor's Equipment to the Employer on the same terms in all respects as the same was hired to the Contractor save that the Employer shall be entitled to permit the use thereof by any other contractor employed by him for the purpose of executing and completing the Works and remedying any defects therein, under the terms of the said Clause 63. |
| Costs for the purpose of Clause  | <b>54.6</b> In the event of the Employer entering into any agreement for the hire of Contractor's Equipment pursuant to Sub-Clause 54.5, all  |



|   |             |  |
|---|-------------|--|
| 63                                      |             | sums properly paid by the Employer under the provisions of any such agreement and all costs incurred by him (including stamp duties) in entering into such agreement shall be deemed, for the purpose of Clause 63, to be part of the cost of executing and completing the Works and the remedying of any defects therein. |
| Incorporation of Clause in Subcontracts | <b>54.7</b> | The Contractor shall, where entering into any subcontract for the execution of any part of the Works, incorporate in such subcontract (by reference or otherwise) the provisions of this Clause in relation to Contractor's Equipment, Temporary Works or materials brought on to the Site by the Subcontractor.           |
| Approval of Materials not Implied       | <b>54.8</b> | The operation of this Clause shall not be deemed to imply any approval by the Engineer of the materials or other matters referred to therein nor shall it prevent the rejection of any such materials at any time by the Engineer.   |

## **Measurement**

|                      |             |   |
|----------------------|-------------|---|
| Quantities           | <b>55.1</b> | The quantities set out in the Bill of Quantities are the estimated quantities for the Works, and they are not to be taken as the actual and correct quantities of the Works to be executed by the Contractor in fulfilment of his obligations under the Contract.   |
| Works to be Measured | <b>56.1</b> | <p>The Engineer shall, except as otherwise stated, ascertain and determine by measurement the value of the Works in accordance with the Contract and the Contractor shall be paid that value in accordance with Clause 60. The Engineer shall, when he requires any part of the Works to be measured, give reasonable notice to the Contractor's authorised agent, who shall:</p> <p>(a) forthwith attend or send a qualified representative to assist the Engineer in making such measurement, and</p> <p>(b) supply all particulars required by the Engineer.</p> <p>Should the Contractor not attend, or neglect or omit to send such representative, then the measurement made by the Engineer or approved by him shall be taken to be the correct measurement of such part of the Works. For the purpose of measuring such Permanent works as are to be measured by records and drawings, the Engineer shall prepare records and drawings as the work proceeds and the Contractor, as and when called upon to do so in writing, shall, within 14 days, attend to examine and agree such records and drawings with the Engineer and shall sign the same when so agreed. If the Contractor does not attend to examine and agree such records and drawings, they shall be taken to be correct. If, after examination of such records and drawings, the Contractor does not agree the same or does</p> |

not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor, within 14 days of such examination, lodges with the Engineer notice of the respects in which such records and drawings are claimed by him to be incorrect. On receipt of such notice, the Engineer shall review the records and drawings and either confirm or vary them.

Method of  
Measurement

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

Breakdown of  
Lump sum Items

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

### **Provisional Sums**

Definition of  
“Provisional  
Sums”

**58.1** “Provisional Sum” means a sum included in the Contract and so designated in the Bill of Quantities for the execution of any part of the Works or for the supply of goods, materials, Plant or services, or for contingencies, which sum may be used, in whole or in part, or not at all, on the instructions of the Engineer. The Contractor shall be entitled to only such amounts in respect of the work, supply or contingencies to which such Provisional Sums relate as the Engineer shall determine in accordance with this Clause. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer.

Use of  
Provisional Sums

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

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

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

Production of  
Vouchers

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

## **Nominated Subcontractors**

Definition of  
“Nominated  
Subcontractor”

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

Nominated  
Subcontractors;  
Objection to  
Nomination

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

(a) that in respect of the work, goods, materials, Plant or services the subject of the subcontract, the nominated Subcontractor will undertake towards the Contractor such obligations and liabilities as will enable the Contractor to discharge his own obligations and liabilities towards the Employer under the terms of the Contract and will save harmless and indemnify the Contractor from and against the same and from all claims, proceeding, damages, costs, charges and expenses whatsoever arising out of or in connection therewith, or arising out of or in connection with any failure to perform such obligations or to fulfil such liabilities, and

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

Design  
Requirements to be  
Expressly Stated

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

Payments to  
Nominated  
Subcontractors

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

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

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

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

Certification of  
Payments to  
Nominated  
Subcontractors

**59.5** Before issuing, under Clause 60, any certificate, which includes any payment in respect of work done or goods, materials, Plant or services supplied by any nominated Subcontractor, the Engineer shall be entitled to demand from the Contractor reasonable proof that all payments, less retentions, included in previous certificates in respect of the work or goods, materials, Plant or services of such nominated Subcontractor have been paid or discharged by the Contractor. If the Contractor fails to supply such proof then, unless the Contractor:

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

(b) produces to the Engineer reasonable proof that he has so informed such nominated Subcontractor in writing, the Employer shall be entitled to pay to such nominated Subcontractor direct, upon the certificate of the Engineer, all payments, less retentions, provided for in the nominated Subcontract, which the Contractor has failed to make to such nominated Subcontractor and to deduct by way of set-off the amount so paid by the Employer from any sums due or to become due from the Employer to the Contractor.

Provided that, where the Engineer has certified and the Employer has paid direct as aforesaid, the Engineer shall, in issuing any further certificate in favour of the Contractor,

deduct from the amount thereof the amount so paid, direct as aforesaid, but shall not withhold or delay the issue of the certificate itself when due to be issued under the terms of the Contract.

## **Certificates and Payment**

### **Monthly Statements**

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

- (a) the value of the Permanent Works executed,
- (b) any other items in the Bill of Quantities including those for Contractor's Equipment, Temporary Works, dayworks and the like,
- (c) the percentage of the invoice value of listed materials, all as stated in the Appendix to Tender, and Plant delivered by the Contractor on the Site for incorporation in the Permanent Works but not incorporated in such Works,
- (d) adjustments under Clause 70, and
- (e) any other sum to which the Contractor may be entitled under the Contract or otherwise.

### **Monthly Payments**

**60.2** The Engineer shall, within 15 days of receiving such statement, deliver to the Employer an Interim Payment Certificate stating the amount of payment to the Contractor which the Engineer considers due and payable in respect of such statement, subject:

- (a) firstly, to the retention of the amount calculated by applying the Percentage of Retention stated in the Appendix to Tender, to the amount to which the Contractor is entitled under paragraphs (a), (b), (c) and (e); of Sub-Clause 60.1 until the amount so retained reaches the Limit of Retention Money stated in the Appendix to Tender, and
- (b) secondly, to the deduction, other than pursuant to Clause 47, of any sums which may have become due and payable by the Contractor to the Employer.

Provided that the Engineer shall not be bound to certify any payment under this Sub-Clause if the net amount thereof, after all retentions and deductions, would be less than the Minimum

Amount of Interim Payment Certificates stated in the Appendix to Tender.

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

Payment of  
Retention Money

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

(b) Upon the expiration of the Defects Liability Period for the Works the other half of the Retention Money shall be certified by the Engineer for payment to the Contractor. Provided that, in the event of different Defects Liability Periods having become applicable to different Sections or parts of the Permanent Works pursuant to Clause 48, the expression "expiration of the Defects Liability Period" shall, for the purposes of this Sub-Clause, be deemed to mean the expiration of the latest of such periods. Provided also that if at such time there shall remain to be executed by the Contractor any work, instructed, pursuant to Clauses 49 and 50, in respects of the Works, the Engineer shall be entitled to withhold certification, until completion of such work of so much of the balance of the Retention Money as shall, in the opinion of the Engineer, represent the cost of the work remaining to be executed.

Correction of  
Certificates

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

Statement at  
Completion

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

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

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

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

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

Final Statement

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

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

(b) any further sums which the Contractor considers to be due to him under the Contract or otherwise. If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed (for the purposes of these Conditions referred to as the "Final Statement").

If, following discussions between the Engineer and the Contractor and any changes to the draft final statement which may be agreed between them, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer an Interim Payment Certificate for those parts of the draft final statement, if any, which are not in dispute. The dispute may then be settled in accordance with Clause 67.

Discharge

**60.7** Upon submission of the Final Statement, the Contractor shall give to the Employer, with a copy to the Engineer, a written discharge confirming that the total of the Final Statement represents full and final settlement of all monies due to the Contractor arising out of or in respect of the Contract. Provided that such discharge shall become effective only after payment due under the Final Payment Certificate issued pursuant to Sub-Clause 60.8 has been made and the performance security referred to in Sub-Clause 10.1, if any, has been returned to the Contractor.

Final Payment Certificate

**60.8** Within 28 days after receipt of the Final Statement, and the written discharge the Engineer shall issue to the Employer (with a copy to the Contractor) a Final Payment Certificate stating:

(a) the amount which, in the opinion of the Engineer, is finally

due under the Contract or otherwise, and

(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled other than under Clause 47, the balance, if any, due from the Employer to the Contractor or from the Contractor to the Employer as the case may be.

Cessation of  
Employer's  
Liability

**60.9** The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or execution of the Works, unless the Contractor shall have included a claim in respect thereof in his Final Statement and (except in respect of matters or things arising after the issue of the Taking-Over Certificate in respect of the whole of the Works) in the Statement at Completion referred to in Sub-Clause 60.5.

Time for Payment

**60.10** The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause or to any other term of the Contract, shall subject to Clause 47, be paid by the Employer to the Contractor within 28 days after such Interim payment Certificate has been delivered to the Employer, or in the case of the Final Payment Certificate referred to in Sub-Clause 60.8, within 56 days after such Final Payment Certificate has been delivered to the Employer. In the event of the failure of the Employer to make payment within the times stated, the Employer shall pay to the Contractor interest at the rate stated in the Appendix to Tender upon all sums unpaid from the date by which the same should have been paid. The provision of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69 or otherwise.

Approval only by  
Defects Liability  
Certificate

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

Defects Liability  
Certificates

**62.1** The Contract shall not be considered as completed until a Defects Liability Certificate shall have been signed by the Engineer and delivered to the Employer with a copy to the Contractor, stating the date on which the Contractor shall have completed his obligations to execute and complete the Works and remedy any defects therein to the Engineer's satisfaction. The Defects Liability Certificate shall be given by the Engineer within 28 days after the expiration of the Defect Liability Period, or, if different defects liability periods shall become applicable to different Sections or parts of the Permanent Works, the expiration of the last such period, or as soon thereafter as any works instructed, pursuant to Clauses 40 and 50, have been completed to the satisfaction of the Engineer. Provided that the issue of the Defects Liability Certificate shall



not be a condition precedent to payment to the Contractor of the second portion of the Retention Money in accordance with the conditions set out in Sub-Clause 60.3.

Unfulfilled  
Obligations

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

## **Remedies**

Default of  
Contractor

**63.1** If the Contractor is deemed by law unable to pay his debts as they fall due, or enters into voluntary or involuntary bankruptcy, liquidation or dissolution (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), or becomes insolvent, or makes an arrangement with, or assignment in favour of, his creditors, or agree to carry out the Contract under a committee of inspection of his creditors, or if a receiver, administrator, trustee or liquidator is appointed over any substantial part of his assets, or if, under any law or regulation relating to reorganization, arrangement or readjustment of debts, proceedings are commenced against the Contractor or resolutions passed in connection with dissolution or liquidation or if any steps are taken to enforce any security interest over a substantial part of the assets of the Contractor, or if any act is done or event occurs with respect to the Contractor or his assets which, under any applicable law has a substantially similar effect to any of the foregoing acts or events, or if the Contractor has contravened Sub-Clause 3.1, or has an execution levied on his goods, or if the Engineer certifies to the Employer, with a copy to the Contractor, that, in his opinion, the Contractor:

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

any of his obligations under the Contract, or

(e) has contravened Sub-Clause 4. 1, then the Employer may, after giving 14 days' notice to the Contractor, enter upon the Site and the Works and terminate the employment of the Contractor without thereby releasing the Contractor from any of his obligations or liabilities under the Contract, or affecting the rights and authorities conferred on the Employer or the Engineer by the Contract, and may himself complete the Works or may employ any other contractor to complete the Works. The Employer or such other contractor may use for such completion so much of the Contractor's Equipment, Temporary Works and materials as he or they may think proper.

Valuation at Date  
of Termination

**63.2** The Engineer shall, as soon as may be practicable after any such entry and termination by the Employer, fix and determine ex part, or by or after reference to the parties or after such investigation or enquiries as he may think fit to make or institute, and shall certify:

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

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

Payment after  
Termination

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

Assignment of

**63.4** Unless prohibited by law, the Contractor shall, if so instructed

Benefit of Agreement

by the Engineer within 14 days of such entry and termination referred to in Sub-Clause 63.1, assign to the Employer the benefit of any agreement for the supply of any goods or materials or services and/or for the execution of any work for the purposes of the Contract, which the Contractor may have entered into.

Urgent Remedial Works

**64.1** If, by reason of any accident, or failure, or other event occurring to, in, or in connection with the Works, or any part thereof, either during the execution of the Works, or during the Defects Liability Period, any remedial or other work is, in the opinion of the Engineer, urgently necessary for the safety of the Works and the Contractor is unable or unwilling at once to do such work, the Employer shall be entitled to employ and pay other persons to carry out such work as the Engineer may consider necessary. If the work or repair so done by the Employer is work which, in the opinion of the Engineer, the Contractor was liable to do at his own cost under the Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Provided that the Engineer shall, as soon after the occurrence of any such emergency as may be reasonably practicable, notify the Contractor thereof.

### Special Risks

No Liability for Special Risks

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

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

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

(c) injury or loss of life.

Special Risks

**65.2** The special risks are:

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

(b) the risks defined under paragraph (b) of Sub-Clause 20.4

insofar as these relate to the country in which the Works are to be executed.

Damage to Works  
by Special Risks

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

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

(b) replacing or rectifying such materials or Contractor's Equipment, and the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 (which shall in the case of the cost of replacement of Contractor's Equipment include the fair market value thereof as determined by the Engineer) and shall notify the Contractor accordingly, with a copy to the Employer.

Projectile, Missile

**65.4** Destruction, damage, injury or loss of life caused by the explosion or impact, whenever and wherever occurring, of any mine, bomb, shell, grenade, or other projectile, missile, ammunition, or explosive of war, shall be deemed to be a consequence of the said special risks.

Increased Costs  
arising from  
Special Risks

**65.5** Save to the extent that the Contractor is entitled to payment under any other provision of the Contract, the Employer shall repay to the Contractor any costs of the execution of the Works (other than such as may be attributable to the cost of reconstructing work condemned under the provisions of Clause 39 prior to the occurrence of any special risk) which are howsoever attributable to or consequent on or the result of or in any way whatsoever connected with the said special risks, subject however to the provisions in this Clause hereinafter contained in regard to outbreak of war, but the Contractor shall, as soon as any such cost comes to his knowledge, forthwith notify the Engineer thereof. The Engineer shall, after due consultation with the Employer and the Contractor determine the amount of the Contractor's costs in respect thereof which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Employer.

**Outbreak of War 65.6** If, during the currency of the Contract, there is an outbreak of war, whether war is declared or not, in any part of the world which, whether financially or otherwise, materially affects the execution of the Works, the Contractor shall, unless and until the Contract is terminated under the provisions of this Clause,

continue to use his best endeavours to complete the execution of the Works. Provided that the Employer shall be entitled at any time after such outbreak of war, to terminate the Contract by giving notice to the Contractor and upon such notice being given, the Contract shall, except as to the rights of the parties under this Clause and Clause 67, terminate, but without prejudice to the rights of either party in respect of any antecedent breach thereof.

Removal of  
Contractor's  
Equipment on  
Termination

**65.7** If the Contract is terminated under the provisions of Sub-Clause 65.6, the Contractor shall, with all reasonable dispatch, remove from the Site all Contractor's Equipment and shall give similar facilities to his Subcontractors to do so.

Payment if  
Contract  
Terminated

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

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

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

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

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

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

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

the time of such termination.

Provided that against any payment due from the Employer under this Sub-Clause, the Employer shall be entitled to be credited with any outstanding balances due from the Contractor for advances in respect of Contractor's Equipment, materials and Plant and any other sums which, at the date of termination, were recoverable by the Employer from the Contractor under the terms of the Contract. Any sums payable under this Sub-Clause shall, after due consultation with the Employer and the Contractor, be determined by the Engineer who shall notify the Contractor accordingly, with a copy to the Employer.

### **Release from Performance**

Payment in Event  
of Release from  
Performance

prejudice

**66.1** If any circumstance outside the control of both parties arises after the issue of the Letter of Acceptance which renders it impossible or unlawful for either or both parties to fulfil his or their contractual obligations, or under the law governing the Contract the parties are released from further performance, then the parties shall be discharged from the Contract, except as to their rights under this Clause and Clause 67 and without to the rights of either party in respect of any antecedent breach of the Contract, and the sum payable by the Employer to the Contractor in respect of the work executed shall be the same as that which would have been payable under Clause 65 if the Contract had been terminated under the provisions of Clause 65.

### **Settlement of Disputes**

Engineer's  
Decision

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

Unless the Contract has already been repudiated or terminated, the Contractor shall, in every case, continue to proceed with the Works with all due diligence and the Contractor and the Employer shall give effect forthwith to every such decision of

the Engineer unless and until the same shall be revised, as hereinafter provided, in an amicable settlement or an arbitral award.

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

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

Amicable  
Settlement

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

## Arbitration

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

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

(b) amicable settlement has not been reached within the period stated in Sub-Clause 67.2 shall be finally settled, unless otherwise specified in the Contract, under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed under such Rules. The said arbitrator/s shall have full power to open up, review and revise any decision, opinion, instruction, determination, certificate or valuation of the Engineer related to the dispute.

Neither party shall be limited in the proceedings before such arbitrator/s to the evidence or arguments put before the Engineer for the purpose of obtaining his said decision pursuant to Sub-Clause 67.1. No such decision shall disqualify the Engineer from being called as a witness and giving evidence before the arbitrator/s on any matter whatsoever relevant to the dispute.

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

Failure to Comply  
with Engineer's  
Decision

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

## **Notices**

Notice to  
Contractor

**68.1** All certificates, notices or instructions to be given to the Contractor by the Employer or the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the Contractor's principal place of business or such other address as the Contractor shall nominate for that purpose.

Notice to Employer  
and Engineer

**68.2** Any notice to be given to the Employer or to the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the respective address as nominated for that purpose in Part II of these Conditions.



Changes  
of Address

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

### **Default of Employer**

Default of  
Employer

**69.1** In the event of the Employer:

(a) failing to pay to the Contractor the amount due under any certificate of the Engineer within 28 days after the expiry of the time stated in Sub-Clause 60.10 within which payment is to be made, subject to any deduction that the Employer is entitled to make under the Contract,

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

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

(d) giving notice to the Contractor that for unforeseen economic reasons it is impossible for him to continue to meet his contractual obligations, the Contractor shall be entitled to terminate his employment under the Contract by giving notice to the Employer, with a copy to the Engineer. Such termination shall take effect 14 days after the giving of the notice.

Removal of  
Contractor's  
Equipment

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

Payment on  
Termination

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

Contractor's  
Entitlement to  
Suspend Work

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

with a copy to the Engineer, suspend work or reduce the rate of work.

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

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

(b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

Resumption of Work

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

### **Changes in Costs and Legislation**

Increase or Decrease of Cost

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

Subsequent Legislation

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

### **Currency and Rates of Exchange**

Currency Restrictions

**71.1** If, after the date 7 days prior to the latest date for submission of tenders for the Contract, the Government or authorised agency

of the Government of the country in which the Works are being or are to be executed imposes currency restrictions and/or transfer of currency restrictions in relation to the currency or currencies in which the Contract Price is to be paid, the Employer shall reimburse any loss or damage to the Contractor arising there from, without prejudice to the right of the Contractor to exercise any other rights or remedies to which he is entitled in such event.

Rates of Exchange

**72.1** Where the Contract provides for payment in whole or in part to be made to the Contractor in foreign currency or currencies, such payment shall not be subject to variations in the rate or rates of exchange between such specified foreign currency or currencies and the currency of the country in which the Works are to be executed.

Currency  
Proportions

**72.2** Where the Employer has required the Tender to be expressed in a single currency but with payment to be made in more than one currency and the Contractor has stated the proportions or amounts of other currency or currencies in which he requires payment to be made, the rate or rates of exchange applicable for calculating the payment of such proportions or amounts shall, unless otherwise stated in Part II of these Conditions, be those prevailing, as determined by the Central Bank of the country in which the Works are to be executed, on the date 28 days prior to the latest date for the submission of tenders for the Contract, as has been notified to the Contractor by the Employer prior to the submission of tenders or as provided for in the Tender.

Currencies of  
Payment for  
Provisional Sums

**72.3** Where the Contract provides for payment in more than one currency, the proportions or amounts to be paid in foreign currencies in respect of Provisional Sums shall be determined in accordance with the principles set forth in Sub-Clause 72.1 and 72.2 as and when these sums are utilized in whole or in part in accordance with the provisions of Clauses 58 and 59.

## PART I – GENERAL CONDITIONS

### Index

|   | Clause |
|---|--------|
| Access to Site  | 42.1   |
| Access to Works, Engineer   | 37.1   |
| Access, Contractor to Satisfy Himself                                       | 11.1   |
| Accident or Injury to Workmen – Insurance Against                           | 24.2   |
| Accident or Injury to Workmen – Liability for                               | 24.1   |
| Address, Change of  | 68.3   |
| Adequacy of Insurance   | 25.2   |
| Adjustment of Contract Price if Variations Exceed 15 per cent of Tender Sum | 52.3   |
| Agreement   | 9.1    |
| Alterations, Additions and Omissions  | 51.    |
|   | & 52.  |
| Ambiguities in Contract Documents   | 5.2    |
| Amicable Settlement of Disputes   | 67.2   |
| Appointment of Assistants to Engineer                                       | 2.4    |
| Approval by the Engineer  | 7.3    |
| Approval of Materials not Implied   | 54.8   |
| Approval Only by Defects Liability Certificate                              | 61.1   |
| Arbitration   | 67.3   |
| Assignment of Contract  | 3.1    |
| Avoidance of Damage to Roads  | 30.1   |
| Bills of Quantities – Estimated Only  | 55.1   |
| Boreholes and Exploratory Excavation  | 18.1   |
| Breakdown of Lump Sum Items   | 57.2   |
| Care of Works   | 20.1   |
| Cash Flow Estimate to be Submitted  | 14.3   |
| Certificate, Final Payment  | 60.8   |
| Certificates and Payment, Monthly Statements                                | 60.1   |
| Certificates, Correction of   | 60.4   |
| Certificate, Taking-Over  | 48.1   |
| Certification of Completion of Works  | 48.1   |
| Certification of Completion of Sections or Parts                            | 48.2   |
| Cessation of Employer's Liability   | 60.9   |
| Change of Address, Notice of  | 68.3   |
| Claims, Contemporary Records  | 53.2   |
| Claims, Notice of   | 53.1   |
| Claims, Payment of  | 53.5   |
| Claims, Substantiation of   | 53.3   |
| Claims Under Performance Security   | 10.3   |
| Clearance of Site on Completion   | 33.1   |
| Commencement of Works   | 41.1   |
| Completion of Works, Time for   | 43.1   |
| Completion of Works, Time for, Extension of                                 | 44.1   |
| Completion, Statement at  | 60.5   |
| Compliance with Insurance Policy Conditions                                 | 25.4   |
| Compliance with Statutes and Regulations                                    | 26.1   |
| Contemporary Records for Claims   | 53.2   |
| Contract Agreement  | 9.1    |
| Contractor Not Relieved of Duties or Responsibilities                       | 14.4   |
| Contractor's Employees  | 16.1   |
| Contractor's Employees, Engineer at Liberty to Object                       | 16.2   |
| Contractor's Entitlement to Suspend Work for Employer's Default             | 69.4   |
| Contractor's Equipment, Conditions of Hire                                  | 54.5   |
| Contractor's Equipment, Employer not Liable for Damage                      | 54.2   |

# Index

## Clause

|  |       |
|--|-------|
| Contractor's Equipment, Insurance of                                   | 21.1  |
| Contractor's Equipment, Reference in Subcontracts                      | 54.7  |
| Contractor's Equipment, Temporary Works and Materials;                 |       |
| Exclusive Use for the Works  | 54.1  |
| Contractor's Equipment, Transport of                                   | 30.2  |
| Contractor's Failure to Carry Out Instructions                         | 49.4  |
| Contractor's Failure to Insure, Remedy                                 | 25.3  |
| Contractor's General Responsibilities                                  | 8.1   |
| Contractor's Superintendence   | 15.1  |
| Contractor to Keep Site Clear  | 32.1  |
| Contractor to Search   | 50.1  |
| Correction of Certificates   | 60.4  |
| Cost of Remedying Defects  | 49.3  |
| Cost of Samples  | 36.2  |
| Cost of Tests  | 36.3  |
| Cost of Tests not Provided for   | 36.4  |
| Covering up Work, Examination Before                                   | 38.1  |
| Cross Liabilities  | 23.3  |
| Currencies of Payment for Provisional Sums                             | 72.3  |
| Currencies, Rates of Exchange  | 72.1  |
| Currency Restrictions  | 71.1  |
| Custody and Supply of Drawings and Documents                           | 6.1   |
| Customs Clearance  | 54.3  |
| Damage to Persons and Property   | 22.1  |
| Damage to Roads, Avoidance of  | 30.1  |
| Damage to Works, Special Risks   | 65.3  |
| Damages, Liquidated  | 47.1  |
| Dates for Inspection and Testing                                       | 37.3  |
| Daywork  | 52.4  |
| Decrease or Increase of Costs  | 70.1  |
| Default of Contractor in Compliance with Instructions on Improper Work | 39.2  |
| Default of Contractor, Remedies for                                    | 63.1  |
| Default of Employer  | 69.1  |
| Defective Materials and Work   | 39.1  |
| Defects, Contractor to Search for, if Required                         | 50.1  |
| Defects, Cost of Remedying   | 49.3  |
| Defects Liability Certificate  | 62.1  |
| Defects Liability Period   | 49.1  |
| Defects, Remedying of  | 49.2  |
| Definitions  | 1.1   |
| Delay, Liquidated Damages for  | 47.1  |
| Delays and Cost of Delay of Drawings                                   | 6.4   |
| Design by Nominated Subcontractors                                     | 59.3  |
| Discharge  | 60.7  |
| Discrepancies in Documents   | 5.2   |
| Dismissal of Contractor's Employees                                    | 16.2  |
| Disorderly Conduct, etc.   | 34.1  |
| Disputes, Engineer's Decision  | 67.1  |
| Disruption of Progress   | 6.3   |
| Documents Mutually Explanatory   | 5.2   |
| Drawings   | 6 & 7 |
| Drawings and Documents – Custody and Supply of                         | 6.1   |
| Drawings and Instructions – Supplementary                              | 7.1   |
| Drawings, Copy to be Kept on Site                                      | 6.2   |
| Drawings, Delays and Cost of Delay of Drawings                         | 6.4   |
| Drawings, Failure by Contractor to Submit                              | 6.5   |
| Employer not Liable for Damage to Contractor's Equipment etc.          | 54.2  |

# Index

## Clause

|   |        |
|---|--------|
| Employer's Liability, Cessation of                                      | 60.9   |
| Employer's Responsibilities   | 19.2   |
| Employer's Risks  | 20.4   |
| Engagement of Staff and Labour  | 34.1   |
| Engineer's Authority to Delegate  | 2.3    |
| Engineer's Determination Where Tests not Provided for                   | 36.5   |
| Engineer's Duties and Authority   | 2.1    |
| Engineer to Act Impartially   | 2.6    |
| Environment – Protection of   | 19.1   |
| Errors in Setting Out   | 17.1   |
| Evidence and Terms of Insurance   | 25.1   |
| Examination of Work before Covering Up                                  | 38.1   |
| Exceptions  | 22.2   |
| Exchange, Rates of  | 72.1   |
| Exclusions  | 21.4   |
| Extension of Time, due to Employer's Failure to give Possession of Site | 42.2   |
| Extension of Time for Completion  | 44.1   |
| Extension of Time for Completion, Contractor's Claim                    | 44.2   |
| Extension of Time for Completion, Engineer's Determination              | 44.3   |
| Extraordinary Traffic   | 30.    |
| Facilities for Other Contractors  | 31.2   |
| Facilities – Rights of Way and  | 42.3   |
| Failure by Contractor to Submit Drawings                                | 6.5    |
| Failure to Comply with Claims Procedure                                 | 53.4   |
| Failure to Comply with Engineer's Decision                              | 67.4   |
| Failure to Give Possession of Site                                      | 42.2   |
| Faulty Work, Removal of   | 39.1   |
| Fees and Notices  | 26.1   |
| Fencing, Watching, Lighting, etc.                                       | 19.1   |
| Final Payment Certificate   | 60.8   |
| Final Statement   | 60.6   |
| Foreign Currencies, Payment in  | 72.    |
| Fossils   | 27.1   |
| Foundations, Examination of   | 38.1   |
| General Responsibilities of Contractor                                  | 8.1    |
| Giving of Notices – Payment of Fees                                     | 26.1   |
| Headings and Marginal Notes   | 1.2    |
| Improper Work and Materials, Removal of                                 | 39.1   |
| Increase or Decrease of Costs   | 70.1   |
| Indemnity by Contract   | 22.1   |
|   | & 24.1 |
| Indemnity by Employer   | 22.3   |
| Independent Inspection  | 37.5   |
| Injury to Persons – Damage to Property                                  | 22.1   |
| Injury to Workmen   | 24.1   |
| Inspection and Testing  | 37.2   |
| Inspection and Testing, Dates for                                       | 37.3   |
| Inspection of Foundations, etc.   | 38.1   |
| Inspection of Operations  | 37.1   |
| Inspection of Site by Contractor  | 11.1   |
| Instructions for Variations   | 51.2   |
| Instructions in Writing   | 2.5    |
| Instructions, Supplementary   | 7.1    |
| Insurance, Adequacy of  | 25.2   |

# Index

Clause

|   |      |
|---|------|
| Insurance, Evidence and Terms of                        | 25.1 |
| Insurance, Minimum Amount of                            | 23.2 |
| Insurance of Works and Contractor's Equipment           | 21.1 |
| Insurance, Remedy on Failure to Insure                  | 25.3 |
| Insurance, Responsibility for Amounts not Recovered     | 21.3 |
| Insurance, Scope of Cover                               | 21.2 |
| Insurance, Third Party                                  | 23.1 |
| Insurance, Workmen                                      | 24.2 |
| Interference with Traffic and Adjoining Properties      | 29.1 |
| Interim Determination of Extension                      | 44.3 |
| Interpretations   | 1.3  |
| Labour, Engagement of                                   | 34.1 |
| Language/s and Law                                      | 5.1  |
| Law to which Contract Subject                           | 5.1  |
| Legislation, Subsequent                                 | 70.2 |
| Lighting, Fencing, Watching, etc.                       | 19.1 |
| Liquidated Damages for Delay                            | 47.1 |
| Liquidated Damages, Reduction of                        | 47.2 |
| Loss or Damage due to Employer's Risks                  | 20.3 |
| Loss or Damage – Responsibility to Rectify              | 20.2 |
| Lump Sum Items – Breakdown of                           | 57.2 |
| Materials and Plant, Transport of                       | 30.3 |
| Materials – Approval of, etc, not Implied               | 54.8 |
| Materials, Improper – Removal of                        | 39.1 |
| Materials, Quality of                                   | 36.1 |
| Materials, Supply of                                    | 8.1  |
| Measurement by Engineer                                 | 56.1 |
| Measurement, Method of                                  | 57.1 |
| Measurement, Quantities Estimated Only                  | 55.1 |
| Methods of Construction                                 | 8.2  |
| Minimum Amount of Insurance                             | 23.2 |
| Monthly Payments  | 60.2 |
| Nominated Subcontractors, Certification of Payments to  | 59.5 |
| Nominated Subcontractors, Definition                    | 59.1 |
| Nominated Subcontractors, Design by                     | 59.3 |
| Nominated Subcontractors, Objection to Nomination       | 59.2 |
| Nominated Subcontractors, Payment to                    | 59.4 |
| Not Foreseeable Physical Obstructions or Conditions     | 12.2 |
| Notice of Claims  | 53.1 |
| Notices and Fees, Payment of                            | 26.1 |
| Notices, Consents and Approvals                         | 1.5  |
| Notice to Contractor                                    | 68.1 |
| Notice to Employer and Engineer                         | 68.2 |
| Objections to Contractor's Employees                    | 16.2 |
| Obstructions or Conditions – Not Foreseeable Physical   | 12.2 |
| Omissions, Alterations and Additions                    | 59.  |
| Openings, Uncovering and making                         | 38.2 |
| Operations, Inspection of                               | 37.1 |
| Order of Work, Contractor to Furnish Programme          | 14.1 |
| Other Contractors, Opportunities for                    | 31.1 |
| Patent Rights   | 28.1 |
| Payment if Contract Terminated for Contractor's Default | 63.3 |
| Payment if Contract Terminated for Employer's Default   | 69.3 |
| Payment of Claims                                       | 53.5 |

# Index

## Clause

|  |       |
|--|-------|
| Payment, Time for  | 60.10 |
| Performance Security   | 10.1  |
| Performance Security – Claims Under                            | 10.3  |
| Performance Security – Period of Validity                      | 10.2  |
| Period of Defects Liability                                    | 49.1  |
| Permanent Works Designed by Contractor                         | 7.2   |
| Physical Obstructions or Conditions – Not Foreseeable          | 12.2  |
| Physical Obstructions or Conditions – Engineer's Determination | 12.3  |
| Plant and Materials, Transport of                              | 30.3  |
| Plant, Conditions of Hire                                      | 54.5  |
| Plant, Customs Clearance                                       | 54.3  |
| Plant, Employer not Liable for damage to                       | 54.2  |
| Plant, etc. – Exclusive Use for the Works                      | 54.1  |
| Plant, Quality of  | 36.1  |
| Plant, Re-export of  | 54.4  |
| Plant, Removal of  | 39.1  |
| Policy of Insurance – Compliance with Conditions               | 25.4  |
| Possession of Site   | 42.1  |
| Possession of Site, Failure to Give                            | 42.2  |
| Power of Engineer to Fix Rates                                 | 52.2  |
| Priority of Contract Documents                                 | 5.2   |
| Programme to be Submitted                                      | 14.1  |
| Progress – Disruption of                                       | 6.3   |
| Progress – Rate of   | 46.1  |
| Protection of Environment                                      | 19.1  |
| Provision to Indemnify Contractor                              | 22.3  |
| Provision to Indemnify Employer                                | 22.2  |
| Provisional Sums, Currencies of Payment                        | 72.3  |
| Provisional Sums, Definition                                   | 58.1  |
| Provisional Sums, Production of Vouchers                       | 58.3  |
| Provisional Sums, Use of                                       | 58.2  |
| Quality of Materials and Workmanship                           | 36.1  |
| Quantities   | 55.1  |
| Rate of Progress   | 46.1  |
| Rates of Exchange  | 72.1  |
| Rates, Power of Engineer to Fix                                | 52.2  |
| Rectification of Loss or Damage                                | 20.2  |
| Reduction of Liquidated Damages                                | 47.2  |
| Re-export of Plant   | 54.4  |
| Regulations, Statutes, etc., Compliance with                   | 26.1  |
| Rejection  | 37.4  |
| Release from Performance                                       | 66.1  |
| Remedies for Default of Contractor                             | 63.1  |
| Remedying of Defects   | 49.2  |
| Remedying of Defects, Cost of                                  | 49.3  |
| Remedy on Contractor's Failure to Insure                       | 25.3  |
| Removal of Contractor's Employees                              | 16.2  |
| Removal of Contractor's Equipment                              | 69.2  |
| Removal of Improper Work, Materials or Plant                   | 39.1  |
| Removal of Plant, etc.   | 65.7  |
| Responsibility to Rectify Loss or Damage                       | 20.2  |
| Responsibility Unaffected by Approval                          | 7.3   |
| Restriction on Working Hours                                   | 45.1  |
| Resumption of Work   | 69.5  |
| Retention Money, Payment of                                    | 60.3  |
| Returns of Labour and Contractor's Equipment                   | 35.1  |



# Index

Clause

|  |       |
|--|-------|
| Revised Programme  | 14.2  |
| Rights of Way and Facilities   | 42.3  |
| Risks, Employer's  | 20.4  |
| Risks, Special   | 65.   |
| Roads, etc., - Damage by Extraordinary Traffic                           | 30.1  |
| Roads, Interference with Access to                                       | 29.1  |
| Royalties  | 28.2  |
| Safety, Security and Protection of the Environment                       | 19.1  |
| Samples, Cost of   | 36.2  |
| Security, Safety and Protection of the Environment                       | 19.1  |
| Setting-Out  | 17.1  |
| Singular and Plural  | 1.4   |
| Site, Clearance on Completion  | 33.1  |
| Site, Contractor to Keep Clear   | 32.1  |
| Site, Inspection of by Contractor  | 11.1  |
| Site Operations and Methods of Construction                              | 8.2   |
| Site, Possession of  | 42.1  |
| Special Risks  | 65.   |
| Staff, Engagement of   | 34.1  |
| Statement at Completion  | 60.5  |
| Statement, Final   | 60.6  |
| Statutes, Regulations, etc. - Compliance with                            | 26.1  |
| Subcontracting   | 4.1   |
| Subcontractors, Nominated  | 59.   |
| Subcontractors, Responsibility of the Contractor for Acts and Default of | 4.1   |
| Subsequent Legislation   | 70.2  |
| Substantial Completion of Sections or Parts                              | 48.3  |
| Sufficiency of Tender  | 12.1  |
| Supply of Plant, Materials and Labour                                    | 8.1   |
| Surfaces Requiring Reinstatement   | 48.4  |
| Suspension, Engineer's Determination                                     | 40.2  |
| Suspension lasting more than 84 days                                     | 40.3  |
| Suspension of Work   | 40.1  |
| Taking Over Certificate  | 48.1  |
| Taking Over of Sections or Parts   | 48.2  |
| Tender Documents   | 11.1  |
| Tender, Sufficiency of   | 12.1  |
| Termination of Contract by Employer                                      | 63.1  |
| Termination of Contract by Employer, Assignment of Benefit               | 63.4  |
| Terms of Insurance   | 25.1  |
| Tests, Cost of   | 36.3  |
| Tests not Provided for - Cost of   | 36.4  |
| Third Party Insurance  | 23.1  |
| Time for Completion  | 43.1  |
| Time for Completion, Extension of  | 44.1  |
| Time for Payment   | 60.10 |
| Traffic, Extraordinary   | 30.1  |
| Traffic, Interference with   | 29.1  |
| Traffic, Waterborne  | 30.4  |
| Transport of Contractor's Equipment and Temporary Works                  | 30.2  |
| Transport of Materials and Plant   | 30.3  |
| Uncovering Work and Making Openings                                      | 38.2  |
| Unfulfilled Obligations  | 62.2  |
| Urgent Remedial Work   | 64.1  |

# Index

Clause

|  |      |
|--|------|
| Valuation at Date of Termination by the Employer     | 63.2 |
| Variations   | 51.1 |
| Variations, Daywork Basis                            | 52.4 |
| Variations, Exceeding 15 per cent                    | 52.3 |
| Variations, Instructions for                         | 51.2 |
| Variations, Power of the Engineer to Fix Rates       | 52.2 |
| Variations, Valuation of                             | 51.3 |
| Vouchers, Production of                              | 58.3 |
| War, Outbreak of                                     | 20.4 |
| Watching and Lighting, etc.                          | 19.1 |
| Waterborne Traffic                                   | 30.4 |
| Work, Examination of Before Covering Up              | 38.1 |
| Work, Improper, Removal of                           | 39.1 |
| Working Hours, Restriction of                        | 45.1 |
| Workmanship, Quality of                              | 36.1 |
| Workmen, Accident or Injury to                       | 24.1 |
| Works, Care of                                       | 20.1 |
| Works, Completion of (Defects Liability Certificate) | 62.1 |
| Works, Commencement of                               | 41.1 |
| Works, Insurance of                                  | 21.1 |
| Works, Remedying of Defects                          | 49.2 |
| Works, Time for Completion of                        | 43.1 |
| Works to be Measured                                 | 56.1 |
| Work, Suspension of                                  | 40.1 |
| Work to be in Accordance with the Contract           | 13.1 |

## **TABLE OF CONTENTS**

### **PART II - PARTICULAR CONDITIONS OF CONTRACT**

| <b>Clause</b> | <b>Title</b>   | <b>Page</b> |
|---------------|--|-------------|
| 1.1           | Definitions  | 147         |
| 2.1           | Engineer's Duties and Authority                        | 147         |
| 2.2           | Engineer's Representative                              | 149         |
| 2.7           | Engineer Not Liable                                    | 149         |
| 2.8           | Replacement of the Engineer                            | 149         |
| 5.1           | Language(s) and Law                                    | 149         |
| 5.2           | Priority of Contract Documents                         | 149         |
| 6.6           | Shop Drawings  | 150         |
| 6.7           | As-Built Drawings                                      | 150         |
| 10.1          | Performance Security                                   | 150         |
| 10.4          | Performance Security Binding on Variations and Changes | 151         |
| 14.1          | Programme to be Submitted                              | 151         |
| 14.3          | Cash Flow Estimate to be Submitted                     | 151         |
| 14.5          | Detailed Programme and Monthly Progress Report         | 151         |
| 15.2          | Language Ability of Contractor's Representative        | 152         |
| 15.3          | Contractor's Representative                            | 152         |
| 16.3          | Language Ability of Superintending Staff of Contractor | 152         |
| 16.4          | Employment of Local Personnel                          | 152         |
| 19.3          | Safety Precautions                                     | 152         |
| 19.4          | Lighting Works at Night                                | 153         |
| 20.4          | Employer's Risks                                       | 153         |
| 21.1          | Insurance of Works and Contractor's Equipment          | 153         |
| 21.4          | Exclusions   | 154         |
| 25.5          | Insurance Company                                      | 154         |
| 31.3          | Co-operation with Other Contractors                    | 154         |
| 34.2          | Rates of Wages and Conditions of Labour                | 154         |
| 34.3          | Employment of Persons in the Service of Others         | 154         |
| 34.4          | Housing for Labour                                     | 154         |
| 34.5          | Health and Safety                                      | 155         |
| 34.6          | Epidemics  | 155         |
| 34.7          | Supply of Water  | 155         |
| 34.8          | Alcoholic Liquor or Drugs                              | 155         |
| 34.9          | Arms and Ammunition                                    | 155         |
| 34.10         | Festivals and Religious Customs                        | 155         |
| 34.11         | Disorderly Conduct                                     | 156         |
| 34.12         | Compliance by Subcontractors                           | 156         |
| 35.2          | Records of Safety and Health                           | 156         |
| 35.3          | Reporting of Accidents                                 | 156         |
| 36.6          | Use of Pakistani Materials and Services                | 156         |
| 41.1          | Commencement of Works                                  | 156         |
| 47.3          | Bonus for Early Completion of Works                    | 157         |
| 48.2          | Taking Over of Sections or Parts                       | 157         |
| 51.2          | Instructions for Variations                            | 157         |

## **TABLE OF CONTENTS**

### **PART II - PARTICULAR CONDITIONS OF CONTRACT**

| <b>Clause</b> | <b>Title</b>                                       | <b>Page</b> |
|---------------|--|-------------|
| 52.1          | Valuation of Variations                            | 157         |
| 53.4          | Failure to Comply                                  | 157         |
| 54.3          | Customs Clearance                                  | 157         |
| 54.5          | Conditions of Hire of Contractor's Equipment       | 157         |
| 59.4          | Payments to Nominated Sub-contractors              | 157         |
| 59.5          | Evidence of Payments                               | 158         |
| 60.1          | Monthly Statements                                 | 158         |
| 60.2          | Monthly Payments                                   | 158         |
| 60.10         | Time for Payment                                   | 158         |
| 60.11         | Secured Advance on Materials                       | 159         |
| 60.11         | Financial Assistance to Contractor                 | 159         |
| 63.1          | Default of Contractor                              | 161         |
| 65.2          | Special Risks                                      | 161         |
| 67.3          | Arbitration  | 161         |
| 68.1          | Notice to Contractor                               | 161         |
| 68.2          | Notice to Employer and Engineer                    | 162         |
| 70.1          | Increase or Decrease of Cost                       | 162         |
| 73.1          | Payment of Income Tax                              | 163         |
| 73.2          | Customs Duty & Taxes                               | 164         |
| 74.1          | Integrity Pact                                     | 164         |
| 75.1          | Termination of Contract for Employer's Convenience | 164         |
| 76.1          | Liability of Contractor                            | 164         |
| 77.1          | Joint and Several Liability                        | 165         |
| 78.1          | Details to be Confidential                         | 165         |

**PART II - PARTICULAR CONDITIONS OF CONTRACT**  
**(Mandatory Provisions not to be Amended / Substituted except as instructed by PEC)**

**1.1 Definitions**

- (a) (i) The Employer is NED University of Engineering & Technology, University Road ,Karachi.
- (a) (iv) The Engineer is M/S Consult-Tech, Commercial Lane 2, Khayaban-e-Shahbaz, DHA Ph-VI, Karachi , or any other competent person appointed by the Employer, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineers is to formulate his certifications/recommendations in relation to all outstanding matters, disputes and claims relating to the execution of the Works during his tenure.

The following paragraph is added:

- (a)(vi) “Bidder or Tenderer” means any person or persons, company, corporation, firm or joint venture submitting a Bid or Tender.
- (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.

**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 Employer before carrying out his duties in accordance with the following Clauses:

- (i) Consenting to the sub-letting of any part of the Works under Sub-Clause 4.1 “Subcontracting”.
- (ii) Certifying additional cost determined under Sub-Clause 12.2 “Not Foreseeable Physical Obstructions or Conditions”.

- (iii) Any action under Clause 10 “Performance Security” and Clauses 21,23,24 & 25 “Insurance” of sorts.
- (iv) Any action under Clause 40 “Suspension”.
- (v) Any action under Clause 44 “Extension of Time for Completion”.
- (vi) Any action under Clause 47 “Liquidated Damages for Delay” or Payment of Bonus for Early Completion of Works (PCC Sub-Clause 47.3).
- (vii) Issuance of “Taking Over Certificate” under Clause 48.
- (viii) Issuing a Variation Order under Clause 51,except:
  - a) in an emergency\* situation, as stated herebelow, 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: Employer may further vary according to need of the project)

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

## **2.2 Engineer's Representative**

The following paragraph is added:

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

The following Sub-Clauses 2.7 and 2.8 are added:

## **2.7 Engineer Not Liable**

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

## **2.8 Replacement of the Engineer**

"If the Employer intends to replace the Engineer, the Employer shall, not less than 14 days before the intended date of replacement, give notice to the Contractor, of the name, address and relevant experience of the intended replacement Engineer. The Employer shall not replace the Engineer with a person against whom the Contractor raises reasonable objection by notice to the Employer, with supporting particulars."

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

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

## **5.2 Priority of Contract Documents**

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

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

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

The following Sub-Clauses 6.6 and 6.7 are added:

#### **6.6 Shop Drawings**

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

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

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

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

#### **10.1 Performance Security**

The text is deleted and substituted with the following:

The Contractor shall provide Performance Security to the Employer in the prescribed form. The said Security shall be furnished or caused to be furnished by the Contractor within 28 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 10% of the Contract Price stated in the Letter of Acceptance. Such Security shall, at the option of the bidder, be in the form of either (a) bank guarantee from any Scheduled Bank in Pakistan or (b) bank guarantee from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan or (c) an insurance company having atleast AA rating from PACRA/JCR.

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

The following Sub-Clause 10.4 is added:



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

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

#### **14.1 Programme to be Submitted**

The programme shall be submitted within 42 days from the date of receipt of Letter of Acceptance, which shall be in the form of:

- i) a Bar Chart identifying the critical activities.
- ii) a CPM identifying the critical path/activities.  
*(Employer to select appropriate one)*

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

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

The following Sub-Clause 14.5 is added:

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

- a) For purposes of Sub-Clause 14.1, the Contractor shall submit to the Engineer detailed programme for the following:
  - (1) Execution of Works;
  - (2) Labour Employment;
  - (3) Local Material Procurement;
  - (4) Material Imports, if any; and
  - (5) Other details as required by the Engineer.
- (b) During the period of the Contract, the Contractor shall submit to the Engineer not later than the 8<sup>th</sup> day of the following month, 10 copies each of Monthly Progress Reports covering:
  - (1) A Construction Schedule indicating the monthly progress in percentage;
  - (2) Description of all work carried out since the last report;
  - (3) Description of the work planned for the next 56 days sufficiently detailed to enable the Engineer to determine his programme of inspection and testing;
  - (4) Monthly summary of daily job record;
  - (5) Photographs to illustrate progress ;and
  - (6) Information about problems and difficulties encountered, if any, and proposals to overcome the same.
- (c) During the period of the Contract, the Contractor shall keep a daily record of the work progress, which shall be made available to the Engineer as and when requested. The daily record shall include particulars of weather conditions, number of men working, deliveries of materials, quantity, location and assignment of Contractor's equipment.

The following Sub-Clauses 15.2 and 15.3 are added:

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

The Contractor's authorised 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 are 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 take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose.

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

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

In the event of work being carried out at night, the Contractor shall at his own cost, provide and maintain such good and sufficient light as will enable the work to proceed satisfactorily and without danger. The approaches to the Site and the Works where the night-work is being carried out shall be sufficiently lighted. All arrangement adopted for such lighting shall be to the satisfaction of the Engineer's Representative.

#### **20.4 Employer's Risks**

The Employer's risks are:

Delete the text and substitute with the following:

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

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

(Employer may vary this Sub-Clause 21.1 (b))

#### **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 Employer.

Costs of such insurances shall be borne by the Contractor.

The following Sub-Clause 31.3 is added:

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

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

The following Sub-Clauses 34.2 to 34.12 are added:

#### **34.2 Rates of Wages and Conditions of 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 employers whose general circumstances in the trade or in industry in which the Contractor is engaged are similar.

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

The Contractor shall not recruit his staff and labour from amongst the persons in the services of the Employer or the Engineer; except with the prior written consent of the Employer or the Engineer, as the case may be.

#### **34.4 Housing for Labour**

Save insofar as the Contract otherwise provides, the Contractor shall provide and maintain such housing accommodation and amenities as he may consider necessary for all his supervisory staff and 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 Employer or if the Employer so desires, the temporary camps or housing provided by the Contractor shall be removed and the Site reinstated to its original condition, all to the approval of the Engineer.

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

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and 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**

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

#### **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 neighbourhood of the Works against the same.

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

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

The following Sub-Clauses 35.2 and 35.3 are added:

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

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

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

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

The following Sub-Clause 36.6 is added:

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

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

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

The text is deleted and substituted with the following:

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

The following Sub-Clause 47.3 is added:

#### **47.3 Bonus for Early Completion of Works**

The Contractor shall in case of earlier completion for either whole or part(s) of the Works pursuant to Sub-Clauses 48.1 and 48.2(a) respectively of the General Conditions of Contract, be paid bonus up-to a limit and at a rate equivalent to 50% of the relevant limit and rate of liquidated damages prescribed in Appendix-A to Bid “Special Stipulations”.

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

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

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

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

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

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

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

This Sub-Clause is deleted in its entirety.

#### **54.3 Customs Clearance**

(Employer may vary this Sub-Clause)

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

The following paragraph is added:

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

The following Sub-Clauses 59.4 & 59.5 are added:

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

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

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

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

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

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

## **60.1 Monthly Statements**

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

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

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

## **60.2 Monthly Payments**

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

## **60.10 Time for Payment**

The text is deleted and substituted with the following:

The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other terms of the Contract, shall, subject to Clause 47, be paid by the Employer to the Contractor within 30 days after such Interim Payment Certificate has been jointly verified by Employer and Contractor, or, in the case of the Final Certificate referred to in Sub Clause 60.8, within 60 days after such Final Payment Certificate has been jointly verified by Employer and Contractor; Provided that the Interim Payment shall be caused in 42 days and Final Payment in 60 days in case of foreign funded project. In the event of the failure of the Employer to make payment within the times stated, the Employer shall pay to the Contractor



compensation at the 28 days rate of KIBOR+2% per annum for local currency and LIBOR+1% for foreign currency, upon all sums unpaid from the date by which the same should have been paid. The provisions of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69.

The following Sub-Clause 60.11 is added:

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

- a) The Contractor shall be entitled to receive from the Employer Secured Advance against an indemnity bond acceptable to the Employer of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the Site but not yet incorporated in the Permanent Works provided that:
  - (1) The materials are in accordance with the Specifications for the Permanent Works;
  - (2) Such materials have been delivered to the Site and are properly stored and protected against loss or damage or deterioration to the satisfaction of the Engineer but at the risk and cost of the Contractor;
  - (3) The Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records shall be available for inspection by the Engineer;
  - (4) The Contractor shall submit with his monthly statement the estimated value of the materials on Site together with such documents as may be required by the Engineer for the purpose of valuation of materials and providing evidence of ownership and payment therefor;
  - (5) Ownership of such materials shall be deemed to vest in the Employer and these materials shall not be removed from the Site or otherwise disposed of without written permission of the Employer; and
  - (6) The sum payable for such materials on Site shall not exceed 75 % of the (i) landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of locally manufactured or produced materials, or (iii) market price of other materials.
- (b) The recovery of Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis.

#### **60.11 Financial Assistance to Contractor**

Financial assistance shall be made available to the Contractor by the Employer by adopting any one of the following three Alternatives:

*(Appropriate alternative only to be retained)*

#### Alternative One: Mobilization Advance

- (a) An interest-free Mobilization Advance up to 15 % of the Contract Price stated in the Letter of Acceptance shall be paid by the Employer to the Contractor in two equal parts upon submission by the Contractor of a Mobilization Advance Guarantee/Bond for the full amount of the Advance in the specified form from a Scheduled Bank in Pakistan or an insurance company acceptable to the Employer:
  - (1) First part within 14 days after signing of the Contract Agreement or date of receipt of Engineer's Notice to Commence, whichever is earlier; and
  - (2) Second part within 42 days from the date of payment of the first part, subject to the satisfaction of the Engineer as to the state of mobilization of the Contractor.
- (b) This Advance shall be recovered in equal instalments; first instalment at the expiry of third month after the date of payment of first part of Advance and the last instalment two months before the date of completion of the Works as per Clause 43 hereof.

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

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

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

#### **65.2 Special Risks**

The text is deleted and substituted with the following:

The Special Risks are the risks defined under Sub-Clause 20.4 sub paragraphs (a) 20 h (h)

#### **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 ....., 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 Employer and the Engineer by registered post, the address of his principal place of business or any change in such address during the period of the Contract.

#### 68.2 Notice to Employer and Engineer

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

- a) The Employer :  
\_\_\_\_\_ *(to be filled in by the Employer as appropriate)* \_\_\_\_\_
- b) The Engineer:  
\_\_\_\_\_ *(to be filled in by the Employer as appropriate)* \_\_\_\_\_

#### 70.1 Increase or Decrease of Cost

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:-

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

Where:

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

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

b, c, d, 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, etc., shall be one;

Ln, Mn, En, etc., are the current cost indices or reference prices of the cost elements for month “n”, determined pursuant to Sub-Clause 70.1(d), applicable to each cost element; and

Lo, Mo, Eo, etc., are the base cost indices or reference prices corresponding to the above cost elements at the date specified in Sub-Clause 70.1(d).

If ‘P’ is the amount payable (prior to adjustment) at B.O.Q. rates for the work carried out in period ‘n’ than adjusted amount payable to the Contractors for work carried out in period ‘n’ =  $P \times P_n$ .

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

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

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

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

#### **(e) Adjustment after Completion**

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

**(f) Weightages**

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

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

**73.1 Payment of Income Tax**

The Contractor, Subcontractors and their employees shall be responsible for payment of all their income tax, super tax and other taxes on income arising out of the Contract

and the rates and prices stated in the Contract shall be deemed to cover all such taxes.

**73.2 Customs Duty & Taxes**

(Employer may incorporate provisions where applicable)

**74.1 Integrity Pact**

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

- (a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by the Contractor or any of his Subcontractors, agents or servants;
- (b) terminate the Contract; and
- (c) recover from the Contractor any loss or damage to the Employer as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agents or servants.

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

#### **75.1 Termination of Contract for Employer's Convenience**

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

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

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

The Contractor or his Subcontractors or assigns shall follow strictly, all relevant labour laws including the Workmen's Compensation Act and the Employer 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 Employer for the fulfilment of the terms of the Contract and shall designate one of such persons to act as leader with authority to bind the joint venture. The composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer.

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

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

## PART II –PARTICULAR CONDITIONS OF CONTRACT

| Index  | Clause |
|--|--------|
| Alcoholic Liquor or Drugs                              | 34.8   |
| Arbitration  | 67.3   |
| Arms and Ammunition                                    | 34.9   |
| As-Built Drawings                                      | 6.7    |
| Bonus for Early Completion of Works                    | 47.3   |
| Cash Flow Estimate to be Submitted                     | 14.3   |
| Commencement of Works                                  | 41.1   |
| Compliance by Sub-Contractors                          | 34.12  |
| Conditions of Hire of Contractor's Equipment           | 54.5   |
| Contractor's Representative                            | 15.3   |
| Co-operation with Other Contractors                    | 31.3   |
| Customs Clearance                                      | 54.3   |
| Customs Duty and Taxes                                 | 73.2   |
| Default of Contractor                                  | 63.1   |
| Definitions  | 1.1    |
| Detailed Programme and Monthly Progress Report         | 14.5   |
| Details to be Confidential                             | 78.1   |
| Disorderly Conduct                                     | 34.11  |
| Employer's Risks                                       | 20.4   |
| Employment of Local Personnel                          | 16.4   |
| Employment of Persons in the Service of Others         | 34.3   |
| Engineer Not Liable                                    | 2.7    |
| Engineer's Duties and Authority                        | 2.1    |
| Engineer's Representative                              | 2.2    |
| Epidemics  | 34.6   |
| Exclusions   | 21.4   |
| Failure to Comply                                      | 53.4   |
| Festivals and Religious Customs                        | 34.10  |
| Financial Assistance to Contractor                     | 60.11  |
| Health and Safety                                      | 34.5   |
| Housing for Labour                                     | 34.4   |
| Increase or Decrease of Cost                           | 70.1   |
| Instructions for Variations                            | 51.2   |
| Insurance of Works and Contractor's Equipment          | 21.1   |
| Insurance Company                                      | 25.5   |
| Integrity Pact   | 74.1   |
| Joint and Several Liability                            | 77.1   |
| Language Ability of Contractor's Representative        | 15.2   |
| Language Ability of Superintending Staff of Contractor | 16.3   |
| Language(s) and Law                                    | 5.1    |
| Liability of Contractor                                | 76.1   |
| Lighting Work at Night                                 | 19.4   |
| Monthly Payments                                       | 60.2   |
| Monthly Statements                                     | 60.1   |

| <b>Index</b>  | <b>Clause</b> |
|---|---------------|
| Notice to Contractor                                  | 68.1          |
| Notice to Employer and Engineer                       | 68.2          |
| Payment of Income Tax                                 | 73.1          |
| Payments of Nominated Subcontractors                  | 59.4          |
| Performance Security                                  | 10.1          |
| Performance Security Binding on Variation and Changes | 10.4          |
| Priority of Contract Documents                        | 5.2           |
| Programme to be Submitted                             | 14.1          |
| Rates of Wages and Conditions of Labour               | 34.2          |
| Records of Safety and Health                          | 35.2          |
| Replacement of the Engineer                           | 2.8           |
| Reporting of Accidents                                | 35.3          |
| Safety Precautions                                    | 19.3          |
| Secured Advance on Materials                          | 60.11         |
| Shop Drawings   | 6.6           |
| Special Risks   | 65.2          |
| Supply of Water                                       | 34.7          |
| Taking Over of Sections or Parts                      | 48.2          |
| Termination of Contract for Employer's Convenience    | 75.1          |
| Time for Payment                                      | 60.10         |
| Use of Pakistani Materials and Services               | 36.6          |
| Valuation of Variations                               | 52.1          |





**N.E.D. UNIVERSITY OF ENGINEERING & TECHNOLOGY,  
KARACHI**

**CONSTRUCTION OF 03 LABORATORIES  
FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

**TECHNICAL SPECIFICATIONS  
(CIVIL / ELECTRICAL / PLUMBING / MV)**

**VOLUME 2**

**Consult-Tech** (Since 1970)

11-C, 3<sup>rd</sup> Floor, Shahbaz Commercial Line No. 2,  
Phase-VI, Defence Housing Authority, Karachi  
Tel +92 21 35847692 – 3, Fax +92 21 35847688

# **ARCHITECTURAL / CIVIL WORKS**

|   |          |
|---|----------|
| <b>1.0 GENERAL AND SITE FACILITIES .....</b>                      | <b>1</b> |
| <b>1.1 INTRODUCTION .....</b>                                     | <b>1</b> |
| <b>1.2 DEFINITIONS .....</b>                                      | <b>1</b> |
| <b>1.3 SCOPE OF WORK .....</b>                                    | <b>2</b> |
| <b>1.4 SUBMITTAL.....</b>   | <b>2</b> |
| <b>1.4.1 CONSTRUCTION PROGRAM .....</b>                           | <b>3</b> |
| <b>1.4.2 NOTICE OF OPERATION .....</b>                            | <b>3</b> |
| <b>1.4.3 AS-BUILT DRAWINGS .....</b>                              | <b>3</b> |
| <b>1.4.4 SHOP DRAWINGS .....</b>                                  | <b>3</b> |
| <b>1.5 TAKING OVER POSSESSION OF SITE.....</b>                    | <b>4</b> |
| <b>1.6 MOBILIZATION .....</b>                                     | <b>4</b> |
| <b>1.7 MONITORING PROGRESS.....</b>                               | <b>4</b> |
| <b>1.7.1 ATTENDANCE AT SITE MEETINGS .....</b>                    | <b>5</b> |
| <b>1.7.2 RECEIVING VISITORS .....</b>                             | <b>5</b> |
| <b>1.8 CONTRACTOR'S SITE FACILITIES.....</b>                      | <b>5</b> |
| <b>1.9 MATERIALS, PLANT, EQUIPMENT AND TOOLS.....</b>             | <b>6</b> |
| <b>1.9.1 EQUAL PRODUCTS AND EQUIVALENTS .....</b>                 | <b>6</b> |
| <b>1.9.2 ADDITIONAL COSTS RELATED TO SUBSTITUTIONS .....</b>      | <b>6</b> |
| <b>1.9.3 FAILURE OF EQUAL PRODUCTS .....</b>                      | <b>6</b> |
| <b>1.9.4 PLANT, EQUIPMENT AND TOOLS .....</b>                     | <b>6</b> |
| <b>1.10 SUFFICIENCY OF MEANS EMPLOYED .....</b>                   | <b>6</b> |
| <b>1.11 PROTECTION AND SAFETY .....</b>                           | <b>6</b> |
| <b>1.11.1 GENERAL .....</b>                                       | <b>6</b> |
| <b>1.11.2 SAFETY OF WORKMEN.....</b>                              | <b>7</b> |
| <b>1.11.3 SITE PRECAUTIONS .....</b>                              | <b>7</b> |
| <b>1.12 CARE OF WORKS .....</b>                                   | <b>7</b> |
| <b>1.12.1 MOVEMENT OF TRANSPORT AND PLANT .....</b>               | <b>7</b> |
| <b>1.12.2 KEEPING WORKS FREE FROM ATMOSPHERIC CONDITION .....</b> | <b>8</b> |
| <b>1.12.3 MATERIALS ON AND UNDER THE SITE .....</b>               | <b>8</b> |
| <b>1.13 SURVEY WORKS .....</b>                                    | <b>8</b> |
| <b>1.13.1 PERMANENT BENCH MARK .....</b>                          | <b>8</b> |
| <b>1.13.2 REFERENCE LINE PILLARS .....</b>                        | <b>8</b> |
| <b>1.14 FABRICATED ITEMS INCORPORATED IN THE WORK .....</b>       | <b>9</b> |

|   |           |
|---|-----------|
| <b>1.15 INSPECTION/TESTS AT FABRICATOR'S WORKSHOP .....</b> | <b>9</b>  |
| <b>1.15.1 GENERAL .....</b>                                 | <b>9</b>  |
| <b>1.15.2 TESTS AND INSPECTION RECORD .....</b>             | <b>9</b>  |
| <b>1.15.3 NOTICE OF WORKS OFF-SITE .....</b>                | <b>10</b> |
| <b>1.15.4 STANDARDS .....</b>                               | <b>10</b> |
| <b>1.15.5 PROPRIETARY PRODUCTS.....</b>                     | <b>10</b> |
| <b>1.15.6 MATERIALS TO BE NEW .....</b>                     | <b>10</b> |
| <b>1.15.7 ORDERS FOR MATERIALS.....</b>                     | <b>10</b> |
| <b>1.15.7 SAMPLES .....</b>                                 | <b>11</b> |
| <b>1.15.8 CERTIFICATES .....</b>                            | <b>11</b> |
| <b>1.16 TOLERANCES .....</b>                                | <b>11</b> |
| <b>1.17 RECORDING OF MEASUREMENT .....</b>                  | <b>13</b> |
| <b>1.18 PAYMENT .....</b>                                   | <b>14</b> |

## **1.0 GENERAL AND SITE FACILITIES**

### **1.1 INTRODUCTION**

These Specifications shall apply to all such works to be executed involving construction of a building and its allied works under the Contract or otherwise directed by the Engineer. In every case, the Work shall be carried out to the satisfaction of the Engineer and conform to the location, lines, dimensions, cross-sections, etc shown on the Drawings or in the Bill of Quantities (BOQ) or as indicated by the Engineer. The quality of materials, processing of materials as may be needed at the site, salient features of the construction work and quality of finished works shall comply with the requirements set forth in the succeeding Sections and Sub-sections. Where the Drawings and Specifications describe a portion of the work in only general terms and not in complete detail, it shall be understood that only the best general practices are to prevail, materials and workmanship of the best quality are to be employed and instructions of the Engineer are to be fully complied with.

Words importing the singular also mean the plural and vice versa where the context so demands. Similarly, words importing the male also mean female or neuter and vice versa where the context so requires. Words have their normal meaning under the English language unless specifically defined.

### **1.2 DEFINITIONS**

The following words and expressions shall have the meaning hereby assigned to them, except where the context otherwise require. However, in the case of any conflict with the stipulations of the Conditions of the Contract, the expressions and meaning of the Conditions of Contract shall prevail.

‘The Employer’ is the N.E.D. University of Engineering & Technology (The PA) representative by its PD/Civil Engineer (Food Project) as PA’s Coordinator or any other representative appointed from time to time by the authority and notified in writing to the Contractor to act as the PA’s representative for the purpose of this Work.

‘The Engineer’ shall mean the engineer designated or any other engineer appointed from time to time by the PA and notified in writing to the Contractor to act as ‘the Engineer’ for the purpose of the Contract.

‘The Contractor’ shall mean any person or corporate body who is pre-qualified under the Project/enlisted with the PEC and whose Tender to carry out the Work has been accepted by the Employer and the legal successors in title to such person, but not (except with the consent of the Employer) any assignee of such person.

A ‘Sub-Contractor’ shall mean any person or corporate body named in the Contract as a Sub-contractor for a part of the Work or any person or corporate body to whom a part of the Work has been subcontracted with the consent of the Engineer and the legal successors in title to such person or corporate body, but not any assignee of any such person or corporate body.

‘The Contract’ is the contract between the Employer and the Contractor to execute, complete and maintain the Work.

The expression of ‘Work’ or ‘Works’ are what the Contract requires by the Contractor to construct, install and hand over to the Employer, as defined in the Tender Documents. Unless there be something either in the subject or context repugnant to such construction it shall be construed and taken to mean the works by or by virtue of Contract to be executed, whether temporary or permanent and whether original, altered, substituted or additional.

‘Site’ means the places provided by the Employer where the Works are to be executed and any other places as may be specifically designated in the Contract as forming part of the Site.

‘Tender’ means the Contractor’s priced offer to the Employer for the execution and completion of the Work and the remedying of any defects therein in accordance with the provisions of the Contract, as accepted by the Letter of Acceptance.

‘Letter of Acceptance’ means the formal acceptance by the Employer of the Tender.

### **1.3 SCOPE OF WORK**

The Work to be carried out under the Contract shall consist of the various items as generally described in the Tender Documents as well as in the BOQ furnished in the Tender Documents.

The Work to be performed shall also include all general works preparatory to the construction of a building and all other related works. The Work shall include works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and of the Drawings, BOQ and these Specifications and further Drawings and Orders as may be issued by the Engineer from time to time. Whether specifically mentioned or not in the various Sections of this Specification, the Scope of Work shall include compliance by the Contractor with all conditions of the Contract, all materials, apparatus, plant, equipment, tools, fuel, water strutting, timbering, transport, offices, stores, workshop, staff, labor and the provision for proper and sufficient protective works, temporary fencing and lighting, etc. It shall also include safety of workers, first-aid equipment, suitable accommodation for the staff and workmen with adequate sanitary arrangements, the effecting and maintenance of all insurance, the payment of all wages, salaries, fees, royalties, duties or other charges arising from the erection of works and the regular clearance of rubbish, reinstating and clearing the site as may be required on completion of the Work, safety of the public and protection of the Work and the adjoining land.

The Contractor shall ensure that all actions are taken to have a built-in quality assurance in the planning and execution of the Work. The quality assurance shall cover all stages of works such as setting out, selection of materials, selection of construction methods, selection of equipment and plant, deployment of personnel and supervisory staff, quality control testing, etc. The work of built-in quality assurance shall be deemed to be covered in the Scope of Work.

### **1.4 SUBMITTAL**

The submittal by the Contractor shall include construction programme, all Shop Drawings, reports, samples, test results etc. to conform with all applicable provisions of the General Conditions of the Contract and as required under the various Sections of these Specifications. The purpose of the submittal required herein is to assure that items furnished and installed are, in all matters of consequence, equivalent to the specified items and that proper records are maintained of the changes made in the Specifications, Drawings or in materials used or any deviations made in the construction process.

The Contractor shall forward all submittal to the Engineer under a cover letter stating that the submittal has been carefully reviewed by the Contractor and that on-site conditions or dimensions where necessary and correctness have been verified and checked.

The submittal shall be reviewed by the Engineer to verify that the Contractor’s obligations are fulfilled as per the turn intention of the Contract. In checking and approving submittal, the Employer does not

relieve the Contractor from responsibilities for construction errors or omissions, which may occur, even though executed in accordance with the approved Shop Drawings. Any such errors or omissions, as is discovered later on, should be corrected by the Contractor irrespective of any approval by the Employer at no additional cost to the Employer. This does not apply to modifications approved as specified herein.

The Contractor shall make submittal of construction requirements at least 10 days prior to actual construction of the component to allow time for checking and re-checking, if necessary. Any works fabricated or installed by the Contractor prior to approval of the Shop Drawings or other required submittal shall be done at his own risk.

#### **1.4.1 CONSTRUCTION PROGRAM**

Within 14 days of the date of the Letter of Acceptance, the Contractor shall submit to the Engineer for his approval a Bar Chart/Gantt Chart showing the program sequence in which works have been proposed to be carried out including the procurement and delivery of equipment and materials.

The Contractor shall, whenever required by the Engineer, also provide in writing a general description of the arrangements and methods, which would be adopted for the execution of the Work.

If at any time it would appear to the Engineer that the actual progress of work does not conform to the approved program, the Contractor shall be obliged to produce for the approval of the Engineer the reasons for any changes with a revised program showing the modifications to the previously approved program necessary to complete the Work on schedule. Submission to and approval by the Engineer of such program or furnishing of such particulars shall neither relieve the Contractor from any of his duties and responsibilities under the Contract nor it shall prejudice the 'Liquidated Damages' Clause of the Contract.

#### **1.4.2 NOTICE OF OPERATION**

The Contractor shall give full and complete written notice of all the important operations, including setting out, to the Engineer sufficiently in advance (not less than 10 days) to enable the Engineer to make such arrangements as the Engineer may consider necessary for inspection and for any other purposes. The Contractor shall not start any important operation without the written approval of the Engineer.

#### **1.4.3 AS-BUILT DRAWINGS**

Before the expiry of the period of maintenance, the Contractor shall submit the full sets of As-Built Drawings of the completed works to the Employer. The sets shall comprise of all Discipline Drawings (9 copies) along with soft copies on a CD.

The As-Built Drawing shall clearly show the lines and dimensions of the permanent construction actually made based on the changes to the original design from time to time as ordered by the Engineer or proposed by the Contractor and approved by the Engineer.

The original soft copies of the Tender Drawings and Design Drawings will be provided to the contractor for producing additional copies, if the contractor requires.

#### **1.4.4 SHOP DRAWINGS**

The Contractor shall prepare the Shop Drawings at his own costs showing clearly all elements of construction that are required to assure proper shop fabrication or job installation of items requiring

Shop Drawings shall be clearly shown. All material quality, finishes, construction details as specifically related to the project must be shown on the Shop Drawings.

### **1.5 TAKING OVER POSSESSION OF SITE**

The Contractor shall, upon receiving the Work Order, immediately take possession of the Site and move his men and materials to prepare the Site in order to create conditions for starting the Work as per terms of the Contract, Drawings and Specifications.

### **1.6 MOBILIZATION**

The work of mobilization shall consist of carrying out the following listed actions together with all other requirements of the Contract with regard to commencing the execution of the Work by the Contractor at his own cost.

Procurement, assembly, repair and make to running condition of all the contractor-owned constructional plant and equipment by the Contractor at any other site as convenient to him.

Transportation of Contractor-owned constructional plant, equipment and materials from the storage site as mentioned above in (a) to the place of construction.

Assembling and installation of all items of constructional plant, equipment, etc. required for the execution of the Work.

Receiving all constructional plant, equipment and materials to be furnished by the Employer, if any, and collect and transport those to the Work site. All materials shall be properly stored, inventoried and protected until used in to the Work and all plant and equipment shall be tested and made ready for use.

Construction of a suitable Site office building or shed for storage of materials and equipment, workshop, other operational buildings and First-Aid Center attended by competent Medical Assistants.

Maintenance of all temporary roads, fences and sanitary facilities, keep all areas used by the Contractor clean, neat, well-kept and in good repair and provide proper drainage to protect the area from surface run-off and flooding.

Provide all the required electric power, water supply and other utility connections to temporary installations at the Site as may be necessary for the execution of the Work.

Obtain all insurance policies, performance bond and payment guarantees as required under this Contract.

Payment of all fees, permits, licenses, etc. as may be required covering the execution of the Contract.

### **1.7 MONITORING PROGRESS**

The Contractor shall furnish the Engineer, without cost to the Employer, at regular monthly interval and in a form and number of copies determined by the Engineer, with the following:

Physical progress for the month under report and the estimated progress for the following month.  
Completion schedules (target and actual) based on the approved construction program.

A tabulation of construction equipment listing the major items and pieces of equipment comprising the construction plant as were utilized for performance of the Work during the month under report.

A tabulation of employees countersigned by the Engineer's representative, showing the supervisory staff and the number of several classes of labor employed by the Contractor in the month under report.

Any report which may be specifically requested by the Employer and/or by the Engineer.



#### **1.7.1 ATTENDANCE AT SITE MEETINGS**

The Contractor shall attend punctually the progress and other on-site meetings as would be requested by the Engineer.

#### **1.7.2 RECEIVING VISITORS**

The Contractor shall receive all authorized visitors of the Employer and allow them to visit the Work in the manner as would be requested by the Employer.

#### **1.8 CONTRACTOR'S SITE FACILITIES**

The Contractor shall, at his own expenses, be responsible for the provision, maintenance, operation and subsequent removal of the following and all other necessary temporary facilities and services on Site those are required to accomplish the Work in a safe and orderly manner as per provisions of the Contract:

All temporary stores, warehouses and workshops.

All temporary buildings for office accommodation for the Contractor's staff.

Living accommodation for staff.

Adequate number of toilets necessary for all persons engaged for the Work with separate arrangements for women. All sewage from toilets shall be disposed off by means of septic tank and soak pit or by some other acceptable disposal system.

To keep all sanitary facilities clean and their frequent disinfecting.

Fencing, lighting and security.

Cranes or other appropriate ways and means for off-loading plant and equipment, placing in temporary storage and moving from storage to equipment locations.

Site transport for the staff.

Electric power for temporary buildings and tools.

Provisions for adequate supply of water of acceptable quality at the Site for use in the Work.

Raw water from Site Tube-wells and provisions for adequate potable water.

In addition to above, the Contractor shall also make available all other necessary temporary facilities and services on Site those are required to accomplish the Work in a safe and orderly manner as per provisions of the Contract.

The Contractor shall submit for the approval of the Engineer Detailed Plans and/or construction Drawings of the temporary buildings, warehouses, workshops and labor camps that he proposes to construct or arrange on lease/rent including the proposals for water and power supply and sewerage facilities. These requirements shall be fulfilled by the Contractor within 10 (ten) days from receipt of the Formal Work Order to commence work (Date of commencement of Work). All buildings and facilities shall be of standard and acceptable to the Engineer.

The labor camps shall be at a location approved by the Engineer and conform to all requirements of the local law. It shall be laid and constructed in accordance with a Drawing prepared by the Contractor and approved by the Engineer.

The Contractor shall be responsible for acquiring the land deemed necessary for the Work beyond the Employer's land and for his temporary buildings, warehouses, workshops, staff quarters, labor camps and any temporary access road. The Contractor shall maintain the Site and all working areas in a safe

and hygienic condition and in all matters of health and sanitation shall comply with the requirements of the local Medical Officer of Health or other competent Authority.

### **1.9 MATERIALS, PLANT, EQUIPMENT AND TOOLS**

The Contractor at his own expenses shall provide the materials, plant, equipment and tools products as shown on the Drawings or as specified in the Contract. Necessary haulage and safe storage of materials, supervision of works etc. shall be provided by the Contractor.

#### **1.9.1 EQUAL PRODUCTS AND EQUIVALENTS**

Except as specifically required otherwise, the mention of any proprietary materials by trade name is intended to establish a standard of quality, appearance, size and durability. The products of other manufacturers may be used subject to the conditions as stated below.

#### **1.9.2 Additional costs related to substitutions**

Any additional costs, or any losses or damages, arising from the substitution of any materials or methods from those originally specified shall be borne by the Contractor, unless such substitution was made at the written request or direction of the Employer.

#### **1.9.3 FAILURE OF EQUAL PRODUCTS**

Where products are accepted, based on representation of the Contractor, as approved equals, those shall be used subject to the same installation and performance standards as required by the original specification. Approval of a request for substitution shall not modify the Contract requirements except as specifically noted. Subsequent failure of "approved equals" shall be considered first. For any evidence of improper installation or product inequality, the installation shall be repaired or corrected as directed by the Engineer at the full costs of the Contractor.

#### **1.9.4 PLANT, EQUIPMENT AND TOOLS**

The Contractor shall furnish all constructional plant, equipment and tools for the proper execution of the Work at his own expenses and keep those in proper working condition. The Contractor shall supply the Employer a list of major items of the constructional equipment and tools that he proposes to use in execution of the Work.

### **1.10 SUFFICIENCY OF MEANS EMPLOYED**

The Contractor shall take upon himself the full and entire responsibilities for the sufficiency of his supervisory and other personnel, plant or equipment or tools, scaffolding, timbering and generally for all means used for the fulfillment of the Contract. In the event of any of these means proving insufficient, the Contractor shall remain fully and entirely responsible for the sufficiency of these means notwithstanding any previous approval or recommendation that might have been given by the Engineer.

### **1.11 PROTECTION AND SAFETY**

#### **1.11.1 GENERAL**

The Contractor at all times shall take all necessary measures to the safety of life and property during construction of various parts of a building. International Safety Manuals used in Engineering Construction Project shall be adopted for protection and safety at the construction Site during the period of construction. Nothing stated herein shall be construed to nullify any rules, regulations, safety

standards or statutes of the local authority, or those contained in the various Acts of the Government of Pakistan. The specific rules, regulations and Acts pertaining to the protection of the public or workmen from health and other hazards wherever specified by the local Authority etc. or by the Act/Ordinance of the Government shall take precedence over whatever are specified herein.

#### **1.11.2 SAFETY OF WORKMEN**

Helmets conforming to and shall be worn by the workmen and other personnel at all times while works are going on.

Safety goggles of accepted standard shall be used by individuals engaged in drilling, cutting, welding and all such works which cause hazard to the eye. The welders and gas cutters shall be equipped with proper protective equipment like gloves, safety boots, aprons and hand shields having filter glass of accepted standard and suitable to the eyes of a particular worker.

#### **1.11.3 SITE PRECAUTIONS**

In absence of boundary walls, construction Site shall be delineated by fences.

Warning signs shall be displayed, where necessary, to indicate hazardous areas like high voltage zone, area of no smoking etc. Hand lamps shall be of low voltage, preferably 24V. All electrically operated hand tools shall be provided with double earthing.

The temporary wells, which shall be provided by the Contractor at the construction Site as a part of the toilet facilities, shall be provided with proper covers. The toilet facilities shall be located at a corner of the Site so as to avoid any obstruction. Protection from bad weather and falling object and proper privacy shall be provided to the toilet users.

Temporary toilets shall be dismantled, all wells filled up, and the whole area made level, dressed and restored back to proper grade at the end of the project.

The Contractor at all times shall protect the excavation, trenches and building materials from rain water, groundwater, backing up of drains and from water of any origin. He shall provide all pumping arrangements for removal of surplus water, coverings and other materials as required.

All rubbish and debris shall be removed from the Site and disposed of at a safe distance as per direction of the Engineer so as not to create any obstruction to Work or give rise to health hazards.

The Contractor shall take all necessary precautions to ensure against fire during construction. The Contractor must make all necessary arrangements for providing adequate protection against fire hazards at the construction site during the period of execution of the Work.

Timber, coal, paints and similar combustible materials shall be separated from each other. A minimum of two dry chemical powder (DCP) type fire extinguishers shall be provided at both open and covered locations where combustible and inflammable materials are stored.

Inflammable liquids like petrol, thinner etc., shall be stored in conformity with the relevant regulations.

#### **1.12 CARE OF WORKS**

##### **1.12.1 MOVEMENT OF TRANSPORT AND PLANT**

The Contractor shall exercise diligence and care in the movement of all transports and plant within the Work area so as not to cause injury or damage to life or property. The Contractor shall be

responsible for restoring any roadway, bridge, culvert etc. damaged by his transports and plant to the satisfaction of the Engineer or the appropriate Authority.

**1.12.2 KEEPING WORKS FREE FROM ATMOSPHERIC CONDITION**

The Contractor shall construct all temporary works and other works and supply and operate pumping plant and ensures all measures as may be found necessary for the construction of the Work under proper atmospheric condition.

Notwithstanding any approval by the Engineer of the arrangements made, the Contractor shall remain responsible for the sufficiency thereof and shall be liable for keeping the works safe at all-time regardless of the climatic condition at his own expenses. Any loss of production, additional overheads or additional costs of any kind that may result from inclement climatic conditions shall be at the Contractor's risk.

**1.12.3 MATERIALS ON AND UNDER THE SITE**

All soil, turf, gravel, stone, timber, or other materials obtained in the excavations, clearing of the Site of the Work and soil stripping, shall belong to the Employer and must not be removed from the Site without the written permission of the Engineer. Provided the Engineer directs the Contractor, he may use for the construction of the Work, any timber obtained from trees felled at the Site and any of the materials excavated under the Contract, which the Engineer may determine to be fit for such use.

**1.13 SURVEY WORKS**

**1.13.1 PERMANENT BENCH MARK**

Before commencing the work, the Contractor shall establish at his own cost, at least 2 (two) permanent Bench Marks (B.M) with permanent pillars at suitable positions as per direction of the Engineer. These B.Ms. shall be incorporated in the Drawings and used for controlling all levels of construction works.

**1.13.2 REFERENCE LINE PILLARS**

The Contractor shall establish permanent Reference Line Pillars (axis pillars, centre line pillars, etc.) at his own cost for all structures before starting of excavation of foundation pits/trenches as per standard practice and or as per direction of the Engineer. The Contractor shall remain responsible for safeguarding all Survey Monuments, Bench Marks, Beacons, etc. The Contractor, at his own expenses, shall make necessary arrangements to protect the B.M pillars against any disturbances, damages, including their maintenance.

The Engineer will provide the Contractor with the data necessary for setting out of the center line. All dimensions and levels shown on the Drawings or mentioned in the Documents forming part of or issued under the Contract shall be verified by the Contractor on the Site and he shall immediately inform the Engineer of any apparent error or discrepancy, if found by him in such dimensions or levels. The Contractor shall, after or in connection with these staking out of the center line, survey the terrain and shall submit to the Engineer for his approval, a profile as required by the Engineer.

Instruments and equipment for surveys shall be subject to rigorous inspection by both the Contractor and the Engineer and any items found to be defective in the opinion of the Engineer, shall be promptly replaced, repaired or adjusted as per his direction. A qualified Surveyor or Engineer shall supervise all survey works.

The checking of the setting-out of works by the Engineer's staff shall not relieve the Contractor of any of his liabilities or responsibilities under the Contract.

#### **1.14 FABRICATED ITEMS INCORPORATED IN THE WORK**

Whenever required by the Specifications to fabricate or manufacture and furnish equipment for incorporation in the permanent works, the Contractor shall submit to the Engineer for his approval the names of the manufacturers or fabricators the Contractor proposes to use and also his detailed Shop Drawings for approval before proceeding with the Work. All such Drawings shall be adequately and properly checked before being submitted to the Engineer for approval and shall be so designated.

Any fabricating or manufacturing undertaken during or before the approval of the Drawings, will be at the Contractor's risk. The Engineer shall have the right reserved to ask the Contractor to make any changes in the Design, which may be found necessary in the opinion of the Engineer, for the equipment or component materials to fully meet the requirements and intent of these Specifications without causing any additional costs to the Employer.

Approval of the Contractor's Drawings shall not relieve the Contractor of any part of his obligation to meet all requirements of these Specifications or of the responsibilities for the correctness of his Drawings. At the time of delivery of the equipment, the Contractor, if requested to do so, shall furnish the Engineer two complete sets of the final approved Drawings.

#### **1.15 INSPECTION/TESTS AT FABRICATOR'S WORKSHOP**

##### **1.15.1 GENERAL**

All equipment furnished under these Specifications and all works performed thereon will be subject to inspection by the Engineer or his authorized representative. Inspection at the manufacturer's plant, when located only in Pakistan, may be made with the intention to determine the meeting of requirements of the Specifications in respect of use of equipment and materials. The Contractor shall notify the Engineer a minimum of 15 (fifteen) days in advance of the date and place of equipment/materials to be available for inspection. No equipment or materials shall arrive at the Site until the Engineer's inspection at the manufacturer's plant or Contractor's storage place outside the actual Site has been made, the Engineer's approval has been given, final Drawings have been furnished by the Contractor and the Contractor's responsibilities for furnishing equipment and materials meeting the requirements of the Contract Document are fully complied with. All costs of the Engineer's inspection shall be borne by the Contractor.

##### **1.15.2 TESTS AND INSPECTION RECORD**

The record shall identify the Contractor and the Supervision Consultant staff (when applicable) involved, the place, the date and time when the inspection is completed, the sections of the Work and the materials tested or inspected and its state of completion. Reference shall be made to the relevant Working Drawings and the specific aspects or properties, which were checked or measured, shall be recorded.

One copy of each record of inspection shall be submitted to the Engineer and one copy of each record of inspection shall be submitted to the Supervision Consultant (when involved). The Contractor shall maintain records of inspections and tests in an orderly fashion at the Site until the issuance of the Defects Liability Certificate for the whole of the Work, or such earlier time as the Engineer may instruct. The Engineer shall have the rights of access to them at all times.

After the issuance of the Defects Liability Certificate for the whole of the Work, or such earlier time as the Engineer may instruct, the Contractor shall, as instructed by the Engineer, either dispose of the records or deliver them as directed.

#### **1.15.3 NOTICE OF WORKS OFF-SITE**

The Contractor shall give adequate written notices to the Engineer on the preparation or manufacture at a place not within the Site of any pre-fabricated units or parts of units or materials to be used in the Work. Such notices shall state the place and time of the preparation or manufacture, quarrying or extraction. The notice be given sufficiently in advance as to enable the Engineer to make arrangements which he may deem necessary for inspection before the start and at any stage of the Work and not only at the time when the units or parts are completed. Off-Site works shall not commence without the prior approval of the Engineer.

Any unit or parts, prepared or manufactured without giving such prior notice to the Engineer, may be rejected, if the Engineer considers that his inspection was necessary during the time of preparation or manufacture. No inspection by the Engineer shall relieve the Contractor of any of his responsibilities, duties and liabilities under the Contract.

#### **1.15.4 STANDARDS**

Except where otherwise specified or authorized by the Engineer, all materials and workmanship shall conform to the latest edition of the relevant Standard Specifications of the ASTM.

Materials meeting other internationally accepted equivalent or higher Standards may be accepted subject to review by the Engineer. The Contractor shall submit in English language any such alternative Standards proposed by him, for approval by the Engineer.

The Contractor shall provide the Engineer 3 (three) sets of each of the Standards, Codes and References to be used in the Contract within 45 (forty-five) days of the Date of Commencement of the Work. In addition, he shall supply 3 (three) copies of any other Standards or Codes subsequently specified or alternatively proposed to be used by the Engineer, the Supervision Consultant (when involved) and the Site Laboratory. All Standards shall be in English. On completion of the Contract, all copies of Standards, Codes and References, so provided, shall become the properties of the Employer.

#### **1.15.5 PROPRIETARY PRODUCTS**

Where a proprietary or brand name or the name of a supplier or manufacturer is indicated on the Drawings or in the Specifications, this would be in respect of items, which have not otherwise being adequately described by ASTM or equivalent recognized Standards. Alternative items based on recognized national Standards of the country of origin may be accepted provided that documented proof in the English language is submitted to the Engineer for his approval sufficiently in advance and showing that the alternative proposal is equal or higher in quality and performance than the specified item.

#### **1.15.6 MATERIALS TO BE NEW**

All materials used in the permanent works shall be new. No materials, incorporated in the permanent works, shall have previously been used in the temporary works.

### **1.15.7 ORDERS FOR MATERIALS**

Before orders are placed for any materials of any description to be used in the permanent works, the Contractor shall submit to the Engineer the names and addresses of the manufacturers or suppliers proposed. Following approval by the Engineer, the Contractor shall submit to him copies of all orders placed for such materials.

### **1.15.7 SAMPLES**

In accordance with the provisions of the Contract, the Contractor shall, in the way as directed by the Engineer, supply samples of materials to be incorporated in the Work. The Contractor shall submit the samples required for approval in labeled boxes suitable for storage and with sufficient time for testing. Due allowance shall be kept for the fact that if samples are rejected, further samples and testing will be required. The Engineer shall keep the approved samples with him and will compare the supply with the sample before acceptance. He shall reject any materials not conforming to the character and quality of the approved samples.

### **1.15.8 CERTIFICATES**

All manufacturer's certificates of tests, proof sheets, mill sheets etc., showing that the materials have been tested in accordance with the requirements of the relevant ASTM or other approved Standard or this Specification, shall be supplied in English language by the Contractor to the Engineer free of charge.

### **1.16 TOLERANCES**

Unless it has been specified in the different Sections otherwise, all works shall be constructed within the tolerances shown in the Table given below.

| Type of Structure   | Item  | Tolerance      |
|---------------------|---|----------------|
| Concrete Structures | <u>Tolerances from the specified position (Structure)</u>   |                |
|                     | Maximum departure of plan position of structure or element  | 25mm           |
|                     | <u>Tolerances from the specified dimensions (Structure)</u>   |                |
|                     | Maximum departure in thickness or cross sectional dimensions of columns, beams, buttresses, wall footings etc., up to and including 500mm thick (except tunnel and shaft linings) | +6mm<br>-3mm   |
|                     | Ditto – between 500mm and 1000mm thick<br>Ditto – between 1000mm and 4000mm thick   | +10mm<br>- 5mm |

**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

N.E.D. University of Engineering & Technology

Section 1: GENERAL AND SITE FACILITIES

|               |  |   |
|---------------|--|---|
|               | <p>Ditto – over 4000mm thick</p> <p><u>Tolerances from specified position (Surface)</u></p> <p>Maximum departure of vertical, sloping or curved surfaces including joint surfaces</p> <p>Maximum departure of horizontal or near-horizontal surfaces including joint surfaces</p> <p><u>Tolerance on Straightness or Departure from Specified</u></p> <p><u>Curve (Surface)</u></p> <p><u>General Surface</u></p> <p>Maximum deviation in horizontal or vertical directions (gradual)</p> <p>Maximum deviation in horizontal or vertical directions (abrupt)</p> | <p>+10mm</p> <p>-8mm</p> <p>+25mm</p> <p>-10mm</p> <p>25mm</p> <p>20mm</p> <p>12mm in 2m</p> <p>6mm</p>   |
|               |  |   |
| Formwork      | <p>Sectional dimension</p> <p>Plumb</p> <p>Levels (before any deflections has taken place)</p>   | <p>±5mm</p> <p>±1 in 1000 of height</p> <p>±3mm</p>   |
| Reinforcement | <p>Length of splice</p> <p>Variation of protective cover</p> <p>Variation in indicated position or reinforcement:</p> <p>Starter bars</p> <p>Slabs and Walls</p> <p>One bar diameter</p> <p>Dimension of bent bars:</p> <p>Stirrups and ties</p> <p>Other bars</p>   | <p>-25mm</p> <p>± 1 in 1000 of ht.</p> <p>± 3mm</p> <p>One bar dia.</p> <p>0.25 times the indicated spacing.</p> <p>±5mm</p> <p>±5mm</p> <p>±10mm</p> |



|              |   |  |
|--------------|---|--|
| R.C.C. Piles | Pre-cast driven pile:<br>Verticality for vertical pile<br>Verticality for raker pile<br>Deviation from position shown on the plan for vertical and raker piles after driving.   | 1 in 50<br>1 in 25<br>1/4 <sup>th</sup> of Least dimension of 75mm whichever is greater. |
|              | Concrete piles casting tolerances:<br>Maximum departure in thickness or cross-sectional dimensions.<br>Deviation of pile face<br>Deviation of cross-section centroid from straight line connecting the centroid of the end faces of the pile. | +6mm<br>-0.00<br>6mm in 3m<br>10mm   |
| Timber Piles | Bored and Cast-in-situ pile:<br>Verticality for vertical pile<br>Verticality for raker pile<br>Deviation from position shown on the plan for vertical and raker pile shaft  | 1 in 75<br>1 in 25<br>Maximum 75mm in any direction                                      |
|              | Deviation of cross-sectional dimension.<br>Deviation of cross-section centroid from straight line joining end face centroid.<br>Level of top Pile.  | -6mm<br>40mm<br>+ 12mm   |

\*In addition to above, other tolerances have also been specified in the different Sections and Sub-sections in the relevant portions.

### 1.17 RECORDING OF MEASUREMENT

Conditions of the Contract, Technical Specifications and Contract Drawings are to be read in conjunction with the Bill of Quantities (BOQ).

General directions and descriptions of works and materials are not necessarily be repeated nor summarized in the BOQ. References to the relevant Sections of the Contract documents shall be made before entering the Tender's rate.

The quantities given in the BOQ are only approximate and provisional and are given to provide a common basis for tendering. It does neither expressly nor by implication prescribed that the actual volume of work to be performed will exactly correspond therewith.

Any clarification regarding the BOQ and the Method of Measurement shall be adjudged by the Engineer in accordance with this Standard Specification, its Sub-sections, BOQ and other Tender Documents.

The works, executed fully complying the Drawings and instructions of the Engineer, will be measured for payment in accordance with the method adopted in the BOQ and the item therein set forth, notwithstanding any custom to the contrary. The net quantities of the finished works in place will always be taken except where otherwise specified.

No allowance shall be made for waste, laps, cuttings, etc. and no deduction will be made for grout nicks, joggle holes or rounded arises and sink age or for fitting iron works, etc.

#### **1.18 PAYMENT**

Full account shall be taken of all information contained in the Tender Documents and made available during the tender period as affects, inter-alia, working methods, haulage requirements and sequence of operations. Full allowance shall be made for all these provisions in the rates and sums entered against the various items in the BOQ of the Contract.

The specified payment Sections/Sub-sections of the Contract shall apply to any additional or varied works, which may be required to execute under the Contract except where specifically varied therein.

The basis of payment will be the actual quantities of works ordered and carried out, as measured by the Engineer (based on the As-Built Drawing, BOQ or otherwise as directed by the Engineer) and valued at the rates and prices of the Tender, where applicable, or otherwise at such rates and prices as (in case of non-tendered items) the Engineer may fix within the Terms of the Contract.

No payment will be made on account of the anticipated profit for work covered by the Contract, which is not performed. No adjustment will also be made in the unit rates set out in the Bill of Quantities because of an increase or decrease in the actual quantities from the Estimated quantities indicated therein, unless otherwise stated in the Conditions of Contract.

Notwithstanding any limit, which may be implied by the wording of the individual item and or the explanations in this Section, it is to be clearly understood that the Tender price is for the works finished and completed in every respect. Full account of all requirements and obligations have to be taken, whether expressed or implied covered by all parts of the Contract. The Tender price shall, therefore, include all incidental and contingent expenses (including all taxes and VATs) and risks of every kind necessary to construct, complete and maintain the whole of the Work in accordance with the Contract. Full allowance is to be made in the Tender price for all costs involved in the following, inter-alia, which are referred to and/or specified herein:

All setting-out and survey works.

Temporary access unless separately billed, fencing, guarding, lighting, and all temporary works including their removal on completion.

Paying fees and giving notices to the Authorities.

Reinstatement of the Site.

Safety precautions and all measures to prevent and suppress fire and other hazards.

**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

N.E.D. University of Engineering & Technology      *Section 1: GENERAL AND SITE FACILITIES*

---

Interference to the works by persons or vehicles being legitimate users of the facilities on or in the vicinity of the Site.

Protection and safety of adjacent structures so far as they may be affected by the works or temporary works.

Supplying, maintaining and removing the Contractor's own housing for staff and labour, offices, workshop, plant yard, transport, welfare, services in connection therewith and other facilities required by the Contractor on completion of work unless separately billed.

Working in the dry condition except where otherwise permitted by the Specification.

Supplying, inspection and testing of materials intended for use in the works including the provision and use of equipment.

Maintaining public roads and footpaths.

Opening quarries and borrow pits including all surveys, site investigations, removal and disposal of overburden, trimming of quarry or borrow pit faces and floors and all measures necessary to render quarries or pits safe and free for draining on completion.

Providing and transporting to Site all equipment necessary for the execution of the Work, setting to works, operating (including all fuel and consumable stores), removal from the Site all construction equipment upon completion of the Work, costs of all tests and other requirements in respect of such plant and equipment.

The requirements and all incidental costs and expenses involved to provide all necessary skilled and unskilled labors and supervision.

Protection of all completed works following operations making good damages to any completed works due to any cause whatsoever, clearing all rubbish as they accumulate and leaving the Site in a tidy condition.

All costs associated with the provision and submission of Progress Reports, Records, Photographs, preparation of the necessary Shop and Working Drawings etc. except those provided in the Bill of Quantities.

Workmen's compensation and Owner's liability insurance.

Payments under the item for hiring of land (if there be any) in addition to the Employer's land for temporary works shall be made in accordance with the receipts obtained from the land owners within the limitation of quoted rate only if such provision is made in the BOQ of the Contract.

Payment of royalties for fill materials obtained from privately owned land/carried earth shall remain included within the rates of the relevant items of the Contract. The volume of borrowed materials shall be calculated on the basis of pre-work and post-work measurements. Finished sections as per

**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

N.E.D. University of Engineering & Technology      *Section 1: GENERAL AND SITE FACILITIES*

---

Drawings will be the basis for post-work measurement while the Work is complete as per Specifications.

Payment shall mean gross payable amount on the rates of the BOQ including the Performance Security.

With regard to the Sub-section on 'Contractor's Site Facilities', payment will be made for hiring land for the Contractor's temporary works outside the Employer's property, only if such provisions are kept in the BOQ of the Contract.

The cost of keeping the works free from water will only be paid for, if referred to in the BOQ of the Contract Documents.

No payment shall be made for any tests required under the Specification unless specifically referred to in the BOQ. If the Engineer requires any tests outside the BOQ, the cost of such test shall be agreed with the Engineer before execution and paid for as a supplementary item.

No direct payment shall be made for works required under other Sub-sections. The costs for such works shall be deemed included in the related items of the BOQ.

|  |           |
|--|-----------|
| <b>2.0 CONSTRUCTION MATERIALS .....</b>                    | <b>16</b> |
| <b>2.1 FIRST CLASS MACHINE MADE BRICKS .....</b>           | <b>16</b> |
| <b>2.2 AGGREGATES .....</b>                                | <b>16</b> |
| <b>2.2.1 COARSE AGGREGATE .....</b>                        | <b>17</b> |
| <b>2.2.2 STONE AGGREGATE .....</b>                         | <b>18</b> |
| <b>2.2.3 STORAGE OF COARSE AGGREGATE .....</b>             | <b>18</b> |
| <b>2.2.4 FINE AGGREGATE .....</b>                          | <b>19</b> |
| <b>2.2.5 IMPURITIES .....</b>                              | <b>19</b> |
| <b>2.2.6 GRADING .....</b>                                 | <b>19</b> |
| <b>2.2.7 FINE AGGREGATE FOR CONCRETE .....</b>             | <b>20</b> |
| <b>2.2.8 FINE AGGREGATE FOR MASONRY .....</b>              | <b>20</b> |
| <b>2.2.9 SAND FILL .....</b>                               | <b>20</b> |
| <b>2.3 CEMENT .....</b>                                    | <b>21</b> |
| <b>2.3.1 WHITE CEMENT .....</b>                            | <b>21</b> |
| <b>2.3.2 REJECTION OF CEMENT .....</b>                     | <b>22</b> |
| <b>2.3.3 STORAGE OF CEMENT .....</b>                       | <b>22</b> |
| <b>2.4 ADMIXTURE .....</b>                                 | <b>22</b> |
| <b>2.5 REINFORCEMENT .....</b>                             | <b>23</b> |
| <b>2.5.1 HIGH STRENGTH DEFORMED ROD .....</b>              | <b>23</b> |
| <b>2.5.2 CLEANING AND STORAGE .....</b>                    | <b>23</b> |
| <b>2.5.3 PRE-STRESSING STEEL AND ANCHORAGE .....</b>       | <b>23</b> |
| <b>2.6 RUSTLESS TYING WIRE .....</b>                       | <b>23</b> |
| <b>2.7 LIME .....</b>                                      | <b>24</b> |
| <b>2.7.1 STORAGE AND HANDLING OF LIME .....</b>            | <b>24</b> |
| <b>2.8 WATER .....</b>                                     | <b>24</b> |
| <b>2.9 FILL .....</b>                                      | <b>24</b> |
| <b>2.10 TIMBER .....</b>                                   | <b>25</b> |
| <b>GENERAL .....</b>                                       | <b>25</b> |
| <b>INSPECTION .....</b>                                    | <b>25</b> |
| <b>WROUGHT FACES AND ALLOWANCES ON JOINER'S WORK .....</b> | <b>25</b> |
| <b>2.12 MARBLE .....</b>                                   | <b>25</b> |
| <b>MARBLE STONE .....</b>                                  | <b>25</b> |
| <b>MARBLE CHIPS .....</b>                                  | <b>25</b> |
| <b>MARBLE DUST .....</b>                                   | <b>26</b> |
| <b>2.13 GLASS GENERAL .....</b>                            | <b>26</b> |

|   |           |
|---|-----------|
| <b>FLAT GLASS</b> .....                                     | <b>26</b> |
| <b>WIRED GLASS</b> .....                                    | <b>26</b> |
| <b>STORAGE AND HANDLING OF GLASS</b> .....                  | <b>26</b> |
| <b>2.14 WIRE GAUGE</b> .....                                | <b>26</b> |
| <b>WIRE GAUGE GENERAL</b> .....                             | <b>26</b> |
| <b>OTHER MATERIALS</b> .....                                | <b>27</b> |
| <b>2.15 PAINTS AND PROTECTIVE MATERIALS</b> .....           | <b>27</b> |
| <b>KNOTTING</b> .....                                       | <b>27</b> |
| <b>RED LEAD PAINT</b> .....                                 | <b>27</b> |
| <b>LINSEED OIL PUTTY</b> .....                              | <b>27</b> |
| <b>VARNISHES/WOOD POLISH</b> .....                          | <b>27</b> |
| <b>WHITE WASH</b> .....                                     | <b>27</b> |
| <b>COLOUR WASH</b> .....                                    | <b>27</b> |
| <b>OIL BOUND DISTEMPER</b> .....                            | <b>27</b> |
| <b>EMULSION PAINTS</b> .....                                | <b>28</b> |
| <b>CREOSOTE</b> .....                                       | <b>28</b> |
| <b>STORAGE AND HANDLING OF PAINT, VARNISHES, ETC.</b> ..... | <b>28</b> |
| <b>2.16 ALUMINIUM MEMBERS</b> .....                         | <b>28</b> |
| <b>2.17 STRUCTURAL STEEL FOR DOORS AND WINDOWS</b> .....    | <b>28</b> |
| <b>2.18 PIPES</b> .....                                     | <b>28</b> |
| <b>M.S. PIPE</b> .....                                      | <b>28</b> |
| <b>PVC PIPE</b> .....                                       | <b>28</b> |
| <b>STORAGE AND HANDLING OF PIPE</b> .....                   | <b>29</b> |
| <b>2.19 GUNNY BAGS</b> .....                                | <b>29</b> |

## **2.0 CONSTRUCTION MATERIALS**

### **2.1 FIRST CLASS MACHINE MADE BRICKS**

First Class Machine Made Bricks shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right-angled edges. They shall be of uniform color (generally deep red or copper), homogeneous in texture and free from cracks, flaws and nodules of free lime. A fractured surface shall show a uniform compact structure free from limps and grits of holes. Other requirements of the First Class Machine Made Bricks shall comply with the following requirements:

|                           |                          |
|---------------------------|--------------------------|
| Minimum crushing strength | 210 kg/cm <sup>2</sup> . |
| Maximum water absorption  | 10% of dry weight        |
| Efflorescence             | Nil                      |
| Dimensions ( + 5mm )      | 200mm x 100mm x 50mm     |

### **2.2 AGGREGATES**

Aggregates shall be hard, strong, durable, dense and free from injurious amount of adherent coatings, clay, lumps, dust, soft or flaky particles, shell, mica, alkali, organic matter and other deleterious substances. The various sizes of particles of which an aggregate is composed of shall be uniformly distributed throughout the mass.

Testing of aggregates shall be in accordance with BS 812 or ASTM C-136.

Approval of a source of aggregate by the Engineer shall not be construed as constituting the approval of all materials to be taken from that source and the Contractor shall be responsible for the specified quantity and quality of all such materials used in the Work. Aggregates shall not be obtained from sources, which have not been approved by the Engineer. The Contractor shall provide means of storing aggregates at each point where concrete is made such that

Aggregates shall be stored on a hard and dry patch of ground covered with a 50mm thick layer of lean concrete.

Each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times.

Contamination of the aggregates by the ground or other foreign materials shall be effectively prevented at all times.

Each heap of aggregate shall be capable of draining freely.  
The aggregates shall be handled so as to avoid segregation.

The Contractor shall make available to the Engineer such samples of the aggregate as he may require. Such samples shall be collected at the point of discharge of aggregate to the batching plant/mixer machine. If any such sample does not conform with the Specifications, the aggregate shall promptly be removed from the Site and the Contractor shall carry out such modifications to the supply and storage arrangements as may be necessary to secure compliance with the Specifications.

### **2.2.1 COARSE AGGREGATE**

Coarse aggregate shall be obtained from breaking hard durable rock or gravel or Picked Jhama Bricks, which conform to the requirements of AASHTO Standard Specifications M-80. Coarse aggregate shall be clean, free from dust and other deleterious materials. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce a workable concrete of maximum density.

Aggregate pieces shall be angular in shape and have granular or crystalline or smooth, but not glossy non-powdery surfaces.

Maximum allowable limits of deleterious substances that shall not be exceeded for coarse aggregate are shown in the following table:

| Material  | Mass Percent                            |
|---|---|
| Soft fragments  | 2.00                                    |
| Clay Lumps  | 0.25                                    |
| Material passing the 0.075mm sieve                                | 0.50 for clay<br>1.50 for fracture dust |
| Thin or elongated pieces: Flakiness Index (BS 882-1992) less than | 50 for uncrushed<br>40 for crushed      |

The Aggregate Crushing Value shall be less than 25% or the Ten percent Fine Value shall be greater than 150 kN according to BS 882-1992. Grading for nominal size coarse aggregate shall comply with the following ASTM C-33 standard gradations:

#### **20mm nominal size Coarse Aggregate**

| Sieve Size (mm) | % Passing by Weight |
|-----------------|---------------------|
| 25              | 100                 |
| 19              | 90-100              |
| 12.50           | 20-55               |
| 9.50            | 0-15                |
| 4.75            | 0-5                 |

#### **40mm nominal size Coarse Aggregate**

| Sieve Size (mm) | % Passing by Weight |
|-----------------|---------------------|
| 50              | 100                 |
| 37.5            | 95-100              |



**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

N.E.D. University of Engineering & Technology      *Section 2: CONSTRUCTION MATERIALS*

|      |       |
|------|-------|
| 19   | 35-70 |
| 9.50 | 10-30 |
| 4.75 | 0-5   |

Coarse aggregate subject to five cycles of the Soundness Test, specified in ASTM C88, shall not show a loss exceeding 10% when magnesium sulphate solution is used except where otherwise approved.

The flakiness and elongation indices of the predominant size fractions in each single sized coarse aggregate, determined in accordance with BS 812, shall not exceed 20% and 35% by weight respectively.

Aggregate for use in concrete which is subject to abrasion and impact shall comply with the Test requirements of BS 812 and the Specification of BS 63 Part 1 and BS 63 Part 2 and BS 882 respectively.

Coarse aggregate shall be tested for drying shrinkage characteristics in accordance with BRS Digest No. 35.

Coarse aggregate shall be stored at Site in such a manner that it is not contaminated by fine aggregate, earth or other foreign matter. Adequate precautions shall be taken to prevent segregation of the coarse aggregate while it is being transported and stacked.

### **2.2.2 STONE AGGREGATE**

The boulders to be used as coarse aggregate in concrete shall be composed of limestone, sandstone, granite, trap rock or rock of similar nature and shall have the following properties:

|                              |                             |
|------------------------------|-----------------------------|
| Minimum compressive strength | 490 kg/cm <sup>2</sup>      |
| Specific gravity             | 2.4-2.7                     |
| Unit-weight                  | 2245-2566 kg/m <sup>3</sup> |
| Porosity                     | 2-6%                        |
| Water absorption             | 1.5 – 5% by weight          |

The boulder shall be of uniform light colour as approved and shall be free from thin lamination, adherent coatings and deleterious substances. The wear loss of coarse aggregate of all types shall not exceed 35% by weight when tested by the Los Angeles Abrasion Test.

The boulders shall be supplied in sizes that can be handled manually by one person. Stock piling shall be such as to permit ready identification of the materials and shall be approved by the Engineer. Site for stockpiles shall be clean prior to storing materials. The stockpiles shall be built up in layers not to exceed 1.22m in height and each layer shall be inspected before the next layer is started. The crushed boulder chips shall be stacked in accordance with the specified sizes in different stacks as directed by the Engineer. Height of each stack should not exceed 33% of the minimum base dimension of the stack.

### **2.2.3 STORAGE OF COARSE AGGREGATE**

Aggregate of different sizes or grades and from different sources of supply shall not be mixed. All aggregate shall be stored separately free from contact with earth and other deleterious matter. The coarse aggregate should be stockpiled in different stacks, according to the sieve sizes.

All precautions shall be taken during transport and stockpiling of coarse aggregate to prevent segregation. Segregated aggregate shall not be used until they have been thoroughly re-mixed and the resulting stack is of uniform and acceptable gradation.

Aggregate shall be stock-piled at least 7 (seven) days prior to their anticipated use to permit the Engineer to sample each stock-pile to determine the acceptability of the material for the intended use.

### **2.2.4 FINE AGGREGATE**

Fine aggregates for use in the concrete and masonry work shall be non-saline clean natural sand and have a Specific Gravity not less than 2.6 and conform to the requirements of ASTM C 144. It shall be angular (gritty to touch), hard and durable, free from clay, mica and soft flaky pieces. All sands must be well washed and clean before use.

A well graded sand should be used for cement work as it adds to the density of the mortars and concretes. Sand required for brick work needs to be finer than that for stone work.

Sand which contains 90% of particles of size greater than 0.06mm and less than 0.2mm is fine sand. On the other hand, sand which contains 90% of particles of size greater than 0.6mm and less than 2mm is coarse sand.

Supply methods and stock piling of sand shall be such, as to permit ready identification of the material delivered and shall be approved by the Engineer.

### **2.2.5 IMPURITIES**

Sand shall be clean and free from injurious amount of organic impurities. Deleterious substances shall not exceed the following percentage by weight.

|                                      |      |
|--------------------------------------|------|
| Material Passing No. 200 sieve       | 2.0  |
| Shale, coat, soft or flaky fragments | 1.0  |
| Sulphur Compounds                    | 0.3  |
| Clay Lumps (wet, on No. 4 sieve)     | 0.00 |

Fine aggregate subject to five cycles of the soundness test, specified in ASTM C88 shall not show a loss exceeding 10 mass percent when magnesium sulphate solution is used except where otherwise approved.

### **2.2.6 GRADING**

Sand shall be well graded from coarse to fine within the limits given below or shall conform to the specified Fineness Modulus.

**2.2.7 FINE AGGREGATE FOR CONCRETE**

| Sieve No. | % Passing by Weight |
|-----------|---------------------|
| 9.5mm     | 100                 |
| 4         | 95-100              |
| 16        | 45-80               |
| 50        | 10-30               |
| 100       | 2-10                |

**2.2.8 FINE AGGREGATE FOR MASONRY**

| Sieve No. | % Passing by Weight |
|-----------|---------------------|
| 4         | 100                 |
| 8         | 95-100              |
| 16        | 70-100              |
| 30        | 40-75               |
| 50        | 10-35               |
| 100       | 2-15                |

**2.2.9 SAND FILL**

Sand for sand fill shall consist of hard, dense, durable materials free from injurious amounts of clay lumps, lightweight materials or other deleterious substances. Unless otherwise specified on the Drawings, sand fill with gunny bags shall have Fineness Modulus not less than 0.8. Sand fill for the Geo-textile bags shall, unless otherwise approved by the Engineer, comply with the following grading:

|                 | mm           |
|-----------------|--------------|
| d <sub>90</sub> | 0.60 to 0.30 |
| d <sub>86</sub> | 0.50 to 0.25 |
| d <sub>60</sub> | 0.40 to 0.20 |
| d <sub>50</sub> | 0.35 to 0.20 |
| d <sub>10</sub> | 0.20 to 0.05 |

### **2.3 CEMENT**

Cement used in the works shall be obtained from manufacturers, approved in writing by the Engineer and shall be Ordinary Portland Cement complying with the requirements of ASTM C150 Type 1 or BS 12 or equivalent standard. Special cements shall conform to the requirements provided in writing by the Engineer.

A certificate showing the place of manufacture and the results of standard tests carried out on the bulk supply from which the cement was extracted must accompany each consignment of cement delivered to the Site.

The Engineer may make any tests, which he considers advisable or necessary to ascertain, if the cement has deteriorated in any manner during transit or storage. Any cement which, in the opinion of the Engineer, is of doubtful quality shall not be used in the Work until it has been re-tested and test result sheets, showing that it complies in all respects with the relevant standard, have been delivered to and accepted by the Engineer.

Cement that becomes lumpy or otherwise deteriorated in transit or storage shall not be used for brick masonry or concrete works. All cement, found unsuitable for use, shall be removed from the Site immediately.

The Engineer shall ask to carry out sampling, inspection and testing of all cement as may consider be necessary. Samples shall be taken as instructed from the Site store or from elsewhere on the Work or from any places where cement is used for incorporation in the Work. The compressive strength and tensile strength of standard cubes and briquettes respectively shall be not less than as follows:

| Days | Compressive Strength (N/mm <sup>2</sup> ) | Tensile Strength (N/mm <sup>2</sup> ) |
|------|---|---------------------------------------|
| 3    | 12.4                                      | 1.0                                   |
| 7    | 19.3                                      | 1.9                                   |
| 28   | 27.6                                      | 2.4                                   |

Initial setting time shall be not less than 45 minutes and the final setting time shall be not more than 8 hours. Cement, when tested for fineness, shall have a specific surface of not less than 160m<sup>2</sup>/kg. Cement when tested for soundness shall not have an expansion of more than 10 mm. The unit weight of cement shall be a minimum of 14.16 KN/m<sup>3</sup>.

#### **2.3.1 WHITE CEMENT**

White Cement shall be made from pure calcite lime stone and have the same physical properties as those of Portland Cement Type 1, ASTM C-150. Atypical composition of White Cement is as follows:

|                                |       |
|--------------------------------|-------|
| CaO                            | 65%   |
| SiO <sub>2</sub>               | 25.5% |
| Al <sub>2</sub> O <sub>3</sub> | 5.9%  |
| Fe <sub>2</sub> O <sub>3</sub> | 0.6%  |
| MgO                            | 1.1%  |
| SO <sub>3</sub>                | 0.1%  |

### **2.3.2 REJECTION OF CEMENT**

The Engineer may reject any cement as the result of any tests thereof notwithstanding the manufacturer's certificate. The Engineer may also reject cement, which has deteriorated owing to inadequate protection or from other causes where the cement is not to his satisfaction. The Contractor shall remove at his cost all rejected cement from the Site without delay.

### **2.3.3 STORAGE OF CEMENT**

Cement shall be delivered at the Site in sound and properly sealed jute/paper bags, each plainly marked with manufacturer's name or registered mark. Cement shall be well protected from weather by tarpaulins or other approved cover during transit. Weight of individual bag containing cement shall be 50 kg and weight of all bags shall be uniform. Weight of cement shall be legibly marked on each bag. Bags in broken or damaged condition shall be rejected.

The Contractor shall provide waterproof and well-ventilated godowns at the specified or approved location at the Site having a floor of wood or concrete raised platform at minimum 450mm above the ground so as to protect the cement against moisture from air or from any other source. Sheds shall be large enough to allow a minimum 300mm gap between the stacked cement and the godown walls to store cement in sufficient quantity to ensure continuity of work and to permit each consignment to be stacked separately therein to permit easy access for inspection. All storage facilities shall be subject to approval by the Engineer.

Immediately upon arrival at the Site, cement shall be stored in the godowns with adequate provisions to prevent absorption of moisture. The Contractor shall use the consignments in the order in which they are received. Cement delivered to the Site in drums or bags provided by the supplier or manufacturer, shall be stored in the drums or bags until used in the Work. Any cement in drums or bags, which has been opened, shall be used immediately on opening. Cement shall not be stored in a godown for more than 3 (three) months if bagged or 6 (six) months, if in bulk or a lesser period as directed by the Engineer. After this period is over, any unused cement shall be removed from the Site.

### **2.4 ADMIXTURE**

Admixture shall be used to provide excellent acceleration of gaining strength at early age and major increase in strength at all ages by significantly reducing water demand in a concrete mix, especially suitable for pre-cast concrete and other high early strength requirements. Admixture shall conform to BS 5075 Part 3 and ASTM C 494.

## **2.5 REINFORCEMENT**

### **2.5.1 HIGH STRENGTH DEFORMED ROD**

Reinforcing steel under this type comprises Grade-60 Deformed re-bars. The steel shall conform to ASTM Specification A 617M or A 615M of yield strength not less than 420 MPa (N/mm<sup>2</sup>). The structural grade shall be made from billets. The ends of the bar shall be machine sheared perpendicular to the axis of the bar. The bars shall be free from injurious defects and shall have a workman like finish.

### **2.5.2 CLEANING AND STORAGE**

Steel reinforcement bars and structural steel shall be stored in a way to prevent distortion, corrosion, scaling and rusting. Reinforcement bars and structural steel sections shall be coated with cement wash before stacking, especially in humid areas. In the case of long time storage or storage in coastal areas, reinforcement bars and steel sections shall be stacked at least 200mm above the ground level.

Steel sections shall be stacked upon platforms, skids or any other suitable supports. Bars of different sizes and lengths and structural sections shall be stored separately to facilitate issues in required sizes and lengths without cutting from standard lengths. Ends of bars and sections of each type shall be painted with separate designated colors.

Tag line shall be used to control the load in handling reinforcing bars or structural steel when a crane is used. Heavy steel sections and bundles of reinforcing bars shall be lifted and carried with the help of slings and tackles.

All bars, prior to its use, shall be cleaned with wire brush to make them free from nail scale, loose rust, dirt, paint, oil, grease or other foreign substances.

Bars of reduced sectional area to excessive rust shall be rejected.

All reinforcing steel shall be stored properly under shed not to be contaminated by oil, grease, dirt or mud.

All stacking and storing of bars shall be the Contractor's responsibility and contingent upon his Tender.

### **2.5.3 PRE-STRESSING STEEL AND ANCHORAGE**

Pre-stressing reinforcement shall comprise high strength seven wire strand, high strength steel wire or high strength alloy bars conforming grade and type as shown on the Drawings.

Un-coated seven-wire strand shall conform to the specifications of AASHTO M 203.

Un-coated stress-relieved steel wire shall conform to the specifications of AASHTO M 204.

Un-coated high-strength bars shall conform to the specifications of AASHTO M 275.

## **2.6 RUSTLESS TYING WIRE**

Rustles tying wire of 18 SWG shall be obtained from approved manufacturers and shall, as regards strength, comply with the requirements specified. The Contractor shall, at his own costs, provide binding wires of required specifications.

## **2.7 LIME**

Lime shall be stone lime of good quality high calcium lime containing calcium oxide from 95% upwards. The impurities, insoluble in acids, should not exceed 3% for the quick lime and 1% for the hydrated lime. Limes shall conform to the requirements of ASTM C 5 for quick lime and ASTM C 207 for hydrated lime.

### **2.7.1 STORAGE AND HANDLING OF LIME**

Quicklime shall be slaked as soon as possible. If not possible, it may be stored in compact heaps having only the minimum of exposed area. The heaps shall be stored on a suitable platform under a roof protected from rain and wind. A minimum space of 300mm shall be provided all round the heaps to avoid bulging of walls.

Un-slaked lime shall be stored in a watertight place and shall be separated from combustible materials.

Hydrated lime shall be supplied either in containers or sacks, such as jute bags lined with polyethylene or high density polyethylene woven bags lined with polyethylene or craft paper bags. It shall be stored in a dry room to protect the lime from dampness and to minimize warehouse deterioration.

When dry slaked lime is to be used within a few days, it shall be stored on a covered platform and protected from rain and wind. It shall be kept in a dry airtight god own when immediate use is not required. However, it shall never be stored for more than two months.

Workmen, handling bulk lime, shall wear protective clothing, respirators and goggles. They shall be instructed for cleanliness as a preventive measure against dermatitis and shall be provided with hand cream, petroleum jelly or similar protectors.

## **2.8 WATER**

Water shall be clean, fresh and free from organic or inorganic matter in solution or suspension in such amount that may impair the strength or durability of the concrete. Water shall be obtained from a supply, where possible. However, it may be taken from any other sources, only if approved. No water from excavation shall be used. Only water of approved quality shall be used for washing shuttering, curing of concrete and similar other purposes.

Water to be used in construction shall be stored in tanks, bottom and the sides of which shall be constructed with brick or concrete. Contact with any organic impurities shall be prevented.

The tank shall be so located as to facilitate easy storage and filling in, and supply for construction works and other purposes.

## **2.9 FILL**

Materials for filling shall be uniform in character throughout and free from substances that by decay or otherwise may cause the formation of hollows or cavities or otherwise affect the stability of the filling.

Earth filling shall be of selected materials obtained from the excavation or carted fine sand as approved by the Engineer. No soft chalk or clay or earth with a predominating clay content shall be used. Hard core shall be selected hard clean gravel, broken brick, broken concrete, broken or crushed stone, quarry waste or similar approved materials. Concrete for filling shall be to the proportions specified.

## **2.10 TIMBER**

### **GENERAL**

All timbers for temporary or permanent works shall be of best quality, sound, straight and well-seasoned. They shall be free from sap, defects, radial cracks, cup-shakes, large/loose/dead knots, or other imperfections and shall show a clean surface with cut.

Timber shall be stored in stacks on well treated and even surfaced beams, sleepers or brick pillars so as to be at least 200mm above the ground level. Members shall be stored separately in layers according to the lengths.

A space of 25mm shall be kept between the members. The longer pieces shall be placed in the bottom layers and the shorter pieces in the top layers. At least one end of the stack shall be in true vertical alignment.

The recommended width and height of a stack are 1.5m and 2.0m respectively. Minimum distance between two stacks shall be 800mm.

The stacks of the timbers shall be protected from hot dry wind, direct sun and rain. Weights may be placed on top of the stacks to prevent wrapping of timber. Nails, metal straps, etc. attached to used timber shall be removed before stacking.

### **INSPECTION**

All timbers shall be subject to inspection at Site piece by piece and shall be to the approval of the Engineer who may reject such timber as is considered by him to be under-specified. In the case of timber specified to be creosoted, the Engineer may reject such timber before or after creosoting, if specifications are not correctly followed. The Contractor shall provide all necessary labor for handling the timber during inspection free of charge.

### **WROUGHT FACES AND ALLOWANCES ON JOINER'S WORK**

All joiner's works shall be wrought and finished with a clean, even and smooth face. Thickness shall be given to include 2mm for each wrought face in soft- wood and 1.5mm for hard wood.

## **2.12 MARBLE**

### **MARBLE STONE**

Marble shall be of Italian origin or equivalent and size as per Drawing having approved color and texture.



**MARBLE CHIPS**

Marble chips shall be white in approved color and shall be of size # 2-3 (retained on screens 6mm and 19mm mesh). The chips shall be of uniform color and texture and shall be made from white marble stone, a calcareous metamorphic rock, which is capable of being polished and have following properties:

|                      |                              |
|----------------------|------------------------------|
| compressive strength | 562 - 844 kg/cm <sup>2</sup> |
| Specific gravity     | 2.72                         |
| Unit-weight          | 2563-2724 kg/m <sup>3</sup>  |

**MARBLE DUST**

Marble dust shall consist of finely ground white marble stone and 90% shall pass sieve # 100.

**2.13 GLASS**

**GENERAL**

All glass shall be obtained from an approved manufacturer and be free from blemishes of all kinds and descriptions, whether surface or internal.

**FLAT GLASS**

Flat glass shall be provided where specified or directed in the following grades:

- 24 oz. flat drawn clear sheet glass.
- 32 oz. clear sheet glass.
- 6mm thick 'Georgian' rough cast wired glass.
- 6mm thick polished glass.

**WIRED GLASS**

Wired glass shall be 6mm thick with wire reinforcements inside and shall be obtained from an approved manufacturer and shall be subject to the approval of the Engineer.

**STORAGE AND HANDLING OF GLASS**

All glass sheets shall be kept dry and stored in a covered place. Glass sheets shall be lifted and stored upright on their long edges and put in to stacks of not more than 25 sheets. They shall be supported at two points at about 300mm from each end by fillets of wood.

The bottom of each stack shall be about 25mm clear from the base of the wall and other support against which the stack rests. The whole stack shall be as close to upright as possible. Smooth floors shall be covered with gunny bags.

Workmen handling glass sheets, remnants and waste glass pieces and fibre-glass shall be provided with gloves, jelly and other suitable hand protections. In removing glass sheets from crates, great care shall be taken to avoid damages and breakage. Glass edges shall be covered or protected to prevent injuries to workmen.

**2.14**

**WIRE GAUGE**

**WIRE GAUGE GENERAL**

Gauge for fly proofing shall be of the quality uniformly woven webbing of 23 meshes per square centimeter. The wire for the gauge shall be of best quality 22 SWG brass or copper wire or any other approved materials.

#### **OTHER MATERIALS**

Gauge known as “plastic gauge” may also be used as and when required by the Engineer.

#### **2.15**

#### **PAINTS AND PROTECTIVE MATERIALS**

##### **KNOTTING**

Knottting shall be uniform dispersion of lac or suitable resin (natural or synthetic) in a suitable solvent.

White lead paint shall be made from pure white lead in accordance with BS 239, mixed with fine boiled linseed oil, turpentine, dryers and pigments and strained free from skins and all extraneous matter before being pigments. If so used, the quantity shall not exceed 8% of the paint mixed ready for the brush. No other ingredient except the coloring matter will be allowed and the color shall be produced by using the least required amount of coloring matter. The proportions of the ingredients for the various coats shall be subject to the approval of the Engineer.

##### **RED LEAD PAINT**

Red lead paint shall be made from non-setting red lead in accordance with BS 217, thoroughly ground and well and freely mixed with approximately 15% of boiled linseed oil to give a paint with good covering power, bobby and adhesion. It shall be determined by tests to be made by the Contractor to the satisfaction of the Engineer. The Engineer may select samples of the paint for analysis after a sufficient quantity of the work about to be painted has been mixed.

##### **LINSEED OIL PUTTY**

Putty for stopping and glazing shall consist of whiting/chalk powder thoroughly ground with linseed oil to form a smooth paste, and shall conform BS 544.

##### **VARNISHES/WOOD POLISH**

The material is required to be clear and transparent and when applied shall on drying, give a glossy coating free from fun and specks. The composition of the varnish shall conform to the requirements of BS 274.

##### **WHITE WASH**

White wash shall be made from pure flat lime brought to the work in an un slaked condition. Water shall be added to this lime in a tub until the mixture is of the consistency of cream and shall be allowed to rest for a period of 48 hours. The mixture shall then be strained through an approved cloth strainer and 4 kg of gum boiled with 12 kg of rice and a suitable quantity of blue shall be added per cubic meter of the mixture.

##### **COLOUR WASH**

Color wash, where not of an approved proprietary brand, shall be made from pure selected fat lime as described above for white wash, to which shall be added and intimately mixed the necessary pigment to produce the tint specified. The pigment shall be to the approval of the Engineer.

### ***OIL BOUND DISTEMPER***

Oil bound distemper shall comply with BS 1053 Type-1 and shall be obtained from an approved manufacturer.

### ***EMULSION PAINTS***

Berger/ICI Emulsion Paints shall preferably be used but the Engineer may allow any other brands of equivalent standard subject to the production of appropriate test certificates and guarantees.

### ***CREOSOTE***

The Creosote is a paint used for preservation of timber. It shall be pure tar distillate of the best quality as obtained and sold under the trade name 'SOLIGNUM'. The 'SOLIGNUM' shall be clear so as not to mar the timber. Other brands equivalent to 'SOLIGNUM' may also be used, if only approved by the Engineer.

### ***STORAGE AND HANDLING OF PAINT, VARNISHES, ETC.***

Paints, varnishes, lacquers and thinners shall be kept in properly sealed or closed containers. The containers shall be kept in a well-ventilated location, free from excessive heat, smoke, sparks or flames. The floor of the paint store shall have at least 100 mm thick loose sand on it.

Temporary electrical wiring and fittings shall not be installed in a paint store. When electrical lights, switches or electrical equipment are necessary to be stored or used in the same room, the room shall be designed in a way to reduce explosion risks.

Buckets containing sand shall be kept ready for use. A five-kilogram dry powder fire extinguisher conforming to accepted standards shall be kept at an easily accessible position close to the paint store.

## **2.16**

### ***ALUMINIUM MEMBERS***

Aluminum doors, windows, curtain walls, etc. shall be of approved standard conforming to the U.S. Architectural Aluminum Manufacturing Association (AAMA) or equivalent specifications. The frames and sash members shall be of extruded shape made of 6063 – T5 high quality aluminum alloy having a minimum section thickness of 2mm unless otherwise shown on the Drawings or indicated in the BOQ and shall conform to the U.S. Aluminum Association or equivalent standard.

## **2.17**

### ***STRUCTURAL STEEL FOR DOORS AND WINDOWS***

All steels used in doors and windows shall be the products of reputable manufacturer and shall conform to the American Standard Specifications. The sections, sizes and profiles shall be as per the requirements for a specific work as shown on the Drawings.

## **2.18 PIPES**

### ***M.S. PIPE***

M.S. Pipe shall be made from low carbon steel conforming to the requirements of ASTM A 53 and physical requirements as specified therein.

**PVC PIPE**

PVC pipe shall be of plasticized poly ring/chloride and shall conform to BS 3500: 1968/3506:1969 or equivalent. The pipes shall be laid and jointed in accordance with the manufacturer's instructions and to the Engineer's satisfaction.

**STORAGE AND HANDLING OF PIPE**

Pipes shall be stored in stacks with stoppers provided at the bottom layer to keep the pipe stack stable. The stack, particularly of smaller diameter pipes, shall be in a pyramid shape. Pipes shall not be stacked more than 1.5m height.

Each stack shall have pipes of the same type and size only. Removal of pipes shall start from the top layer and by pulling from one end. A pipe shall not be stored inside another pipe. The pipes may also be placed alternately length and crosswise.

PVC pipes shall be stored in a shaded area. The ends of pipe, particularly those especially prepared for jointing, shall be protected from abrasion. Damaged portion of a pipe shall be cut out completely.

Pipes of conducting materials shall be stacked on solid level sills and contained in a manner to prevent spreading or rolling of the pipe. For storage in large quantity, suitable packing shall be placed between the layers. During transportation, the pipes shall be so secured as to prevent displacement/rolling.

**2.19**

**GUNNY BAGS**

The gunny bags used in the permanent works shall be new, 50/75 kg capacity bags similar to those normally used. The Contractor shall submit sample bags to the Engineer for his approval.

|  |           |
|--|-----------|
| <b>3.0 MATERIAL TESTING .....</b>                | <b>30</b> |
| <b>3.1 GENERAL .....</b>                         | <b>30</b> |
| <b>3.2 TESTS 3.2.1 BRICKS .....</b>              | <b>30</b> |
| <b>3.2.2 COARSE AGGREGATE .....</b>              | <b>30</b> |
| <b>3.2.3 FINE AGGREGATE .....</b>                | <b>30</b> |
| <b>3.2.4 CEMENT .....</b>                        | <b>30</b> |
| <b>3.2.5 REINFORCEMENT .....</b>                 | <b>31</b> |
| <b>3.2.6 TEST FOR WATER .....</b>                | <b>31</b> |
| <b>3.2.7 WORKABILITY TEST FOR CONCRETE .....</b> | <b>31</b> |
| <b>3.2.6 STRENGTH TEST FOR CONCRETE .....</b>    | <b>31</b> |

### **3.0 MATERIAL TESTING**

#### **3.1 GENERAL**

Notwithstanding the requirements stated in the detailed specifications for individual items, the following minimum tests shall be performed in the laboratories (NED University Laboratory or Karachi Shipyard & Engineering Works Laboratory) or as directed by the Engineer.

Contractor's Materials Engineer will be responsible for liaison and coordination with the Site laboratory, the Engineer, field sampling/testing staff and off-Site laboratories to ensure that all sampling, specified tests and inspections are carried out in a timely manner.

No inspection or approval by the Engineer shall relieve the Contractor of any of his duties and obligations under the Contract.

All test types and quantities described in the following Sub-sections are considered "Normal Testing" and anything beyond that in type and quantity is considered as "Special Testing". The Engineer may increase the frequency of testing as per requirement.

#### **3.2 TESTS**

##### **3.2.1 BRICKS**

For each consignment not exceeding 100,000 bricks, minimum 6 (six) bricks shall be tested to ascertain:

- Dimensions and unit weight
- Compressive strength
- Water absorption
- Efflorescence

##### **3.2.2 COARSE AGGREGATE**

The tests mentioned below shall be carried out for each day's casting or per 15 cubic meter of concrete whichever provides the greater number of tests.

- Gradation
- Unit weight
- Water absorption
- Specific gravity
- Abrasion loss/Crushing loss

##### **3.2.3 FINE AGGREGATE**

The tests mentioned below shall be carried out for each day's casting or per 15 cubic meter of concrete whichever provides the greater number of tests.

- Gradation
- Fineness Modulus (F.M.).
- Specific Gravity
- Water absorption
- Surface moisture

##### **3.2.4 CEMENT**

For each consignment of a particular brand not exceeding 25 tons, at least 3 (three) samples collected random shall be tested prior to the cement be incorporated in to the works to ascertain:

- Consistency
- Setting time
- Compressive strength
- Fineness

### **3.2.5 REINFORCEMENT**

For each consignment not exceeding 10 (ten) tons or as directed, 3 (three) representative samples of each size of M.S. bar shall be tested for:

Cross sectional area

Unit weight

Measurement of deformation

Yield strength

Tensile strength

Elongation

Bending

Only Test Certificates issued by NED University Laboratory or Karachi Shipyard & Engineering Works Laboratory shall be accepted by the Engineer.

### **3.2.6 TEST FOR WATER**

Water will be tested to ensure that it remains free of oil, salt, acid, alkali, sugar, vegetable or other injurious substances.

### **3.2.7 WORKABILITY TEST FOR CONCRETE**

The Slump Test shall be carried out as frequently as required by the Engineer and not less than one per hour during placing of concrete.

### **3.2.6 STRENGTH TEST FOR CONCRETE**

The compressive strength of the concrete shall be determined by Cylinder Test. The Cylinder molds shall be 150mm in diameter and 300mm long. Each class of concrete shall be represented by at least six Cylinders. Not less than one group of six test Cylinders shall be made for each 30 cubic meter of structural concrete, but there shall be at least one group of six test Cylinders for each day's concrete work. For columns and girders, one set of test Cylinders would be made from each batch of concrete not exceeding one cubic meter. Samples from which compression test specimen are molded, shall be obtained in accordance with the Method of Sampling Fresh Concrete (ASTM C 172). The concrete samples would be collected from a point just before final placement or as directed by the Engineer. Cylinders may be collected from any batch (load) including the first. Specimens made to check the adequacy of the proportions for strength of concrete or as a basis for acceptance of concrete shall be made and cured in accordance with methods and curing, concrete compression and flexure test specimens in the field (ASTM C 31 or equal). Strength tests shall be made in accordance with the method of test for compressive strength of molded concrete cylinders (ASTM C 39 or equal).

Six Cylinders would form a set of sample for strength determination. Three Cylinders shall be tested at seven days and three cylinders shall be tested at twenty-eight days. Every twenty-eight days Cylinders shall attain the minimum specified compressive strength. The Contractor shall perform trial mix of his own to determine the characteristic strength or mean strength that has to be attained.

The twenty-eight days' strength tests shall be used as a basis for acceptance of the concrete. Seven days' tests are made to obtain advance information on the adequacy of strength development. Age-strength relationships shall be pre-established for the materials and proportion used.

|   |           |
|---|-----------|
| <b>4.0 OFFICE SPACE AND FACILITIES FOR ENGINEER .....</b> | <b>32</b> |
| <b>4.1 FIELD OFFICE .....</b>                             | <b>32</b> |
| <b>4.2 OFFICE EQUIPMENT AND STATIONARY ARTICLES .....</b> | <b>32</b> |
| <b>4.3 VEHICLE FACILITY .....</b>                         | <b>33</b> |
| <b>4.4 SURVEY EQUIPMENT .....</b>                         | <b>33</b> |
| <b>4.5 OFFICES AND EQUIPMENT .....</b>                    | <b>34</b> |
| <b>4.6 SIGNBOARDS .....</b>                               | <b>34</b> |
| <b>4.7 PROGRESS IN PHOTOGRAPHS AND VIDEOS .....</b>       | <b>34</b> |
| <b>4.8 MEASUREMENT AND PAYMENT .....</b>                  | <b>35</b> |



#### **4.0 OFFICE SPACE AND FACILITIES FOR ENGINEER**

##### **4.1 FIELD OFFICE**

In addition to the office space required for his own use, the Contractor shall provide and maintain Field Office with toilet facilities, furniture and office equipment for the use of the Engineer and his staff.

Field Office for the Engineer shall mean a building having a minimum 150 square feet net clear internal floor area exclusive of walls and partitions, staircase and toilet and have number of rooms as required by the Engineer. It shall be constructed in 250mm thick brick wall in appropriate cement mortar with C.I. sheet roofing and a protective ceiling made of hard board and timber to the satisfaction of the Engineer. The floor shall be 75mm thick lean concrete with 30mm thick mortar on the top with a neat cement finish to give a smooth look. The foundation of this building shall be sound to the satisfaction of the Engineer. The building shall have required number of doors and windows. Uninterrupted power supply facility, if necessary, shall be made available by means of arranging a stand-by generator.

Access road to the Field Office, sufficient parking accommodation and hard standing sheds for vehicles along with boundary fencing shall be constructed by the Contractor.

The Contractor shall provide, for each office, one office table and four chairs of standard, approved by the Engineer. Safety helmets in adequate numbers be always made available for use of the staff and the visitors.

Offices shall be maintained watertight and shall be provided with ventilation. All doors shall be fitted with approved locks. Windows shall be provided with separate screens and blinds and shall have interior locking devices too.

All offices, complete with furnishings, fittings, access roads and hard standings, shall be ready, for occupation by the Engineer within four weeks of the date when the Contractor first occupies the Site.

All offices shall be regularly and properly cleaned as long as they are in use.

All access roads and hard standings shall be maintained in a convenient trafficable condition throughout the Contract period.

The general location of the Field Office shall be decided by the Engineer in consideration of the Contractor's Work Plans. The Field Office shall be situated at locations that shall be free from flooding.

The Contractor shall submit for the approval of the Engineer, along with the Tender, Plans and Drawings showing the details for the building including plans and designs for foundations, access roads, sheds, etc. Plans shall also be submitted showing architectural and structural details and the proposed layout of electrical and running water supply, roads and hard standings thereto. The Engineer may require revision of the said plan prior to the approval for construction.

Prior to the occupation of the office, the Engineer may specify to the Contractor the defects in the work whereupon he may occupy the office and withhold payment for the work in this item until the Contractor remedies and makes good the said defects to the satisfaction of the Engineer.

On completion of the Contract the Field Office including furnishings shall become the property of the Employer.

##### **4.2 OFFICE EQUIPMENT AND STATIONARY ARTICLES**

The Contractor shall require to purchase and supply the following Office equipment and consumables to the Engineer:

Two Computer (English) of approved brand with printer, internet / Auto CAD facilities.

Two Mobile Phones with monthly billing limit upto 5,000 PKR/phone.

Minor items of field office equipment such as file trays, punches, staplers etc. in reasonable number/quantities as requested by the Engineer.

Consumables such as papers, pens, files etc. in reasonable number/quantities as requested from time to time by the Engineer.

Upon completion of the Contract, the office equipment listed above shall remain the property of the Employer.

#### **4.3 VEHICLE FACILITY**

The Contractor shall provide 1 new Suzuki Swift DLX Automatic with fuel limit of 20,000 PKR/month or similar with comprehensive insurance and driver for the duration of the contract. They shall be available for the full time use of the Consultant's Representative and his staff. The contractor shall maintain, repair and service the vehicles regularly and provide immediately, at his own expense, an equivalent or better replacement when a vehicle becomes unusable for any reason.

#### **4.4 SURVEY EQUIPMENT**

As per requirement of the program, survey equipment shall be provided on each contract Site for use by the staff of the Contractor and the Engineer. A tentative list of such survey equipment is given below:

|   |       |
|---|-------|
| Optical Square  | no.   |
| Spirit level (metal 1m long)                              | no.   |
| Steel measuring tape 25m long                             | no.   |
| Steel measuring tape 5m long                              | no.   |
| Levelling staff 3m long                                   | no.   |
| Ranging Poles   | no.   |
| Surveyor's plumb bob                                      | no.   |
| Wild T-1A Theodolite with tripod<br>(or equivalent)       | no.   |
| Wild NA-2A Automatic Level with tripod<br>(or equivalent) | no.   |
| Total Station with Tripod                                 | 1no.  |
| Traversing targets with tripods                           | 1 no. |
| Magnetic Compass  | 1 no. |

Miscellaneous tools and minor items of survey equipment such as umbrellas, hammers, knives etc. shall be made available at Site in reasonable numbers at all times for use by the staff of the Contractor and the Engineer.

Consumables such as pegs, stakes, string lines, paint, marking crayons, etc., shall be made available at Site in reasonable numbers and quantities at all times for use by the staff of the Contractor and the Engineer.

Upon completion of the Contract, the survey equipment listed above shall remain the property of the Contractor.

#### **4.5 OFFICES AND EQUIPMENT**

The Contractor shall provide and maintain an inventory of all furnishings and equipment and shall replace any equipment, which is lost or irreparably damaged subject to the condition that the Engineer shall ensure his staff to take all reasonable precautions in the handling, operation and transportation of such equipment.

The Contractor shall pay all expenses in respect of water, electricity (where available), garbage cleaning etc. necessary for running the Office and maintaining conducive environment.

The Contractor shall place all necessary support staff such as office boys, cleaners, messengers, road-men, chain-men etc. in required number to the Engineer and his personnel in smooth performing of his responsibilities.

#### **4.6 SIGNBOARDS**

The Contractor shall supply, erect and maintain in good condition at least two Identification Signboards of sizes to be specified by the Engineer to be fixed one at each end of the Work at a place clearly visible to the public. The Signboards shall be mounted on steel pipe frames with the required sizes at a height 2m above the ground and shall be sufficiently strong to withstand the wind forces. The board shall be fabricated from steel angle and plates and painted with suitable colors and written in English as per direction of the Engineer.

Each board shall display:

- The name of the Project
- The name of the Work
- The name of the Employer
- The name of the Consultant
- Contract value
- Date of commencement of work
- Date of completion of work
- Other particulars, which will be asked by the Engineer.

#### **4.7 PROGRESS IN PHOTOGRAPHS AND VIDEOS**

Photographs and videos showing the progress of works and special photographs showing particular features or other matters of interest in connection with the Work or their surroundings shall be taken every month by an approved qualified photographer/cameraman to the choice of the Engineer. Number of photographs/video clips will not exceed 10 (ten) per month.

Four color un-mounted prints of a size 250mm on approved photographic paper of every such photograph inscribed with its serial number, date of shooting and a short title shall be furnished to the Engineer every month.

All negatives and video clips shall be numbered, filed and retained at the Site. On completion of the Contract, those shall become the properties of the Employer and shall be handed over to the Employer by the Contractor.

6 (six) complete sets of color prints of the finished permanent Work, not exceeding 20 (twenty) photographs in number, shall be taken when and as directed by the Engineer prior to finally granting

the Contractor the Certificate of Completion and shall be suitably mounted, titled and supplied to the Engineer.

#### **4.8 MEASUREMENT AND PAYMENT**

Provisions for Office space and facilities for the Engineer shall not be measured.

Payment for all the items as stated below shall be for the full period of the Contract including any extension, if allowed. At the end of contract period all items listed will be Client's Property.

Payment for all equipment, signboards, photographs, video clips, services etc. of the Field Office detailed in this Sub-section shall be made as described below, where price and payment shall be the full compensation for complying with this Section of the Specification and the Conditions of the Contract.

Payment of rates for the pay items shall be the full compensation for supplying, erecting and maintaining the Field Office for the Engineer including all furniture, fixtures and fittings, access roads, office equipment, signboards, photographs, video clips etc. all in full compliance with the requirements of this Section.

No separate payment shall be made to the Contractor for providing the requisite tools, minor items and the consumables. Compensation for these items shall be deemed to be included in the other pay items of the BOQ.

| <b>Item of Payment</b>  | <b>Unit</b> |
|---|-------------|
| Supply , erection and maintenance of Signboards   | Lump sum    |
| Providing, erection and maintenance of office for the Engineer including all office equipment and consumables | Lump sum    |
| Providing Vehicles  | Lump Sum    |
| Providing photographs   | Lump sum    |

|  |           |
|--|-----------|
| <b>5.0 SITE PREPARATION .....</b>      | <b>36</b> |
| <b>5.1 SITE PREPARATION .....</b>      | <b>36</b> |
| <b>5.1.1 DESCRIPTION.....</b>          | <b>36</b> |
| <b>5.1.2 COMMENCEMENT .....</b>        | <b>36</b> |
| <b>5.1.3 DRAWINGS .....</b>            | <b>36</b> |
| <b>5.1.4 SETTING OUT.....</b>          | <b>36</b> |
| <b>5.1.5 EARTHWORKS, GENERAL .....</b> | <b>36</b> |
| <b>5.1.6 CLEARING OF SITE .....</b>    | <b>36</b> |
| <b>5.1.7 MEASUREMENT .....</b>         | <b>36</b> |
| <b>5.1.8 PAYMENT .....</b>             | <b>36</b> |

## **5.0 SITE PREPARATION**

### **5.1 SITE PREPARATION**

#### **5.1.1 DESCRIPTION**

This item of work shall consist of clearing the Site, undertaking general type of earthworks, setting out, etc. as shown on the Drawings, stated in the BOQ and/or as instructed by the Engineer.

#### **5.1.2 COMMENCEMENT**

The Contractor shall give the Engineer at least 7 (seven) days written notice of his intention to commence work on any part of the Site. Works shall not be commenced until written approval has been received by the Contractor from the Engineer.

#### **5.1.3 DRAWINGS**

The works are to be carried out in accordance with the Drawings and as directed by the Engineer. It may become necessary or desirable, during the progress of the Work, to change any feature shown on the Drawings in accordance with the actual field conditions. Whenever this may occur, the Contractor shall perform the required works to the revised dimensions in accordance with the written instructions of the Engineer.

#### **5.1.4 SETTING OUT**

Prior to the commencement of the Work, the Contractor shall study the Drawings and fully understand all aspects of the Work and co-relate the same with the dimensions shown on the Structural Drawings and shall fix up the alignment, set the Bench Mark (B.M) pillars, levels, pegs etc.

The Contractor shall check all the vital measurements of the layout plan of the building and submit a report to the Engineer the deviation, if required any from the dimensions shown in the approved Drawings for the building before starting construction works. In case of any deviation of unacceptable amount, the Engineer will inform the Contractor of the remedial measures, which may be necessary under a particular situation.

Cutting or filling charts, prepared by the Engineer, will be given to the Contractor to sign as a token of his agreement.

#### **5.1.5 EARTHWORKS, GENERAL**

Earthwork shall be undertaken to the lines and levels shown on the Drawings unless directed otherwise by the Engineer. In carrying out the earthworks, the Contractor shall take all necessary precautions to avoid damage to or deterioration of the earthwork materials and existing ground.

#### **5.1.6 CLEARING OF SITE**

The Site shall be cleared as required to remove all stumps, roots, vegetable and other objectionable materials specifically within the areas for construction of structure, appurtenance and any other facilities indicated on the Drawings or designated by the Engineer. The cleared materials shall be deposited on the approved off-Site areas or burnt as directed by the Engineer.

#### **5.1.7 MEASUREMENT**

The works on Site preparation shall not be measured.

#### **5.1.8 PAYMENT**

No direct payment shall be made for works required under this Section. Costs for such works shall be deemed included in the related items of the BOQ.

|  |           |
|--|-----------|
| <b>6.0 EXCAVATION AND BACK-FILL FOR STRUCTURES .....</b> | <b>37</b> |
| <b>6.1 DESCRIPTION .....</b>                             | <b>37</b> |
| <b>6.2 MATERIALS .....</b>                               | <b>37</b> |
| <b>6.2.1 EXCAVATED MATERIAL .....</b>                    | <b>37</b> |
| <b>6.2.2 ORDINARY FILL .....</b>                         | <b>37</b> |
| <b>6.2.3 SAND .....</b>                                  | <b>37</b> |
| <b>6.3 BLINDING CONCRETE .....</b>                       | <b>37</b> |
| <b>6.3.1 CEMENT .....</b>                                | <b>37</b> |
| <b>6.3.2 COARSE AGGREGATE .....</b>                      | <b>38</b> |
| <b>6.3.3 FINE AGGREGATE .....</b>                        | <b>38</b> |
| <b>6.3.4 WATER .....</b>                                 | <b>38</b> |
| <b>6.4 CONSTRUCTION METHODS .....</b>                    | <b>38</b> |
| <b>6.4.1 EXCAVATION .....</b>                            | <b>38</b> |
| <b>6.4.2 POOR FOUNDATION MATERIAL .....</b>              | <b>39</b> |
| <b>6.4.3 DISPOSAL OF EXCAVATED MATERIAL .....</b>        | <b>39</b> |
| <b>6.4.4 PUMPING AND BAILING .....</b>                   | <b>40</b> |
| <b>6.4.5 BACK-FILLING .....</b>                          | <b>40</b> |
| <b>6.4.6 COFFERDAM .....</b>                             | <b>41</b> |
| <b>6.5 MEASUREMENT .....</b>                             | <b>41</b> |
| <b>6.6 PAYMENT .....</b>                                 | <b>42</b> |

## **6.0 EXCAVATION AND BACK-FILL FOR STRUCTURES**

### **6.1 DESCRIPTION**

This item of work shall consist of excavation in any type of soil/material for the foundation of structures, disposal of excavated materials, construction and removal of cofferdams, sheeting and other temporary works in protecting the stability and safety of the excavated foundations, pumping, de-watering/bailing water from foundations, back-filling of completed structures with suitable back-fill.

No separate payment shall be made for the excavation and back-fill for structures when the works will involve use of cofferdams. The costs of this temporary work shall be deemed included as part of the Tender sum.

The Work shall be carried out at the locations and according to the lines, levels, grades and dimensions shown on the Drawings, stated in the BOQ and/or as directed by the Engineer.

### **6.2 MATERIALS**

#### **6.2.1 EXCAVATED MATERIAL**

The Engineer shall classify all excavated materials either as suitable for fill or as waste.

Approved suitable excavated materials free from large lumps, wood or other objectionable materials shall be placed as back-fill above the level of pile except where other materials are shown on the Drawings, stated in the BOQ and/or required by the Engineer.

#### **6.2.2 ORDINARY FILL**

Ordinary fill consists of earth having Liquid Limit not exceeding 50 and Plasticity Index not exceeding 20, as determined by AASHTO T89 & T90, and shall be used as back-fill material above the level of pile caps and areas except where other materials are shown on the Drawings, stated in the BOQ and/or required by the Engineer.

#### **6.2.3 SAND**

Unless otherwise stated on the Drawings or in the BOQ or ordered by the Engineer, back-fill material below the top level of pile caps shall consist of sand free from chemical contamination with not more than 10% of the material passing the No. 200 sieve (U.S. size). All other specifications should conform to what have been illustrated under the relevant Sub-section of this Specification. The sand to be used shall be approved by the Engineer prior to placing.

### **6.3 BLINDING CONCRETE**

Blinding concrete shall be placed as backfill as shown on the Drawings, stated in the BOQ and/or ordered by the Engineer. The material shall conform to the specifications stated below:

#### **6.3.1 CEMENT**

Cement shall conform to the requirements of ASTM specification C 150 Type 1 or similar approved standard for normal Portland cement.

Cement shall be free from any hardened lumps and foreign matter. It shall have a minimum of 90% of particles by weight passing the 75-micron sieve, an initial setting time in excess of 45 minutes and a final setting time of not more than 375 minutes.

All other specifications should conform to what have been illustrated under the relevant Sub-sections of this Specification.



### **6.3.2 COARSE AGGREGATE**

Except otherwise stated, coarse aggregate shall consist of hard, durable angular fragments of crushed stone and/or crushed natural gravel conforming all other specifications illustrated under the relevant Sub-section of this Specification.

### **6.3.3 FINE AGGREGATE**

All specifications should conform to what have been illustrated under the relevant Sub-section of this Specification.

### **6.3.4 WATER**

Water shall be subject to the approval of the Engineer and shall be reasonably clear, free from oil, alkali, salts, acid and organic substances and other deleterious materials or objectionable quantities of suspended materials. All other specifications shall be in accordance with the requirements illustrated under the relevant Sub-section of this Specification.

## **6.4 CONSTRUCTION METHODS**

### **6.4.1 EXCAVATION**

The Contractor shall notify the Engineer before commencing excavation of the foundation trenches so that the cross-section, elevations and measurements of the undisturbed ground may be taken. The natural ground adjacent to the structure shall not be disturbed without taking any permission from the Engineer.

Trenches and foundation pits for structures shall be excavated to the lines, grades and elevations as shown on the Drawings or as directed by the Engineer. The elevations of the bottom of the foundations shown on the Drawings are approximate only and the Engineer may order such changes as deemed necessary to provide a secured foundation.

Where unstable soil is encountered at the bed level, it should be brought to the notice of the Engineer and all such unstable soil shall be removed as directed and replaced with suitable materials to provide adequate support for the structure.

On acceptance of the materials forming the bottom of any excavation by the Engineer subsequently becoming unacceptable to him due to exposure to weather condition or due to flooding or have become puddled, soft or loose during the work process, the Contractor shall remove such damaged, soft, or loose materials and make additional excavation as per requirement. Such additional excavation shall be held as excess excavation and the cost of the excess excavation and subsequent replacement with a suitable back-fill shall be at the expenses of the Contractor.

Any erroneous excavation or excess excavation for the conveniences of the Contractor, or over excavation performed by the Contractor for any purpose or reasons shall be at the expenses of the Contractor. If the excavation for foundations exceeds the depths specified, the Contractor shall bring it back to the specified levels with sand, mass concrete or other approved materials conforming Standard Specifications at the Contractor's own expenses.

Excavation shall be sufficiently large to provide necessary working space, shuttering and any other Temporary Works required during construction.

Boulders, roots and any other objectionable materials encountered in excavation, shall be removed. The excavated foundation shall be cleared of all loose materials and cut to a firm surface.

When the footing is to rest on the ground and not on piles, special cares shall be taken not to disturb the bottom of the excavation and excavation to final grade shall be deferred until immediately before

the footing is placed. If foundation fill material is required, it shall be placed and compacted in layers not more than 150mm thick or as directed by the Engineer. The dry density on compaction within 300mm below the top level shall not be less than 100% maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.

In excavating foundation trenches, the last 150mm layer shall not be excavated until immediately before commencing the construction work except that the Engineer shall instruct otherwise. Any damages to the work due to the Contractor's operation shall be repaired at the expenses of the Contractor.

The Contractor shall be solely responsible for the safety and stability of the excavation and shall provide all protective supports, bracing, sheet piles, shoring etc. as required. Shoring should be adequate to provide enough safety to all the adjacent structures and land.

Excavated materials, classified as suitable for fill, shall be stockpiled. Waste materials and suitable fill materials in excess of requirement, shall be disposed of by the Contractor outside the limits of the Site.

The foundation material shall be cleared of all loose and displaced materials and cut to a firm surface, either leveled, stepped or serrated, as specified or shown on the Drawing or directed by the Engineer leaving a smooth solid bed to receive foundation.

No footing, bedding material or structure shall be placed on any foundation until the Engineer has inspected and approved the depth of excavation and the foundation materials.

#### **6.4.2 POOR FOUNDATION MATERIAL**

When, in the opinion of the Engineer, the bottom of any excavated foundation is of soft or otherwise unsuitable material, the Contractor shall remove the unsuitable material and fill with sand or blinding concrete at the direction of the Engineer. The sand or concrete shall be placed following the procedures specified for back-filling. Sand shall be clear, all passing a No.4 sieve (U.S. size).

When the ground between the piles is too soft to support the green concrete, the Contractor shall submit his proposal for a bottom form to the Engineer for his approval. Extra excavation and foundation-fill or concrete-fill in such case will not be paid separately.

If the bottom form is carried out by strengthening the ground in the aforementioned way, the Contractor shall, if requested, submit calculations showing that the pile cap will not be harmed during hardening due to differential settlement between the piles and the strengthened ground.

#### **6.4.3 DISPOSAL OF EXCAVATED MATERIAL**

All excavated materials, so far accepted by the Engineer as suitable, shall be utilized as back-fill or embankment-fill. The surplus materials shall be termed as waste.

Excavated materials, suitable for use as back-fill, shall be deposited by the Contractor in spoil heaps at points convenient for re-handling of the materials during the back-filling operations.

Excavated materials shall be deposited in such places and in such a manner as not to cause damage to roads, services or properties either within or outside the project area and so as to cause no impediment to the drainage of the Site or surrounding areas. The location of spoil heaps shall be subject to the approval of the Engineer.

Waste materials shall be disposed of in accordance with the instruction of the Engineer.

#### **6.4.4 PUMPING AND BAILING**

The foundation shall be kept free from water at all times during the construction period. The ground water level shall be maintained at a minimum of 0.9m below the lowest designed excavation level.

Pumping and bailing from any foundation shall be done so as to preclude the possibility of the movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of concrete and for at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or from well points.

The Contractor shall be solely responsible and include in his rates all costs in designing the de-watering system, providing all equipment and accessories required for de-watering. The rates shall also include cost for transportation, furnishing, installation, safe operation and maintaining of the system including operators, mechanics, the supply of power, fuel, lubricants, spares, repairing, etc. throughout and the removal of the equipment at the end of the construction period under this Contract.

Excavations shall be as dry as possible prior to and during placing concrete. Placing of concrete under water will only be permitted if indicated on the Drawings or approved by the Engineer.

#### **6.4.5 BACK-FILLING**

All excavated spaces shall be back-filled around the permanent structure to original ground level. Prior to placing back-fill, all trash, metal, debris, lumber, bricks, soft materials and similar objectionable foreign materials shall be removed from the area to be back-filled. No back-fill shall be placed against any structure without the prior permission of the Engineer.

Any protective support, bracing or shoring shall be removed, as the back-filling progresses in such a manner as to prevent caving-in.

Back-fill shall be of approved materials that will produce a dense and well-compacted filling. The material shall be free from large lumps, organic or extraneous materials.

Ordinary fill placed as back-fill shall be laid and compacted. The moisture content of the fill materials, before compaction, shall be within + 5% of the Optimum Moisture Content. Each layer of materials shall be compacted uniformly using approved compaction equipment and procedures. The materials shall be compacted to achieve not less than 90% Maximum Dry Density (STD) beneath the bottom level. The dry density, after compaction within 300mm below the top level, shall not be less than 95% Maximum Dry Density as determined in accordance with AASHTO T99 or ASTM D698 and soaked CBR (4 days) should be greater than 4% at 95% Maximum Dry Density. The compacted layer shall be approved by the Engineer before the Contractor can commence a new layer.

Sand back-fill shall be placed and thoroughly compacted in layers of not more than 150mm. Sand should be clear, all passing a No. 4 U.S. Standard Sieve and conforming generally to ASTM C 144 for fine aggregate with F.M. not less than 1.2 or as required by the Engineer.

Layers of filling shall be tested as directed by the Engineer. Each compacted layer shall not be covered until the Engineer is satisfied that the specified degree of compaction has been achieved.

In placing back-fill, the materials shall be placed in, as far as possible, to approximately the same height on each side of the structure. If conditions require appreciable higher back-filling on one side, the additional materials shall not be placed until permission is given by the Engineer on being satisfied by himself that the structure has enough strength to withstand any created pressure.

In general, no structure shall be subject to the pressure of back-filling until 3 (three) days on expiry of the period designated for removal of forms. This period shall be extended if abnormal curing conditions exist.

Adequate provisions shall be made for drainage during placing back-fill.

#### **6.4.6 COFFERDAM**

The term “cofferdam” denotes any temporary or removable structure, constructed to hold the surrounding earth, water or both, out of the excavation whether such structure is constructed of earth, timber, steel, concrete or any combination of these. The term includes earth dikes, timber cribs, sheet piling, removable steel shells and all bracings and it shall be understood to include excavation enclosed by pumping wells and well points.

Cofferdams shall be constructed so as to control water to preclude sliding and caving-in of the walls of the excavation.

The interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction and removal of any required forms and the inspection of the interior and to permit pumping.

If possible, cofferdams shall be so designed that no cross bracing shall be left in place. If this is not possible, bracing left in place shall be of structural steel. The end of such structural members that would be exposed when the structure is completed shall be boxed back at least 50mm behind the face. The resulting holes shall be completely filled with concrete.

In general, sheet-piling cofferdams shall extend well below the bottom of the footings and shall be well braced and made maximum watertight.

When conditions are encountered which, in the opinion of the Engineer, render it impossible to de-water the foundation before placing of brickwork or concrete, the Engineer may require the construction of a concrete foundation or seal. This shall be placed as directed by the Engineer. The foundation shall then be de-watered and the footing placed.

When foundation piles are to be driven inside a cofferdam and it is judged impossible to de-water the cofferdam before placing concrete, the excavation may be extended below the design level to a depth sufficient to allow for swell of the materials during pile driving operations. Any materials that rise above the design level shall be removed.

Where it is possible to de-water the cofferdam, the foundation materials shall be removed to exact grade after the foundation piles are driven.

The natural streambed adjacent to the cofferdam shall not be disturbed without the permission of the Engineer. Any excavation adjacent to the cofferdam shall be back-filled to the original ground level to the satisfaction of the Engineer.

Unless otherwise provided, cofferdams shall be removed on completion of the structure without disturbing or marring the finished work. The Engineer may order the Contractor to leave any part or the whole of the cofferdam in place and this shall not entitle the Contractor to claim for any additional payments.

The Contractor shall submit Drawings showing his proposed methods of cofferdam construction. However, the Contractor shall remain fully responsible for the adequacy of the design for strength and stability and for the safety of the people working therein.

#### **6.5 MEASUREMENT**

The volume of excavation and back-fill shall be measured in cubic meter.

The quantity of excavation for structures to be measured for payment shall include excavation for all structures.

Back-filling with previously excavated materials shall not be measured or paid for separately but shall be deemed included within the rate for excavation.

Volumes to be excavated for blinding concrete shall not be measured and the price for the excavation thereof shall be included in the above measured item for excavation and back-fill.

Back-fill with concrete or sand, where directed by the Engineer, including concrete seals shall be measured separately as the volume within the plan outline and top and bottom surfaces. Concrete or sand, placed to back-fill excavation beyond the excavation required, will not be measured for payment.

If sand fill is ordered over top level of pile cap, the fill shall be the specified filling volume measured on the Drawings up to the profiles agreed upon in writing by the Engineer.

Removal of cofferdams, slides, silting or filling, if required, shall neither be measured nor paid for.

#### **6.6 PAYMENT**

The work measured shall be paid for at the Contract unit prices per cubic meter as shown in the Bill of Quantities. The payment shall be the full compensation for all excavations and back-filling for structures including supply of all materials, labor, equipment, tools and incidentals necessary to the successful completion of the work.

The payment shall also be the full compensation for excavation and subsequent back-filling of working space around the foundation structure for shoring and other protective supports, for construction and removal of cofferdams, for de-watering and for disposal of surplus excavated materials by hauling to any distance at approved locations.

Should it be necessary, in the opinion of the Engineer, to lower the footings to an elevation below the level shown on the Drawings, payment for the excavation and backfill for structures required below plan level down to and including an elevation 1.5m below plan level for any individual footing will be made at a unit price equal to 115% of the Contract unit price and payment for the excavation from an elevation greater than 1.5m below plan level down to and including an elevation 3m below plan level will be made at a unit price equal to 125% of the Contract unit price for "Excavation and Back-filling for Structures".

No additional extra compensation will be allowed for any required cofferdam adjustments arising from such lowering of footings.

In case where the extra depth required for any footing or footings exceeds 3m, a supplementary agreement shall be made covering the quantities recovered from depths in excess of 3m below the plan grade.

Payment for Back-filling shall be included in the pay item for "Excavation and Back fill for Structures" except for sand fill and concrete fill. These fill types shall be measured as provided above and paid for at the concerned Contract unit prices. However, no compensation shall be made for less Back-filling with excavated materials or more surplus to waste in the pay item of "Excavation and Back-filling for Structures".

All payments for the Back-filling and compaction of those areas, which were removed as structural excavation shall be included in the appropriate unit rates as shown below:

| <b>Item of Payment</b>                  | <b>Unit</b>              |
|---|--------------------------|
| Excavation and back-fill for structures | Cubic meter / Cubic feet |
| Concrete back-fill for structures       | Cubic meter / Cubic feet |
| Sand back-fill for structures           | Cubic meter/ Cubic feet  |

|  |           |
|--|-----------|
| <b>7.0 EARTH FILLING AND SAND FILLING .....</b>    | <b>44</b> |
| <b>7.1 EARTH FILLING .....</b>                     | <b>44</b> |
| <b>7.1.1 DESCRIPTION.....</b>                      | <b>44</b> |
| <b>7.1.2 MATERIALS .....</b>                       | <b>44</b> |
| <b>7.1.3 CONSTRUCTION METHODS.....</b>             | <b>44</b> |
| <b>CLEARING .....</b>                              | <b>44</b> |
| <b>GRUBBING.....</b>                               | <b>45</b> |
| <b>OWNERSHIP OF CLEARED MATERIALS .....</b>        | <b>45</b> |
| <b>SPREADING AND COMPACTION OF EARTH FILL.....</b> | <b>45</b> |
| <b>MANUALLY COMPACTED FILL.....</b>                | <b>45</b> |
| <b>PROCEDURES FOR MANUAL COMPACTION .....</b>      | <b>46</b> |
| <b>MECHANICAL COMPACTION.....</b>                  | <b>46</b> |
| <b>7.1.4 MEASUREMENT .....</b>                     | <b>46</b> |
| <b>7.1.5 PAYMENT .....</b>                         | <b>47</b> |
| <b>7.2 SAND FILLING .....</b>                      | <b>47</b> |
| <b>7.2.1 DESCRIPTION.....</b>                      | <b>47</b> |
| <b>7.2.2 MATERIALS .....</b>                       | <b>47</b> |
| <b>7.2.3 CONSTRUCTION METHODS.....</b>             | <b>48</b> |
| <b>GENERAL .....</b>                               | <b>48</b> |
| <b>SPREADING AND COMPACTION OF SAND FILL .....</b> | <b>48</b> |
| <b>PROCEDURE FOR MANUAL COMPACTION .....</b>       | <b>48</b> |
| <b>MECHANICAL COMPACTION.....</b>                  | <b>49</b> |
| <b>7.2.4 MEASUREMENT .....</b>                     | <b>49</b> |
| <b>7.2.5 PAYMENT .....</b>                         | <b>49</b> |

## **7.0 EARTH FILLING AND SAND FILLING**

### **7.1 EARTH FILLING**

#### **7.1.1 DESCRIPTION**

This work shall consist of filling any place by furnishing, placing, compacting and shaping suitable earth material of acceptable quality obtained from approved sources to make up levels to the lines, levels, grades, dimensions and cross sections in accordance with these specifications and as shown on the Drawings and/or as instructed by the Engineer.

#### **7.1.2 MATERIALS**

All fill materials shall be free from roots, sods or other deleterious materials. All fill materials shall be stockpiled outside the working areas. Materials shall be tested and approved by the Engineer. The selected fill so stockpiled, shall satisfy the following criteria:

Liquid limit of fraction passing 425-micron sieve shall not exceed 50% as determined by AASHTO T89.

Plasticity index of fraction passing 425-micron sieve shall not exceed 20% as determined by AASHTO T90.

The dry density after compaction in layers more than 300mm below top level shall not be less than 90% of the maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.

The dry density after compaction within 300mm below the top level (or such greater depth if shown on the plans and drawings) shall not be less than 95% maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.

Soaked (4 day) CBR greater than 4% at 95% MDD. The moisture content at the time of compaction shall be the optimum moisture content  $\pm 5\%$ . Sampling to be carried out as per ASTM D 75 and D 3665.

#### **7.1.3 CONSTRUCTION METHODS**

##### **GENERAL**

Prior to placing any fill upon any area, all clearing and grubbing operations shall be completed following the procedures stated below.

The original ground surface should be prepared by scarifying, watering, aerating and compacting.

The dry density after compaction shall not be less than 90% of MDD (STD).

Filling in swamps or water shall be carried out as indicated on the Drawings and as described in these Specifications. The Contractor shall, when ordered by the Engineer, excavate or displace swampy ground and backfill with suitable materials. Such backfill shall be river or beach sand unless otherwise directed by the Engineer.

The materials that are borrowed from canals or other waterlogged areas for use as fill material, being saturated, shall initially be stockpiled to drain the excess water before placing it in the designated areas.

##### **CLEARING**

Clearing shall consist of the removal and disposal of everything above foundation level except those the Engineer directs are to be left undisturbed. The materials to be cleared shall include but not necessarily be limited to trees, stumps, logs, bush, undergrowth, grass, crops, loose vegetable matter and structures unless provided elsewhere.

All tree stumps shall completely be removed within the limits of earthwork.

Clearing shall also include the removal of existing fences, remnants of buildings, etc.



**GRUBBING**

Grubbing shall be confined to major roots beneath the excavations. In agricultural areas where the ground has been formed into ridges of dikes, the ground shall be roughly leveled or graded to form a surface suitable for filling and to the satisfaction of the Engineer.

**OWNERSHIP OF CLEARED MATERIALS**

All cleared materials shall, unless otherwise provided for in the Contract, be the property of the Department.

**SPREADING AND COMPACTION OF EARTH FILL**

Earth carried from outside shall be placed on the land to be developed in horizontal layers and each layer shall not exceed a loose thickness that is required to obtain a compacted thickness of 150mm. The earth of each basket is to be placed near to the earth placed before it and spread systematically. The Contractor shall not be allowed to throw earth in heaps.

The materials to be compacted shall be deposited in horizontal layers on the land to be developed with a loose thickness as stated above. The clods of earth shall be broken down to a maximum size of 25mm by striking the clods with the back of a spade or by using wooden drag or ladder or by any other suitable means before the next basket of earth is thrown close to it. Distribution of materials shall be made in such a way that the compacted materials will become homogeneous and free from lenses, pockets, streaks or other imperfections. Excavating and placing operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability and for this purpose the preceding compacted layer shall be scarified before placing a new layer.

All fill materials shall generally be compacted mechanically. However, under some special circumstance and when specifically allowed under the BOQ, the fill may be allowed to be compacted manually.

If the density measurement checks fall below the specified density level, re-compacting shall be required irrespective of the field compaction trial results. The Contractor shall be carried out such works

Earth fill materials, which does not contain sufficient moisture requirement for compaction in accordance with the requirements of this Sub-section shall be reworked and watered as per direction of the Engineer. The Contractor shall carry out this work at his own expenses.

Earth fill materials containing excess moisture shall be reworked and dried prior to or during compaction. Drying of wet materials shall be performed by methods proposed by the Contractor and approved by the Engineer at the expenses of the Contractor.

Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.

**MANUALLY COMPACTED FILL**

Fill shall be placed and compacted in layers for 150mm maximum compacted thickness, uniformly spread and compacted over the fill area of each layer. If for any reason, progress in compaction of the fill is interrupted for any unreasonable time, the surface area of the fill shall be scarified or ploughed before compaction continues. Each layer shall be compacted, using controlled manual compaction methods to achieve at least 85% of the Standard Proctor maximum dry density.

Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall

be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.

Under special circumstances and if directed by the Engineer, the Contractor shall excavate 5 to 10 trial pits each of size 2m long, 1m wide and 2m depth or to a depth of the improved land (whichever is less) at random spacing to test the degree of compaction. The size of voids encountered shall not exceed 5 cm in diameter and the number of voids shall be less than 10 per square meter.

#### **PROCEDURES FOR MANUAL COMPACTION**

The earth shall be compacted manually using concrete drop hammers each weighing 6 kg to 7 kg, fitted with a shaft of about 1.5m long. Ramming shall reduce the voids and shall continue until no further shrinkage of earth is possible by ramming.

Before commencing ramming, the moisture content of the soil shall be increased or decreased as per requirement by sprinkling the soil with water or by allowing natural drying of the soil as applicable so as to ensure that the materials shall have a moisture content of not less than 5% or greater than 5% dry of the optimum moisture required for the purpose of compaction. Both wetting and drying may be aided by furrowing the fill and then re-spreading when the moisture content is suitable.

If the moisture content exceeds the aforementioned tolerance, the compaction operations shall not proceed until the material is wetted or allowed to dry out, as the case may be to obtain optimum moisture content within the permitted tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor related to wetting or drying the materials or on account of any delays occasioned thereby.

The preceding operations shall continue layer after layer until the top of the filling is reached.

#### **MECHANICAL COMPACTION**

In the case of mechanical compaction, area of development, designated on the Drawings or by the Engineer, shall be compacted to the lines and grades shown on the Drawings or established by the Engineer. The Contractor's operations in importing materials, designated for use, shall be such as will result in an acceptable gradation of material when placed as determined by the Engineer.

Just prior to and during placement operations, the materials shall have a moisture content of not greater than 5% wet or less than 5% dry of the optimum moisture required for the purpose of compaction, as determined by Test No. 12 of BS 1337 and approved by the Engineer. The materials shall be so worked as to have uniform moisture content throughout the entire layer.

If the moisture content exceeds the aforementioned tolerance, the compaction operations shall not proceed until the materials are wetted or allowed to dry out, as the case may be to obtain the optimum moisture content within the permissible tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any

operations of the Contractor related to wetting or drying the materials or on account of any delays occasioned thereby.

When the material has been conditioned and placed as specified or directed, it shall be compacted with appropriate motorized vibratory compaction equipment or tampers of adequate weight and size as approved by the Engineer. Each layer shall be compacted to obtain at least 98% compaction of the maximum dry density. If the test results show that the density has not met the requirement, the Contractor shall have to carry out further compaction until the required density is achieved. The in-situ dry density of the compacted fill shall be determined by the Sand Replacement Method described in Test No. 15 of BS 1377 or by other similar approved tests at locations as ordered by the Engineer.

#### **1.4 MEASUREMENT**

Measurements for earth filling works shall be taken for payment in cubic meters on cross sections compacted and accepted in place. The volume to be measured will be the net volume of required and accepted filling, actually constructed and completed in accordance with the Specifications, to the lines, levels and cross sections required as per the Drawings or such other dimensions as directed by the Engineer. This stipulation of volume determination will be regardless of the method of excavation, filling, re-sectioning and backfilling at structures or type of materials.

The cross sections to be used shall be measured by pre-work (after clearing and stripping) and post-work field surveyed sections. Pre-work sections of the portion of the work allotted to the Contractor, computed through survey works, shall be signed by the Contractor before executing the works for retention by the Engineer.

#### **1.5 PAYMENT**

The unit rate paid per cubic meter for earth filling shall be in accordance with the Contract unit price, which payment shall constitute the full compensation for furnishing all materials and providing all labor, tools and equipment and works as specified. The rate shall also include costs of all other items related therewith and all incidentals, which may need to be completed to execute the work strictly in accordance with the Specifications and/or as per the directions of the Engineer.

Costs of all works and the cost of lead, lift or carriage shall be included in the unit rates for the relevant item of earth filling works of the BOQ of the Contract. Unless otherwise specified, no royalties will be paid for the purchase of earth from a private land regardless of its distance from the Site. No additional payment shall be made for purchasing a land and excavating the fill outside the rate agreed in the Contract for the item of earth filling works.

No direct or separate payment shall be made for works required under the other sub-items of this item. Costs for such works shall be deemed to have included in the related items of the BOQ.

Payment shall only be made when all works have been completed in accordance with the designed sections satisfying all specifications and accepted by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>             |
|------------------------|-------------------------|
| Earth filling          | Cubic meter/ Cubic feet |

#### **2.0 SAND FILLING**

##### **2.1 DESCRIPTION**

This work shall consist of filling in foundation trenches, inside plinth or at any other places by furnishing, placing, compacting and shaping suitable sand of acceptable quality and F.M. to make up levels to the lines, levels, grades, dimensions and cross sections in accordance with these specifications and as shown on the Drawings or BOQ and/or as instructed by the Engineer.

##### **2.2 MATERIALS**

Materials shall be of natural sand free from vegetable matters, from soft particles and from clay. F.M. of sand shall be in accordance with the stipulations of the BOQ or as per the direction of the Engineer.

All fill materials shall be stockpiled outside the working areas. Materials shall be tested and approved by the Engineer. The selected sand fill so stockpiled, shall satisfy the following criteria:

The fraction passing the 425-micron sieve shall have a Plasticity Index not greater than 10 (AASHTO, Soil Classification A-2-4).

The material shall have a soaked CBR value not less than 8% when compacted to 98% of maximum dry density as to be determined by AASHTO T-99.

### **7.2.3 CONSTRUCTION METHODS**

#### **GENERAL**

Prior to placing any sand fill upon any area, all clearing and grubbing operations shall be completed. Within the limits of sand filling, tree stumps shall completely be removed. The original ground surface should be prepared by scarifying, watering, aerating and compacting.

#### **SPREADING AND COMPACTION OF SAND FILL**

Sand fill shall be placed on the desired place in horizontal layers and each layer shall not exceed a loose thickness that will be required to obtain a compacted thickness of 150mm. Sand in each basket is to be placed near to the sand placed before it and spread systematically. The Contractor shall not be allowed to throw sand in heaps.

The compacted materials should become homogeneous and free from lenses, pockets, streaks or other imperfections. Placing operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability and for this purpose the preceding compacted layer shall be scarified before placing a new layer.

All fill materials shall generally be compacted mechanically. However, under some special circumstance and when specifically allowed under the BOQ, the fill may be allowed to be compacted manually.

If the density measurement checks fall below the specified density level, re-compacting shall be required irrespective of the field compaction trial results. The Contractor shall carry out such works at his own expenses.

Sand fill materials not containing sufficient moisture requirement for compaction in accordance with the requirements of this Sub-section, shall be reworked and watered as per the direction of the Engineer. The Contractor shall carry out this work at his own expenses.

Sand fill materials containing excess moisture shall be reworked and dried prior to or during compaction. Drying of wet materials shall be performed by methods proposed by the Contractor and approved by the Engineer at the expenses of the Contractor.

Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.

#### **PROCEDURE FOR MANUAL COMPACTION**

Sand shall be compacted manually by using concrete drop hammers each weighing 6 kg to 7 kg, fitted with a shaft of about 1.5m long. Ramming shall reduce the voids and shall continue until no further shrinkage of sand is possible by ramming.

Before commencing ramming, the moisture content of sand shall be increased or decreased as per requirement by sprinkling water or by allowing natural drying of sand as applicable so as to ensure that the materials shall have a moisture content of not less than 3% or greater than 3% dry of the optimum moisture required for the purpose of compaction respectively.

The compaction operations shall not proceed until the material is wetted or allowed to dry out, as may be required, to obtain optimum moisture content within the tolerances as permitted above. However, there may be an exception with a specific approval of the Engineer. No adjustment in price

shall be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.

The preceding operations shall continue layer after layer until the top of the filling is reached.

### **MECHANICAL COMPACTION**

In the case of mechanical compaction, area of filling, designated on the Drawings or by the Engineer, shall be compacted to the lines and grades shown on the Drawings or established by the Engineer. The Contractor's operations in importing materials, designated for use, shall be such as will result the desired F.M.

Just prior to and during compacting operations, the materials shall have a moisture content of not greater than 3% wet or less than 3% dry of the optimum moisture required for the purpose of compaction, as determined by Test No. 12 of BS 1337 and approved by the Engineer. The materials shall be so worked as to have uniform moisture content throughout the entire layer.

If the moisture content is less than optimum by more than 3% or is greater than optimum by more than 3%, the compaction operations shall not proceed until the material is wetted or allowed to dry out, as may be required, to bring the optimum moisture content within the tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.

When the material has been conditioned and placed as specified or directed, it shall be compacted with appropriate motorized vibratory compaction equipment or tampers of adequate weight and size as approved by the Engineer. Each layer shall be compacted to obtain at least 98% compaction of the maximum dry density (STD). If the test results show that the density has not met the requirement, the Contractor shall have to carry out further compaction until the required density is achieved.

### **2.4 MEASUREMENT**

Measurement shall be taken for payment on the compacted volume of completed and accepted works in cubic meter. The cross sections to be used will be the areas bound by the original ground (existing) shaped or leveled, the sides and the bottom of the foundation or the floor.

### **2.5 PAYMENT**

Payment for sand filling shall be made at the Contract unit price per cubic meter measured as provided above which price shall constitute the full compensation for furnishing all materials with their storage, placing, leveling and shaping, wetting or drying, compacting the fill materials and providing all equipment, tools and all incidentals necessary to complete the work true to the Specifications and/or as per the directions of the Engineer.

Payment shall only be made when all works have been completed in accordance with the designed sections satisfying all Specifications and accepted by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>              |
|------------------------|--------------------------|
| Sand filling           | Cubic meter / Cubic feet |

|  |           |
|--|-----------|
| <b>8.1 SCOPE .....</b>                           | <b>50</b> |
| <b>8.2 CODES AND STANDARDS .....</b>             | <b>50</b> |
| <b>8.3 SUBMITTALS .....</b>                      | <b>50</b> |
| <b>8.4 SUCTION RATE .....</b>                    | <b>50</b> |
| <b>8.5 SOLUBLE SALT CONTENT .....</b>            | <b>50</b> |
| <b>8.6 PRODUCTS .....</b>                        | <b>50</b> |
| <b>8.6.1 MATERIALS FOR BLOCKS .....</b>          | <b>50</b> |
| <b>8.6.2 CONCRETE BLOCK MAKING .....</b>         | <b>50</b> |
| <b>8.6.3 PROPERTIES OF BLOCKS .....</b>          | <b>51</b> |
| <b>8.6.4 MORTAR CONSTITUENTS .....</b>           | <b>52</b> |
| <b>8.6.5 MORTAR PROPORTIONS AND MIXING .....</b> | <b>52</b> |
| <b>9.6.8 REINFORCING AND ANCHORS .....</b>       | <b>52</b> |
| <b>8.6.7 ERECTION / WORKMANSHIP .....</b>        | <b>52</b> |
| <b>8.6.8 CURING .....</b>                        | <b>53</b> |
| <b>8.6.10 TOLERANCES .....</b>                   | <b>53</b> |
| <b>8.6.11 MEASUREMENT &amp; PAYMENT .....</b>    | <b>53</b> |

## **8.0 CEMENT CONCRETE BLOCK MASONRY**

### **8.1 SCOPE**

The work covered by this section of the Specifications consists of furnishing all labour, tools scaffolding, hoisting equipment and masonry materials of every kind; and in performing all operations in connection with procurement, transportation and delivery, erection and building in of all work classified as masonry work and/or included as such herein, i.e., concrete masonry units; masonry mortars; and all related items and appurtenances, including all items supplied by other trades and customarily built-in and/or installed under mason work or required to complete mason work, in strict accordance with the requirements of the Drawings and Schedules, as specified herein, and subject to the Terms and Conditions of the CONTRACT Documents.

### **8.2 CODES AND STANDARDS**

Unless otherwise specified or shown, the following codes and standards shall apply:

|                   |  |
|-------------------|--|
| <b>ASTM C31</b>   | <b>Making and curing concrete test specimen in the field.</b>    |
| <b>ASTM C39</b>   | <b>Compressive Strength of cylindrical concrete specimen.</b>    |
| <b>ASTM C90</b>   | <b>Hollow load bearing concrete masonry units.</b>               |
| <b>ASTM C144</b>  | <b>Aggregate for masonry mortar</b>                              |
| <b>ASTM C270</b>  | <b>Mortar for unit masonry</b>                                   |
| <b>ASTM C404</b>  | <b>Aggregate for masonry grout</b>                               |
| <b>ASTM E119</b>  | <b>Fire tests of building construction and materials</b>         |
| <b>UBC UL-618</b> | <b>Concrete masonry units, fire resistance index</b>             |
| <b>ACI 531</b>    | <b>Building code requirements for concrete masonry structure</b> |

### **8.3 SUBMITTALS**

Samples:

Submit three samples of each type of block required, and the full range of exposed texture to be used in the completed works. The review will be for texture only.

Test Reports:

Reports for compressive strengths of masonry units, grout and mortar.

### **8.4 SUCTION RATE**

The CONTRACTOR shall, at his own cost, satisfy the ENGINEER that the suction rate of the block when determined in accordance with Appendix 'A' of BS 3921 does not exceed 20g/cm.sq/min., or that the CONTRACTOR is able to adjust it so that it does not exceed this value on SITE.

### **8.5 SOLUBLE SALT CONTENT**

For exposed block work, the contents by weight percent of soluble sulfate, calcium, magnesium, potassium and sodium radicals, shall not exceed 0.30, 0.10, 0.03 and 0.03 percent respectively, when ascertained in accordance with BS 3921 at the cost of the CONTRACTOR.

### **8.6 PRODUCTS**

#### **8.6.1 MATERIALS FOR BLOCKS**

Cement, aggregate and water for concrete blocks shall conform to the requirements as specified in the section for Plain and Reinforced Concrete.



### **8.6.2 CONCRETE BLOCK MAKING**

The blocks shall be machine molded. The block making machines shall be of the standard approved by the ENGINEER. They shall be operated according to the instructions laid down by the manufacturers.

The blocks shall be continuously water cured by sprinkling for a minimum of 10 days and covered between sprinkling operations with 4 mils thick polyethylene sheeting. After 10 days' water-curing period the blocks shall be air dried. Under no circumstances will blocks be used in the work until they are completely dry. During curing period no surface of the block will be allowed to dry.

Cured concrete blocks shall be stored off the ground, stacked on level platforms, which allow air circulation under stacked units. Units shall be covered and protected against wetting.

Care shall be exercised in the handling of all concrete blocks. No damaged blocks shall be used in the work.

The blocks cast on different dates shall be stacked separately and must be labeled showing the date on which they are cast.

### **8.6.3 PROPERTIES OF BLOCKS**

Block sizes, unless otherwise indicated on drawings, shall be 16" by 8" by 4", 6", & 8" thickness (Approximately 400 by 200 by 100, 150 & 200 mm). Physical requirements shall comply with relevant ASTM or equivalent approved standards.

For non-load bearing wall the cement, sand and coarse aggregate shall be volume batched in the minimum ratio of one-part cement, three parts sand and six parts coarse aggregate and shall be mixed in a concrete mixer.

For load bearing Hollow/Solid block wall the mix unless otherwise stated shall be proportioned to meet the following strength requirements:

Solid Load Bearing Concrete Masonry Units shall have a 28 days' compressive strength of not less than 1500 psi (106 kg/cm. sq.) average of 3 units tested or 1200 psi (85 kg/cm. sq.) per individual unit tested.

Hollow Load Bearing Concrete Masonry Units shall comply with ASTM C90, grade N-1 (moisture controlled), and shall have a 28-days compressive strength of 1350 psi (96 kg/cm. sq.) average of 3 units tested and 800 psi (57 kg/cm. sq.) on individual unit tested. The compressive strengths shall be verified by tests in accordance with UBC section 2404, para 2

The CONTRACTOR shall provide test results proving the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test results shall be provided as required by the ENGINEER, to ensure that all batches of blocks have the minimum specified crushing strength.

The test shall be carried out by an authority approved by the ENGINEER. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The ENGINEER will require to periodically test samples of blocks, and the CONTRACTOR shall make any necessary arrangements.

Hollow concrete block units wherever specified shall have cores with cross sectional area at least equal to the percent of gross area of block given below:

|                 |                |
|-----------------|----------------|
| 8 in. (200 mm)  | 38 percent     |
| 6 in. (150 mm.) | 30 percent     |
| 4 in. (100 mm)  | No requirement |

Minimum shell wall thickness be 1-1/4 in. (32 mm).

Permissible tolerance in size of block shall be 1/8 in (3 mm) each way.

Special shapes for lintels, corners, jambs, sash, cleanouts, control joints and headers, bonding and other particular needs shall be provided where required.



#### **6.4 MORTAR CONSTITUENTS**

Cement:

Cement shall conform to ASTM C-150, type II low alkali non-staining without air entrainment

Sand (Aggregate):

Sand and its grading shall comply with the requirements of ASTM C-144, 100% passing the U.S. equivalent No. 16 sieve. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the ENGINEER.

Water:

Water shall conform to the specifications set forth in Section of Plain and Reinforced Concrete.

Lime:

Hydrate lime shall conform to ASTM C-207 type S. If it is not available, use quick lime according to ASTM C-5.

#### **6.5 MORTAR PROPORTIONS AND MIXING**

Cement, Lime and Sand shall be mixed in proportion, by volume, as follows:

Type (1) 1:1:6 (Cement: Lime: Sand)

Type (2) Alternatively use 1:4 (Cement: sand) mix subject to the prior approval of the ENGINEER.

Mix only as much mortar in a mortar mixer as can be used in one hour for Type-1 and 30 minutes for Type-II after water has been first mixed into the batch.

Do not re-temper the mortar.

Where cement lime mortar is used, sand and lime shall be mixed first and cement to be added later on.

Compressive strength of mortar specimen tested in accordance with ASTM C39 shall not be less than 2500 psi (210 Kg/cm sq.)

#### **6.8 REINFORCING AND ANCHORS**

All masonry walls shall be reinforced. At least one vertical and one horizontal reinforcing member shall be provided for every 16 sq.ft of wall elevation or as per structural drawings.

Block masonry anchors and ties required to connect masonry with structural member unless shown otherwise on drawings, shall be 3/8" dia. (10-mm dia) bars every 4-5th course, anchored 6" in each jointing element.

Additional details of anchors, if any, are shown on drawings.

Alternate compatible anchoring system may be used subject to the approval of the ENGINEER.

All reinforcing steel shall conform to ASTM A 615 grade 40 deformed bars as specified in section 3310 plain and reinforced concrete.

#### **6.7 ERECTION / WORKMANSHIP**

Blocks shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at center of units in alternate courses below. Each course shall be properly bonded at corners and intersections of walls. Courses of block shall be kept plumb throughout, and corners reveals shall be true and in plumb.

Standard width of mortar joints for both horizontal and vertical joints shall be 1/2" (12.5 mm) maximum. Mortar joints in walls shall have full mortar coverage on vertical and horizontal faces between the blocks. Mortar joints on wall including struck joints, shall be thoroughly compacted and pressed tight against the edges of the blocks with proper tools. Block terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joint shall be packed solidly with mortar between the top of the block and the bottom of slab or beam. Expansion joints shall be kept free from mortar or other debris.

Unless otherwise shown on the drawings or specified by the ENGINEER, the spaces around door frames and other material or built in items shall be solidly filled with mortar. Spaces around the door and window holdfasts shall be filled in with 3 ksi concrete. Work required to be built in with masonry including door frame anchors, wall plugs, dovetail anchors and accessories shall be built in as the erection progresses.

The block work shall be carried up in uniform manner and no portion shall be carried more than 3. ft (1 meter) above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and leveled round each floor.

Sleeves, chases and holes etc. shall be built in as construction proceeds. Chasing of completed walls or the formation of holes shall only be carried out with the approval of the ENGINEER.

Walls of blocks indicated as being non-load bearing shall not be constructed on the in-situ concrete floor slab unit until the floor shuttering is struck and the concrete has obtained sufficient strength to support their weight. Tothing into load bearing walls shall not be permitted.

#### **8.6.8 CURING**

Masonry wall shall be cured by keeping it moist with water for at least 10 days after its construction. ENGINEER may direct additional curing if required.

#### **8.6.9 SCAFFOLDING**

CONTRACTOR shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the ENGINEER shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the CONTRACTOR in the unit rate for masonry items.

Damage to masonry from scaffolding or from any other object shall be repaired by the CONTRACTOR at his own cost.

#### **8.6.10 TOLERANCES**

All block work shall be erected plumb and true to line and level with the maximum variation in any story height or any length of wall being 1/8" (3 mm) in 10 feet (3 meter). The maximum tolerance in the length, height or width of any single masonry unit shall be +/- 1/8" (3 mm).

#### **8.6.11 MEASUREMENT & PAYMENT**

Unless otherwise specifically stated in the Bill of Quantities or herein, all items shall be deemed to be inclusive of, but not limited to the following:

- Labor and all costs in connection therewith.

- Materials, goods and all costs in connection therewith e.g. conveyance; delivery; unloading; storing; returning packing; handling; hoisting; lowering; making curing etc.

- All fixtures and all costs in connection therewith for precast works.

- Fitting and fixing materials and goods in position.

- Use of plant and scaffolding.

- Cutting and patching work required for installation of built-in-work.

- Waste of materials.

- Square cutting.

- Establishment charges, overhead charges and profit.

- All other expenses, charges and taxes specified in Conditions of Contract.

Works shall be measured net as fixed in position as per Drawings and instructions of the ENGINEER. Each measurement shall be taken to the nearest 1/2" (12.5 mm). This rule shall not apply to any dimensions stated in descriptions.

Masonry work will be paid for according to the actual net area of masonry work in square feet (Sq. m.) for the required thickness or the actual net volume of masonry work in cubic feet (C.M.) as described in the Bill of Quantities. All the openings left in the masonry walls will be deducted.

Providing and fixing all joint reinforcing bars, reinforcing bar anchors and dovetail anchors shall be deemed to be included in the unit rate for masonry work.

Due to different thickness of the slab in different areas or rooms or for any other reason whatsoever, if the chiseling of the masonry is required the CONTRACTOR shall do so at his own cost. Where for any reason whatsoever, the height of the wall is short of ceiling height, the remaining height shall be made good with (f'c = 3000 psi) concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under the item of masonry of the walls. In case where lintel heights are such that the CONTRACTOR has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiseling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate for masonry.

|  |           |
|--|-----------|
| <b>CONCRETE WORK</b> .....                     | <b>55</b> |
| <b>9.1 CONCRETE FOR STRUCTURES</b> .....       | <b>55</b> |
| <b>9.1.1 DESCRIPTION</b> .....                 | <b>55</b> |
| <b>9.1.2 MATERIALS</b> .....                   | <b>55</b> |
| <b>GENERAL</b> .....                           | <b>55</b> |
| <b>CEMENT</b> .....                            | <b>55</b> |
| <b>USE OF CEMENT</b> .....                     | <b>55</b> |
| <b>COARSE AGGREGATE</b> .....                  | <b>55</b> |
| <b>NOMINAL SIZE OF COARSE AGGREGATE</b> .....  | <b>55</b> |
| <b>FINE AGGREGATE</b> .....                    | <b>56</b> |
| <b>WATER</b> .....                             | <b>56</b> |
| <b>ADMIXTURES</b> .....                        | <b>56</b> |
| <b>9.1.3 TESTING OF MATERIALS</b> .....        | <b>57</b> |
| <b>GENERAL</b> .....                           | <b>57</b> |
| <b>CEMENT</b> .....                            | <b>57</b> |
| <b>AGGREGATE</b> .....                         | <b>57</b> |
| <b>WATER</b> .....                             | <b>58</b> |
| <b>ADMIXTURES</b> .....                        | <b>58</b> |
| <b>9.1.4 COMPOSITION OF CONCRETE</b> .....     | <b>58</b> |
| <b>CONCRETE CLASSES</b> .....                  | <b>58</b> |
| <b>9.1.5 REGULATION OF WATER CONTENT</b> ..... | <b>59</b> |
| <b>9.1.6 DURABILITY OF CONCRETE</b> .....      | <b>60</b> |
| <b>SPECIAL EXPOSURES</b> .....                 | <b>60</b> |
| <b>SULPHATE EXPOSURES</b> .....                | <b>60</b> |
| <b>CORROSION OF REINFORCEMENT</b> .....        | <b>61</b> |
| <b>9.1.7 DESIGN OF CONCRETE MIX</b> .....      | <b>61</b> |
| <b>STRENGTH</b> .....                          | <b>62</b> |
| <b>WATER/CEMENT RATIO</b> .....                | <b>62</b> |
| <b>CEMENT TYPE AND MINIMUM CONTENT</b> .....   | <b>62</b> |
| <b>MINIMUM FILLER CONTENT</b> .....            | <b>62</b> |
| <b>COARSE AGGREGATE</b> .....                  | <b>62</b> |
| <b>FINE AGGREGATE</b> .....                    | <b>62</b> |
| <b>WORKABILITY</b> .....                       | <b>62</b> |
| <b>9.1.8 PROPORTIONING OF MIX</b> .....        | <b>63</b> |
| <b>9.1.9 CONCRETE IN BLINDING LAYERS</b> ..... | <b>63</b> |
| <b>9.1.10 BATCHING</b> .....                   | <b>64</b> |
| <b>GENERAL</b> .....                           | <b>64</b> |
| <b>BINS AND HOPPERS</b> .....                  | <b>64</b> |

|   |           |
|---|-----------|
| <b>SCALES .....</b>   | <b>64</b> |
| <b>9.1.11 QUALITY CONTROL OF CONCRETE .....</b>                   | <b>64</b> |
| <b>GENERAL .....</b>  | <b>64</b> |
| <b>ADJUSTMENT OF WATER/CEMENT RATIO .....</b>                     | <b>65</b> |
| <b>SLUMP TESTS.....</b>   | <b>65</b> |
| <b>COMPRESSIVE STRENGTH .....</b>                                 | <b>65</b> |
| <b>FAILURE TO PASS TESTS .....</b>                                | <b>66</b> |
| <b>TESTING HARDENED CONCRETE .....</b>                            | <b>66</b> |
| <b>9.1.12 CONCRETE CONSTRUCTION .....</b>                         | <b>66</b> |
| <b>9.1.12.1 GENERAL .....</b>                                     | <b>66</b> |
| <b>9.1.12.2 MIXING CONCRETE .....</b>                             | <b>66</b> |
| <b>GENERAL .....</b>  | <b>66</b> |
| <b>MIXERS AT THE SITE OF CONSTRUCTION .....</b>                   | <b>67</b> |
| <b>CENTRAL PLANT MIXERS .....</b>                                 | <b>67</b> |
| <b>HAND MIXING .....</b>  | <b>67</b> |
| <b>9.1.12.3 CONVEYING CONCRETE .....</b>                          | <b>68</b> |
| <b>GENERAL .....</b>  | <b>68</b> |
| <b>AGITATOR TRUCKS.....</b>                                       | <b>69</b> |
| <b>NON-AGITATOR TRUCKS.....</b>                                   | <b>69</b> |
| <b>TRUCK OR TRANSIT MIXERS .....</b>                              | <b>69</b> |
| <b>9.1.12.4 HANDLING AND PLACING OF CONCRETE .....</b>            | <b>70</b> |
| <b>9.1.12.5 DEPOSITING CONCRETE UNDER WATER .....</b>             | <b>72</b> |
| <b>9.1.12.6 COMPACTION OF CONCRETE .....</b>                      | <b>73</b> |
| <b>9.1.13 PROTECTION OF CONCRETE FROM ADVERSE CONDITIONS.....</b> | <b>74</b> |
| <b>GENERAL .....</b>  | <b>74</b> |
| <b>PROTECTION FROM RAIN .....</b>                                 | <b>74</b> |
| <b>PROTECTION FROM HOT WEATHER .....</b>                          | <b>74</b> |
| <b>PROTECTION FROM COLD WEATHER .....</b>                         | <b>74</b> |
| <b>SPECIAL REQUIREMENTS FOR ROOF SLABS .....</b>                  | <b>75</b> |
| <b>CONCRETE EXPOSED TO SALT WATER .....</b>                       | <b>75</b> |
| <b>9.1.14 PERFORATIONS AND EMBEDDING OF SPECIAL DEVICES .....</b> | <b>75</b> |
| <b>9.1.15 CURING OF CONCRETE GENERAL.....</b>                     | <b>76</b> |
| <b>MATERIALS .....</b>  | <b>77</b> |
| <b>WATER.....</b>   | <b>77</b> |
| <b>LIQUID MEMBRANES .....</b>                                     | <b>77</b> |
| <b>WATERPROOF SHEET MATERIALS .....</b>                           | <b>77</b> |
| <b>METHODS.....</b>   | <b>77</b> |
| <b>FORMS-IN-PLACE METHOD .....</b>                                | <b>77</b> |

|  |           |
|--|-----------|
| <b>WATER METHOD .....</b>                                  | <b>77</b> |
| <b>LIQUID MEMBRANE CURING COMPOUND METHOD .....</b>        | <b>77</b> |
| <b>WATERPROOF COVER METHOD .....</b>                       | <b>78</b> |
| <b>ACCELERATED CURING.....</b>                             | <b>78</b> |
| <b>FIELD CURED SPECIMENS .....</b>                         | <b>78</b> |
| <b>9.1.16 FINISH AND FINISHING.....</b>                    | <b>78</b> |
| <b>GENERAL.....</b>  | <b>78</b> |
| <b>CONCRETE SURFACE FINISHING.....</b>                     | <b>79</b> |
| <b>ORDINARY FINISH.....</b>                                | <b>80</b> |
| <b>GROUT CLEANING.....</b>                                 | <b>80</b> |
| <b>RUBBED FINISH.....</b>                                  | <b>80</b> |
| <b>TOOLED FINISH.....</b>                                  | <b>81</b> |
| <b>SANDBLASTED FINISH.....</b>                             | <b>81</b> |
| <b>WIRE BRUSHED OR SCRUBBED FINISH.....</b>                | <b>81</b> |
| <b>INSPECTION AND MAKING GOOD.....</b>                     | <b>81</b> |
| <b>PROTECTION .....</b>                                    | <b>81</b> |
| <b>9.1.17 SECOND STAGE CONCRETE.....</b>                   | <b>81</b> |
| <b>9.1.18 FACTORY MADE PRE-CAST CONCRETE ELEMENTS.....</b> | <b>82</b> |
| <b>HANDLING AND STACKING OF PRE-CAST UNITS.....</b>        | <b>82</b> |
| <b>9.1.19 CONTROL OF HEAT IN STRUCTURES.....</b>           | <b>83</b> |
| <b>9.1.20 BACK-FILL TO STRUCTURES.....</b>                 | <b>83</b> |
| <b>9.1.21 CLEANING UP.....</b>                             | <b>83</b> |
| <b>9.1.22 MEASUREMENT.....</b>                             | <b>83</b> |
| <b>9.1.23 PAYMENT .....</b>                                | <b>83</b> |
| <b>9.2 FALSE WORK AND FORMS .....</b>                      | <b>84</b> |
| <b>9.2.1 SCAFFOLDING (FALSE WORK).....</b>                 | <b>84</b> |

**9.0 CONCRETE WORK**

**9.1 CONCRETE FOR STRUCTURES**

**9.1.1 DESCRIPTION**

This work shall consist of construction of all Portland Cement Concrete in structures, with or without reinforcement, which shall involve furnishing, placing, finishing and curing of concrete. All items of concrete work shall include elements of structures constructed by cast-in-place and pre-cast methods using either plain or reinforced concrete or any combination thereof and shall conform to the specifications and requirements of the different Sub-sections of this item of work. All structures shall be built in a workman like manner to the lines, grades and dimensions shown on the Drawings or as directed by the Engineer.

All concrete works shall be carried out in accordance with BS 8110 or ASTM C-685 and as specified by the Engineer.

All sampling and testing of constituent materials shall be carried out in accordance with the provisions of the appropriate British or American Standard and all sampling and testing of fresh and hardened concrete shall be carried out in accordance with the provisions of BS 1881 "Method of Testing Concrete" or similar under ASTM C 39.

**9.1.2 MATERIALS**

**GENERAL**

Concrete shall be manufactured with the essential ingredients of Portland cement, fine aggregate, coarse aggregate and water as specified and shall be well mixed and brought to the proper consistency. Type and source of ingredients used in concrete shall conform to the approved samples and shall not be varied. The requirement for concrete, its constituent materials, methods and procedures shall conform to any of the Standard Specifications of ASTM, or BS or any other equivalent standard unless otherwise specified herein or directed by the Engineer.

Materials shall conform to the requirements specified below and in the relevant Section titled 'Construction Materials' of this Specification.

**CEMENT**

Cement used in the works shall be Ordinary Portland Cement complying with the requirements of ASTM C 150 Type 1 or BS 12 or equivalent standard. Special cements shall conform to the requirements provided by the Engineer.

**USE OF CEMENT**

Cement of different manufacturers and with different brands or types shall be kept separately and shall not be used in the same mix.

Consignment of cement shall be used in the order of delivery.

Only one brand, grade or kind of cement shall be used in a given structure, except upon the written permission of the Engineer.

**COARSE AGGREGATE**

Coarse aggregate for all types of Concrete with the exception of blinding concrete shall conform to the requirements of ASTM C 33.

Coarse aggregate shall be hard, durable, clean, free from dust and other deleterious materials. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce workable concrete of maximum density.

**NOMINAL SIZE OF COARSE AGGREGATE**

Different sizes of coarse aggregates should be mixed in proportions, which would be determined during trial mixes. The coarse aggregate to be used in the concrete mix shall be dry mixed from different sizes in specified/selected proportion one day before casting.

Nominal size of the coarse aggregate shall not be larger than one-fifth of the narrowest dimension between sides of forms or one-third the depth of slabs or three-fourth the minimum clear spacing between individual reinforcing bars or bundle of bars.

**FINE AGGREGATE**

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of concrete. It shall conform to the requirements of ASTM C-33 or equivalent standard.

**WATER**

All sources of water for use in concrete shall be subject to the approval of the Engineer. Water shall be reasonably clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. Water whose concentration of chloride ion is in excess of 3,000 ppm (parts per million) shall not be used for the production of concrete. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. Such comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength. Any indications of unsoundness, change in time of setting of plus or minus 30 minutes or more, or reduction of more than 10 percent in mortar strength shall be sufficient cause for rejection of the water under test.

**ADMIXTURES**

Suitable admixtures may be used in concrete mixes with the prior acceptance of the Engineer. The type and source of admixture, and the amount added and method of use shall be to the acceptance of the Engineer, who shall be provided with the following data:

The manufacturer's recommended dosage and detrimental effects of under-dosage and over- dosage.

The chemical name of the main active ingredients in the admixture.

Whether or not the admixture contains chloride and, if so, the chloride content of the admixture expressed in percentage of equivalent anhydrous calcium chloride by weight of admixture.

Whether or not the admixture leads to the entraining of air when used at the manufacturers recommended dosage.

Evidence of previous satisfactory performance of concrete containing the additive.

Admixtures containing chloride other than impurities from admixture ingredients shall not be used in concrete containing embedded aluminium, or in concrete cast against permanent galvanized metal forms.

In admixtures for use in reinforced concrete, the chloride ion content shall not exceed one percent by weight of the admixture. If more than one admixture is used, the admixtures shall be compatible with each other and shall be incorporated into the concrete mix in correct sequence so that the desired effects of all admixtures are obtained.

Fly ash or other pozzolans used as admixtures shall conform to 'Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete (ASTM C 618)'. All air entraining admixtures shall conform to 'Specification for Air entraining Admixtures for Concrete (ASTM C 260)'.



Air entraining and chemical admixtures shall be incorporated into the concrete mix in a water solution. The water so included shall be considered to be a portion of the allowed mixing water. Admixtures shall be incorporated through a dispensing system sufficiently accurate to deliver within + 5% of the approved dosage rate.

All admixtures shall be used strictly in accordance with the manufacturer's instructions. A 'Literature of Compliance' of the admixture shall be furnished to the Engineer for each shipment of admixture used in the work. The said literature shall be based upon laboratory test results from an approved testing facility and shall authenticate that the admixture meets all requisite specifications.

### **9.1.3 TESTING OF MATERIALS**

#### **GENERAL**

All tests shall be performed at Site and/or in the PEC Laboratories. Testing outside the scope of Site or PEC Laboratories shall be carried out at a recognized laboratory that will be designated by the Engineer. The test results shall be authenticated by the Head of the Laboratory.

#### **CEMENT**

Hydraulic cement shall be sampled and tested in accordance with the standard methods referred to in AASHTO M 85.

Cement may be sampled either at the factory or at the Site of the Work as provided in the Specifications.

The Contractor shall notify the Engineer of dates of delivery so that there will be sufficient time for sampling the cement, either at the factory or upon delivery. If this is not done or if additional tests are necessary, the Contractor may be required to re-handle the cement in the store for the purpose of obtaining the required samples.

Sampling shall normally be instructed by the Engineer for every stored 200 cubic meter of concrete production with the concerned cement type or if the source of cement has been changed.

#### **AGGREGATE**

Tests to assess the suitability of the aggregates proposed for use in concrete to be placed in the permanent works shall be as follows:

- Grading
- Magnesium sulphate soundness
- Specific gravity and water absorption
- Clay, silt and dust content
- Organic impurities
- Sulphate and chloride content
- Elongation and flakiness
- Potential alkali reactivity
- Los Angeles Abrasion Test
- Aggregate drying shrinkage.

These tests are to be carried out in accordance with the appropriate ASTM Standards and the results shall comply with the limits given therein or as otherwise stated in this Specification. Grading shall be carried out at least at a weekly interval when concrete is being produced on a regular basis or before the start of production when irregular.

The Contractor shall supply samples of the aggregate materials proposed to be used for testing of Elongation and Flakiness Index, Los Angeles Abrasion Value (coarse aggregate) and Fineness Modulus (fine aggregate) and grading and other tests as required by the Engineer.

From the aggregate materials proposed by the Contractor, samples shall be selected according to ASTM D 75 and D 3665 in the presence of the Engineer. The samples shall be brought to the Site laboratory and tested for proving their conformance with the relevant Section of BS or ACI Codes.

The quality control of the aggregate shall be as directed by the Engineer. Grading shall normally be checked daily.

Moisture content of the aggregate shall be determined daily and at any time when a change in the moisture content is expected.

If the Contractor proposes to change the source of supply of aggregates, samples from the new source shall similarly be supplied and tested.

Grading of mixed coarse aggregate shall be checked at Site.

#### **WATER**

The water used in mixing or curing concrete shall be tested by methods described in AASHTO Test Method T 260.

In sampling water for testing, care shall be taken that the containers are clean and that samples are representative.

When comparative tests are made with a water of known satisfactory quality, any indication of unsoundness, marked change in time of setting, or a reduction of more than 10 percent in mortar strength, shall be sufficient cause for rejection of the water under test.

Water shall be tested before commencement of work or any time required by the Engineer, or if the source is changed.

#### **ADMIXTURES**

The Contractor shall submit to the Engineer specifications and samples of any admixtures or additives that he proposes to use at least 28 days before the commencement of construction or manufacture of the particular structure on which he intends to use the admixture.

Any tests the Engineer may require on concrete mixes on account of the Contractor's proposal to use additives shall be carried out at the expenses of the Contractor.

#### **9.1.4 COMPOSITION OF CONCRETE CONCRETE CLASSES**

The class of concrete and properties applicable to the concrete in various parts of structures shall be as specified in the following table.

Each mix shall be designed to ensure optimum workability, prevent segregation and produce a dense, durable concrete by adjusting the fine and coarse aggregate proportions following procedures as stated under the Sub-section of 'Design of Concrete Mix' of this Specification.

| Concrete Class | 28 day Cylinder strength in lbs/in <sup>2</sup> (minimum) | Coarse Aggregate Type | Mix Ratio (by volume) (only indicative) |
|----------------|---|-----------------------|---|
| A-1            | 4000  | Crushed Stone         | 1:1:2                                   |
| A-2            | 3000  | Crushed Stone         | 1:1.5:3                                 |
| A-3            | 2500  | Crushed Stone         | 1:2:4                                   |

The various classes of concrete shall be placed at locations as would be specified on the Drawings (if so) or elsewhere as directed by the Engineer.

Strength requirement is the only determining factor for acceptance of any above stated class of concrete. The mix ratio only shows the minimum cement requirement and it shall not put the Engineer under any obligation to accept concrete unless the requisite strength is established. If required, the cement content has to be increased to attain the desired strength without any additional costs to be paid to the Contractor.

Strength of each and every cylinder tested should conform the aforementioned specified value. Trial mixes for every class of concrete with representative material from the Site, shall be prepared by the Contractor in the laboratory in accordance with the approved procedures. The nominal strength in these tests shall exceed the specified minimum strength by 10%.

If required, suitable admixtures as approved by the Engineer would have to be added to the concrete mix to attain the desired strength without any additional costs to be paid to the Contractor. The effect of the admixture shall be carefully observed by trial mix and tests before its use.

As the work progresses, the Engineer reserves the right to change the proportions from time to time, if conditions warrant so in the interest of satisfactory output. Any such changes will be made at no additional compensation to the Contractor.

#### **9.1.5 REGULATION OF WATER CONTENT**

The amount of water used in the concrete for volume batching shall be regulated to adjust for any variation of the moisture content or grading of the aggregates as they enter the mixer as follows:

The batched volume of damp fine aggregate shall be corrected to the equivalent volume of dry aggregate. The volume of moisture in the aggregates shall be deducted from the free water to be added to the mix. To expedite correction to fine aggregate, a “bulking curve” showing the relation between moisture content and increase over dry volume shall be prepared in advance by tests on the fine aggregate used. The Engineer may direct the use of a slump less than that specified whenever concrete of such lesser slump can be consolidated into place by means of vibration specified herein. Addition of water to overcome stiffening of the concrete before placing will not be permitted. Concrete shall have uniform consistency from batch to batch. Aggregate shall not be batched for concrete when free water is dripping from the aggregate.

Concrete mix proportions shall be such that the concrete is of adequate workability and can properly be compacted. Suggested ranges of values of workability of concrete for some placing conditions are given in the following Table.

| Degree of Workability | Placing Conditions  | Nominal maximum aggregate (mm) | Compacting factor | Slump mm |
|-----------------------|---|--------------------------------|-------------------|----------|
| Very Low              | Small sections (i.e. pre-cast or > 300mm thick) subjected to intensive vibration and large sections to normal vibration | 20                             | 0.78              | 0-10     |
|                       |   | 40                             | 0.78              | 0-25     |

|        |   |    |      |         |
|--------|---|----|------|---------|
| Low    | Simple reinforced sections with vibration and large sections without vibration              | 20 | 0.85 | 10-25   |
|        |   | 40 | 0.85 | 25-50   |
| Medium | Simple reinforced sections without vibration and heavily reinforced sections with vibration | 20 | 0.92 | 25-50   |
|        |   | 40 | 0.92 | 50-100  |
| High   | Heavily reinforced sections without vibration   | 20 | 0.95 | 50-125  |
|        |   | 40 | 0.95 | 100-175 |

When the consistency of the concrete is found to exceed the nominal slump, the mixture of subsequent batches shall be adjusted to reduce the slump to a value within the nominal range. Batches of concrete with a slump exceeding the maximum specified shall not be used in the work.

If concrete of adequate workability cannot be obtained by the use of the minimum cement content as would be allowed, the cement and water content shall be increased without exceeding the specified water/cement ratio, or an approved admixture shall be used.

#### **9.1.6 DURABILITY OF CONCRETE SPECIAL EXPOSURES**

For concrete intended to have low permeability when exposed to water, the water cement ratio shall not exceed 0.50.

For corrosion protection of reinforced concrete exposed to brackish water, sea water or spray from these sources, the water cement ratio shall not exceed 0.40.

If minimum requirement of concrete cover as given under the Section on 'Reinforcing Steel' is increased by 12mm, water cement ratio may be increased to 0.45.

The requirement of water cement ratio on Normal Weight Aggregate Concrete, if exposed to Sulphate containing solutions, shall be calculated using the weight of cement meeting the requirements of ASTM C 150 or C 595 plus the weight of fly ash or pozzolan satisfying ASTM C 618 and/or slag satisfying ASTM C 989.

#### **SULPHATE EXPOSURES**

Concrete to be exposed to sulphate containing solutions or soils shall conform to the requirements of the Table given below or be made with a cement that provides sulphate resistance with the maximum water cement ratio provided in the Table.

Calcium chloride shall not be used as an admixture in concrete exposed to severe or very severe sulphate containing solutions, as defined in Table given below.

#### **Requirements for Normal Weight Aggregate Concrete Exposed to Sulphate Containing Solutions**

| <b>Sulphate exposure</b> | <b>Water Soluble Sulphate (SO<sub>4</sub>) in soil (percent by weight)</b> | <b>Sulphate (SO<sub>4</sub>) in water (ppm)</b> | <b>Cement Type <sup>1</sup></b> | <b>Maximum Water Cement Ratio, by weight</b> |
|--------------------------|--|---|---------------------------------|--|
|--------------------------|--|---|---------------------------------|--|

|                       |           |                 |  |      |
|-----------------------|-----------|-----------------|--|------|
| Negligible            | 0.00-0.10 | 0-150           |  |      |
| Moderate <sup>2</sup> | 0.10-0.20 | 150-100         | II, IP(MS),<br>IS(MS),<br>P(MS),<br>I(PM) (MS)<br>I(SM) (MS) | 0.50 |
| Severe                | 0.20-2.00 | 1500-<br>10,000 | V  | 0.45 |
| Very<br>Severe        | Over 2.00 | Over<br>10,000  | V plus<br>pozzolan <sup>3</sup>                              | 0.45 |

**Note :**

For types of cement see ASTM C150 and C595.

Sea water

Pozzolan that has been determined by test or service record to improve Sulphate resistance when used in concrete containing Type V cement.

**CORROSION OF REINFORCEMENT**

For corrosion protection, maximum water soluble Chloride ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious materials, and admixtures, shall not exceed the limits specified in the Table given below. When testing is performed to determine water soluble Chloride ion content, test procedures shall conform to AASHTO T 260, "Methods of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials".

| Type of Member   | Chloride | Maximum water soluble<br>ion (C1) in Concrete, percent<br>by weight of cement |
|--|----------|---|
| Reinforced concrete exposed to chloride in service                         |          | 0.15  |
| Reinforced concrete that will be dry or protected from moisture in service |          | 1.00  |
| Other reinforced concrete construction                                     |          | 0.30  |

When reinforced concrete will be exposed to brackish water, sea water, or spray from these sources, the above requirements for water cement ratio, or concrete strength and minimum cover requirements (shown under the relevant Sub-section of the Section on 'Reinforcing Steel') shall be satisfied.

**9.1.7 DESIGN OF CONCRETE MIX**

When designing the concrete mix, the following conditions shall be considered:

**Strength**

The class of the concerned concrete is to be as shown on the Drawings (if shown). The class is the specified cylinder strength of 28 days and shall be determined as indicated above in the Table under the Sub-section on 'Concrete Classes' of this Section.

**Water/Cement Ratio**

The ratio of free water to cement when using saturated surface dry aggregate shall be as low as possible and not to exceed 0.50 by weight for all concrete.

For concrete in pile caps in contact with the ground, the water cement ratio shall not exceed 0.45.

**Cement Type and Minimum Content**

Type-1 Cement shall be used for all classes for "Concrete".

**Minimum Filler Content**

Filler is defined as fine concrete aggregates including cement with a grain diameter less than 0.25mm. It shall not be less than (except mass concrete) 435 Kg per cubic meter Concrete for maximum 20mm size Coarse Aggregate. The same for maximum 40mm size Coarse Aggregate shall not be less than 350 kg per cubic meter of Concrete.

**Coarse Aggregate**

The maximum size of the coarse aggregate shall be either 40mm or 20mm and the grading and quality shall be as indicated in the portion of 'Coarse Aggregate' under the Sub-section on 'Construction Materials' of this Specification or as specified on the Drawings or as directed by the Engineer.

**Fine Aggregate**

The grading and quality is to be as indicated in the portion of Sub-section on 'Fine Aggregate' under the Section on 'Construction Materials' of this Specification or as specified on the Drawings or as directed by the Engineer.

**Workability**

The concrete shall be of suitable workability to obtain full compaction. Slumps measured, as described in ASTM C-143 shall be in accordance with the values shown unless otherwise required or approved by the Engineer.

The designed concrete mix shall be approved by the Engineer to meet the requirements for each structural component.

Prior to the commencement of concrete operations, the Contractor shall design a mix for the concrete and prepare and test concrete samples of this mix under laboratory conditions. Preliminary mixes shall be repeated and adjusted as necessary to produce a concrete mix meeting the requirements stated under the Sub-section on "Composition of Concrete" of this Specification. The details of the mix and test results shall be submitted to the Engineer for his approval.

Following the Engineer's approval of the mix design, the Contractor shall prepare a trial mix in the presence of the Engineer. The trial mix shall be batched, mixed and handled using the same methods and plant, the Contractor proposes to use. The mix shall comprise not less than half a cubic meter of concrete. The proportions of cement, aggregates and water shall be carefully determined by weight in accordance with the Contractor's approved mix design and sieve analysis shall be made for the fine and coarse aggregates.

Twelve concrete cylinder samples shall be made from the trial mix in the presence of the Engineer. The concrete cylinders shall be made, cured, stored and tested in accordance with BS 1881 or ASTM C-39. Six cylinders shall be tested at 7 days and six cylinders shall be tested at 28 days. If the strength of any of the cylinders tested at 28 days is recorded below the characteristic strength, the Contractor shall redesign the mix, make further preliminary mixes for the Engineer's approval. He shall then undertake additional trial mixes and test the resultant samples until a satisfactory mix is obtained and approved by the Engineer.

From the same mix as that from which the test specimens are made, the workability of the concrete shall be determined by the slump test in accordance with ASTM C-143. The remainder of the mix shall be cast in a mould and compacted. After 24 hours, the sides of the mould shall be struck off and the surface examined in order to satisfy the Engineer that an acceptable surface can be obtained with the mix.

When a proposed mix has been approved, no variation shall be made in the mix proportions, or in the type, size, grading zone or source of any of the constituents without the consent of the Engineer. He may require further trial mixes to be made before any such variation is approved.

Until the Engineer approves the results of trial mixes for a particular class of concrete, no concrete of the relevant class shall be placed in the works.

During production, the Engineer may require additional trial mixes before a substantial change is made in the materials or in the proportions of the materials to be used. However, it will not need to be carried out when adjustments are made to the mix proportions during production in order to minimize the variability of strength and to approach more closely the target mean strength.

Trial mixes for mass concrete are not requested provided the Contractor is able to submit test results from mixes carried out before which prove that the demanded quality of the mass concrete is according to the Specifications.

When the Contractor intends to purchase factory-made pre-cast concrete units, trial mixes may be dispensed with provided that evidence is given to satisfy the Engineer that the factory regularly produces concrete, which complies with the Specifications. The evidence shall include details of mix proportions, water-cement ratios, slump tests and strengths obtained at 28 days.

Selection of the trial mix is the ultimate responsibility of the Contractor regardless of its approval accorded by the Engineer

#### **9.1.8 PROPORTIONING OF MIX**

Proportions of materials for concrete shall be such that:

- Workability and consistency are achieved for proper placement into forms and around reinforcement, without segregation or excessive bleeding.
- Resistance to special exposures to meet the durability requirements are provided, and
- Conformance with strength test requirements is ensured.

The approved mix shall be proportioned by weight or, except cement by volume, if volume batching is approved by the Engineer. Allowance shall be made for the moisture content of the aggregates.

Fine and coarse aggregates and water may only be measured by volume in boxes or containers approved by the Engineer. Cement shall be added to Concrete Mixer by whole number of bags only.

#### **9.1.9 CONCRETE IN BLINDING LAYERS**

The blinding concrete/lean concrete (Mix 1:3:6) shall be mixed in proportion by volume wherever specified on the Drawings. Ordinary Portland Cement and well-graded aggregate of maximum nominal size, not exceeding 40mm, shall be used unless otherwise specified.



**9.1.10 BATCHING**

**GENERAL**

The Contractor shall provide and maintain suitable measuring equipment and devices of good order required to determine and control accurately the relative amount of various materials entering the mix.

All measurements shall be by weight/volume and shall be accurate within a tolerance of 1% for each batch. Besides, the deviation from the average amount of filler from ten samples of different batches of fresh concrete should not be more than 6%.

Satisfactory methods of handling materials shall be employed.

A batching plant shall be used for measuring materials but alternative methods proposed by the Contractor may be considered subject to the approval of the Engineer. The batching plant shall include bins, weighing hoppers and scales for the fine aggregate and for each separated size of coarse aggregate. If cement is used in bulk, a bin, hopper and scales for the cement shall be included. The container shall be watertight.

Provisions satisfactory to the Engineer shall be made for batching other components of the mix at the batching plant or at the mixer, as may be necessary. The batching plant may be either of stationary or of mobile type. It shall always be properly leveled within the accuracy required for the proper operation of the weighing mechanisms.

**BINS AND HOPPERS**

Bins with adequate separate compartments for fine aggregate and for each required size of coarse aggregate shall be provided in the batching plant. Each compartment shall discharge efficiently and freely in to the weighing hopper. Means of control shall be provided so that as the quantity desired in the weighing hopper is being approached, the material may be added slowly and shut off with precision. A port or other opening for removing an overload of the several materials from the hopper shall be provided.

Weighing hoppers shall be constructed so as to discharge fully.

**SCALES**

The scales for weighing aggregates and cement shall be of either the beam type or the dial type without spring. They shall be accurate within one-half of 1% under operating conditions throughout the range of use. Ten 25 kilogram weights shall be available for checking the accuracy. All exposed fulcrums, clevises and similar working parts of scales shall be kept clean. When beam-type scales are used, provision shall be made for indicating to the operator that the required load in the weighing hopper is being approached. The device shall indicate at least the last 100 kilograms of load and upto 25 kilograms over-load. All weighing and indicating devices shall be in full view of the operator while charging the hopper and he shall have convenient access to all controls.

Cement may be measured by weight, or in standard bags weighing 50 kilograms net each. When measured by weight, a separate satisfactory scale and hopper shall be provided together with a boot or other approved device to transfer the cement from the weighing hopper.

The amount of water shall be measured by weight separately on an individual scale or may be measured by volume.

Any solid admixture, to be added, shall be measured by weight. However, liquid or pest admixtures may be measured by volume or weight.



**9.1.11 QUALITY CONTROL OF CONCRETE**

**GENERAL**

The Contractor shall assume the full responsibility that the quality of the concrete conforms to the Specifications and this responsibility shall not be waived by the tests carried out and the test results approved by the Engineer.

The Contractor shall thus at his own discretion establish additional testing procedures as necessary. The Contractor shall be responsible for providing samples of concrete and its constituent materials either for testing by himself or for testing at the Engineer's laboratory or laboratory designated by the Engineer. For this purpose, concrete test cylinders, which shall be made in accordance with BS 1881/ASTM C 31 shall be deemed to be 'Samples'. All sampling of constituent materials shall be carried out in accordance with the provisions of the appropriate British/American Standard and all sampling of fresh and of hardened concrete shall be carried out in accordance with the provisions of BS 1881/ASTM C 31 unless such provision is at variance with the Specification.

The tests, which the Contractor is required to undertake on behalf of the Engineer, are those to be carried out on fresh concrete at the place of final deposit, or elsewhere at Site as directed by the Engineer.

**ADJUSTMENT OF WATER/CEMENT RATIO**

The Contractor shall test aggregates for moisture content and so determine the water- cement ratio of the fresh concrete. Determination of water-cement ratio shall be carried out as required by the Engineer and the results and calculations shall be submitted to him.

**SLUMP TESTS**

Slump testing of concrete shall be carried out as required by the Engineer. The minimum is one test at the commencement of each casting, one per hour of casting and one each time a strength test specimen is taken.

The Engineer shall make available a slump cone at Site and the testing shall be carried out in accordance with ASTM C-143.

The slump of concrete to be used in the works shall not exceed the slump of the trial mix by more than 10% and shall in any case be not more than the maximum specified.

**COMPRESSIVE STRENGTH**

The Contractor shall, in the presence of the Engineer, sample concrete for testing from the batching and mixing plant at the time of pouring of concrete into the forms or elsewhere. Samples shall be obtained at uniform intervals throughout the production or delivery of concrete for a given placement.

The Contractor shall carry out cylinder testing of concrete strength as required by the Engineer. A minimum of three test cylinders shall be taken for each day's casting or for every 15 cubic meters of concrete cast in larger pours.

After stripping, each cylinder shall be indelibly marked with the date of taking cylinder, location in the structure and prescribed number.

The Engineer shall make available 2 sets of three test moulds (cylinder) at Site. Samples for testing shall be taken in the presence of the Engineer and shall be dated.

Tests cylinder shall be tested for 7 days and 28 days compressive strength in accordance with ASTM C-39.

A strength test result shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

Average of three consecutive strength tests equals or exceeds the specified strength.

No individual strength test (average of two cylinders) falls below the specified strength by more than  $3.5 \text{ N/mm}^2$ .

However, the following may be an alternative –

The average strength of the three consecutive cylinders, tested at 28 days, shall exceed the specified strength. One out of the three cylinders tested may have a value less than the specified strength provided that it is not less than 85% of the specified strength, except that not more than one test result per element may be below the specified strength.

#### **FAILURE TO PASS TESTS**

If cylinders taken at Site during the progress of the works fail to reach the specified strength, no further pouring of concrete shall take place until the cause of the failure has been established and corrective measures have been taken to the satisfaction of the Engineer.

The Engineer may require that core samples are taken and tested in accordance with ASTM C 42 or similar standard or other tests be performed on sections of the works made from the suspect concrete. If such tests fail to demonstrate the integrity of the sections of the works, all sections made with the suspect concrete shall be removed from the Site. Costs of all such tests and removal of concrete including the cost of the concrete shall be borne by the Contractor.

#### **TESTING HARDENED CONCRETE**

Entire operation shall be carried out as per the approval of the Engineer with due precaution so that the structural integrity is no way affected. The Contractor shall remain responsible for any negligence. If approved by the Engineer, on each specific occasion, hardened concrete liable to rejection shall be tested for compressive strength in accordance with ASTM C 42 at the Contractor's expenses. Unless otherwise directed, cores shall be 150mm in diameter. At least three specimens shall be cored and tested from the locations as directed by the Engineer.

If the average compressive strength of the core specimens, so obtained, is equal to or greater than 85% of the specified 28-days cylinder, compressive strength for that section of the work (the concrete represented by the core specimen) shall be considered to be structurally satisfactory.

If the concrete is considered to be structurally satisfactory, the holes left by the removal of the test cores shall be appropriately repaired or as directed by the Engineer. Unless otherwise directed, concrete that will fail to meet the requirements of the Specifications shall be removed and replaced in an approved manner without any extra costs to the Employer.

#### **9.1.12 CONCRETE CONSTRUCTION**

##### **9.1.12.1**

##### **GENERAL**

The Contractor shall, in due time and as soon as possible, submit his proposed construction methods and work programme along with Shop Drawings to the Engineer and shall obtain his approval before commencement of any works.

The Contractor shall maintain an adequate number of trained and experienced supervisors and foremen at the Site to supervise and control the Work.

##### **9.1.12.2 MIXING CONCRETE**

##### **GENERAL**

All concrete shall be mixed in batch mixers. It may be mixed at the Site of construction, at a central plant, or in transit. Each mixer shall have attached to it, in a prominent place, a manufacturer's plate

showing the capacity of the drum in terms of mixed concrete and the speed of rotation of the mixing drum.

#### **MIXERS AT THE SITE OF CONSTRUCTION**

Mixers at local Sites shall be approved drum-type capable of combining the aggregate, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period and of discharging the mixture without segregation.

The mixer shall be equipped with a suitable charging hopper, water storage and a water-measuring device, accurate within 1%. Controls shall be so arranged that the water can be applied only while the mixer is being charged. Suitable equipment for discharging the concrete shall be provided. The mixer shall be cleaned at suitable intervals. The pickup and throw over blades in the drum shall be replaced when they have lost 10% of their depth. The mixer shall be operated at a drum speed of not less than 15 nor more than 20 revolutions per minute at the recommended speed of the manufacturer. The batched materials shall be so charged into the drum that a portion of the water shall enter in advance of the cement and aggregates and the water shall continue to flow into the drum for a minimum time of 5 seconds after all the cement and aggregates are in the drum. Mixing time shall be measured from the time all materials, except water, are in the drum and shall, in the case of mixers having a capacity of 1 cubic meter or less, not be less than 50 seconds nor more than 70 seconds. Mixing shall be continued for at least 90 seconds after all materials are in the drum, unless a shorter time is shown to be satisfactory by the mixing uniformity tests of 'Specification for Ready Mixed Concrete' (ASTM C 94). In the case of dual drum mixers, the mixing time shall not include transfer time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein. Any concrete mixed less than the specified minimum time shall be discarded and disposed of by the Contractor at his own expenses.

The volume of concrete, mixed per batch, shall not exceed the mixer's nominal capacity in cubic meters as shown on the manufacturer's guaranteed capacity standard rating plate on the mixer. However, an overload upto 20% of the mixers nominal capacity may be permitted provided concrete test data for strength, segregation and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

Re-tempering concrete by adding water or by other means shall not be permitted. Concrete, which is not of the required consistency at the time of placement, shall not be used.

#### **CENTRAL PLANT MIXERS**

These mixers shall be of approved drum type capable of combining the aggregate, cement and water into a thoroughly mixed and uniform mass within the specified mixing period and of discharging the mixture without segregation. Central plant mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed. The water system for a central mixer shall be either a calibrated measuring tank or a meter and shall not necessarily be an integral part of the mixer.

The mixer shall be cleaned at suitable intervals. It shall be examined daily for changes in interior condition. The pick-up and throw-over blades in the drum shall be replaced when they have lost 10% of their depth.

Central plant mixers, which have a capacity of 2-5 cubic meters and greater than 5 cubic meters, may permit a minimum mixing time of 90 seconds and 120 seconds respectively provided a mixing analysis and tests of the job materials indicate such produced concrete is equivalent to strength and uniformity to that attained as stated in the preceding paragraphs.

### **HAND MIXING**

The Engineer shall normally not allow any hand mixing in the preparation of concrete. However, under some special circumstances, exigencies and for small works, it may be compelling to allow hand mixing while preparing the concrete. In the case hand mixing is allowed, the procedures stated below shall be followed in a chronological order:

Water-tight platform should be constructed with cement concrete or bricks. The size of the platform shall be such that it will be possible to accommodate the requisite quantity of mixture in a single batch. The materials of a single batch should be calculated out carefully.

The requisite quantity of sand, being determined at a certain proportion, should be measured in a wooden box of specified size and to be spread on the platform with uniform thickness and the top is to be leveled. The requisite quantity of cement should also be measured and spread with uniform thickness over the stack of sand.

Sand and cement as stacked above shall have to be mixed up by reversing with spade starting from one end and progressing towards the other. This procedure to be carried on carefully, thoroughly and repeatedly in such a manner that the mixture ultimately turns into a uniform colour and density. The mixture should then be stacked in a heap on a portion of the platform.

The requisite quantity of coarse aggregate should then be stacked on the left out spaces of the platform and the top surface be leveled. The previously mixed sand and cement mixture shall then be spread with uniform thickness over the coarse aggregate. The height of these two layers in combination should better not to exceed 250mm. They are then to be thoroughly mixed with spade for several times. In each time, the mixing should proceed from one end. The mixing shall be continued until the mixture takes a uniform colour and density. The mixture will then be stacked with uniform height and leveled (the height of the stack may normally be maintained at 250mm).

The top surface of the stack will then be shaped concave and the requisite amount of water to be poured in. It is then be thoroughly mixed with spade with caution and as quickly as possible. The mixing shall be continued till the mixture takes a uniform colour and density. The mixture shall invariably be conveyed, placed, compacted and to be given the final shape within 45 minutes on mixing.

### **1.12.3 CONVEYING CONCRETE**

#### **GENERAL**

Concrete shall be conveyed from the mixer/batching plant to the place of final deposit as rapidly as possible by methods that will prevent segregation or loss of materials. Conveying equipment shall be capable of providing a supply of concrete to the place of deposit without segregation of ingredients and without interruptions sufficient to permit loss of plasticity between successive increments. Re-mixing of concrete shall not be allowed. Concrete, which does not reach its final position in the forms within the stipulated time, shall not be used.

Mixed concrete shall be transported from the central mixing plant to the work Site in agitator trucks or upon written permission by the Engineer in non-agitator trucks. Delivery of concrete shall be so regulated that placing is at a continuous rate unless delayed by the placing operations. The intervals

between delivery of batches shall not be so great as to allow the concrete in place to harden partially, and in no case such an interval shall exceed 30 minutes.

#### **AGITATOR TRUCKS**

Unless otherwise permitted in writing by the Engineer, agitator trucks may be used for transportation of central plant mixed concrete. Agitator trucks shall have watertight revolving drums suitably mounted and shall be capable of transporting and discharging the concrete without segregation. The agitating speed of the drum shall not be less than 2 or more than 6 revolutions per minute. The volume of the mixed concrete permitted in the drum shall not exceed the manufacturer's rating nor exceed 80% the gross volume of the drum.

Upon approval by the Engineer, open-top revolving-blade truck mixers may be used in lieu of agitating trucks for transportation of central plant mixed concrete.

The interval between introduction of water into the mixer drum and final discharge of the concrete from the agitator shall not exceed 45 minutes. During this interval the mix shall be agitated continuously.

#### **NON-AGITATOR TRUCKS**

Bodies of non-agitating equipment shall be smooth, watertight metal containers equipped with gates that will permit control of the discharge of the concrete. Covers shall be provided when needed for protection against weather.

The non-agitating equipment shall permit delivery of the concrete to the work Site in a thoroughly mixed and uniform mass with a satisfactory degree of discharge.

Uniformity shall be satisfactory, if samples from the one-quarter and three-quarter points of the load do not differ by more than 30mm in slump. Discharge of concrete shall be completed within 30 minutes after the introduction of the mixing water to the cement and aggregate.

#### **TRUCK OR TRANSIT MIXERS**

These shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may readily be verified and the counters shall be actuated at the commencement of mixing operations at designated mixing speeds. The mixer when loaded shall not be filled to more than 60% of the drum gross volume. The mixer shall be capable of combining the ingredients of the concrete in to a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

Except when intended for use exclusively as agitators, truck mixers shall be provided with a water-measuring device to measure accurately the quantity of water for each batch. The delivered amount of water shall be within plus or minus 1% of the indicated amount.

Truck mixers may be used for complete mixing at the batch plant and as truck agitators for delivery of concrete to job Site or they may be used for complete mixing of the concrete at the job Site. They shall either be a closed watertight revolving drum or an open top revolving blade or paddle type.

The amount of mixing shall be designated in number of revolutions of the mixer drum. When a truck mixer is used for complete mixing, each batch of concrete shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment as the "mixing speed". Such designation shall appear on a metal plate attached to the mixer. If the batch is at least 0.5 cubic meter less than guaranteed capacity, the number of revolutions at mixing speed may be reduced to not less than 50. Mixing in excess of 100 revolutions shall be at the agitating speed. All materials, including the mixing water, shall be in the mixer drum before actuating the revolution counter, which will indicate the number of revolutions

of the drum or blades. When wash water (flush water) is used as a portion of the mixing water for the succeeding batch, it shall be accurately measured and taken into account in determining the amount of additional mixing water required.

When wash water is carried on the truck mixer, it shall be carried in a compartment separate from the one used for carrying or measuring the mixing water. The Engineer will specify the amount of wash or flush water and may specify a "dry" drum, if wash water is used without measurement or without supervision.

When a truck is used for complete mixing at the batch plant, mixing operations shall begin within 30 minutes after the cement has been added to the aggregate. After mixing, the truck mixer shall be used as an agitator, when transporting concrete, at the speed designated as agitating speed by the manufacturer of the equipment. Concrete discharge shall be completed within 45 minutes after the addition of cement to the aggregates. Each batch of concrete, delivered at the job Site, shall be accompanied by a time slip issued at the batching plant, bearing the time of departure therefrom. When the truck mixer is used for the complete mixing of the concrete at the job Site, the mixing operation shall begin within 30 minutes after cement has been added to the aggregates.

The rate of discharge of the plastic concrete from the mixer drum shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully opened.

#### **9.1.12.4 HANDLING AND PLACING OF CONCRETE**

Concrete placing shall not be commenced without the written approval of the Engineer or his representative. This approval shall be in the form of a standard checklist approved by the Engineer prior to the commencement of the Work. The checklist shall be filled in and approved by the Engineer or his representative during his inspection and acceptance of materials, plant and equipment, concrete pouring arrangements, the positioning, fixing and condition of reinforcement and any other items to be embedded including the cleanliness, alignment and suitability of the containing surfaces or formwork.

The temperature of concrete at the time of placing shall not exceed 35°C.

In preparation for the placing of concrete all sawdust, chips and other construction debris and extraneous matter shall be removed from the interior of forms. 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 service unnecessary. These temporary members shall entirely be removed from the forms and not be buried in the concrete. The concrete shall be placed in the position and sequences indicated on the Drawings, and Specification or as directed by the Engineer. The concrete shall be placed in clean, oiled formwork and compacted before initial set has occurred. In any event concrete shall not be placed later than 30 minutes from the time of mixing.

Concrete shall be placed in horizontal layers and each layer shall not be more than 600mm 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 batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the batches. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer that has not taken the initial set.

The concrete shall be deposited as far as possible in its final position without re-handling or segregation and in such a manner so as to avoid displacement of the reinforcement and other embedded items or formwork.

Open troughs and chutes shall be of metal or metal line. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization of the Engineer. Where chutes are used to convey the concrete, their slopes shall not be such as to



cause segregation. Where long steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. In case an inferior quality of concrete is produced by the use of such conveyors, the Engineer may order discontinuation of their use and the installation of a satisfactory method of placing.

Pneumatic placing of concrete shall be permitted only if authorized by the Engineer. The equipment shall be so arranged that a vibration does not 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 place of deposit. The position of the discharge end of the line shall not be more than 3m from the point of deposit. The discharge lines shall be horizontal or inclined upwards from the machine. At the conclusion of placement, the entire equipment shall be thoroughly cleaned.

Placement of concrete by pumping shall be permitted only if authorized by the Engineer. The equipment shall be so arranged that vibrations do not 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 produced. 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 is no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned.

For simple spans, concrete shall preferably be deposited by beginning at the centre of the span and working from the centre towards 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, the concrete placing sequence shall be as shown on the plans or agreed by the Engineer.

Concrete in slab and girder haunches less than 1m in height shall be placed at the same time as that in the girder stem.

Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided.

Concrete in T-beam or deck girder may be placed in one continuous operation, if permitted by the Engineer.

Concrete in columns and pier shafts shall be placed in one continuous operation unless otherwise directed.

Unless otherwise permitted by the Engineer, no concrete shall be placed in the superstructure until the column forms have been stripped off sufficiently to determine the character of the concrete in the columns. The load of the superstructure shall not be applied to the supporting structures until they have been in place at least 14 days unless otherwise permitted by the Engineer.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable materials to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smoothen with a trowel. Where a "feather edge" might be produced at a construction joint, an inset form shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 150mm in the succeeding layer. Work shall not be discontinued within 450mm of the top of any face unless provision has been made for a coping less than 450mm thick, in which case, if permitted by the Engineer, a construction joint may be made at the under side of the coping.

Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon the reinforcement steel and the surfaces of forms shall be removed. Dried mortar chips and

dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete while cleaning the reinforcement steels.

Where concrete is required to be placed against undisturbed ground, the entire space between the finished concrete surface and the ground, including any over-break, is to be completely filled with concrete of the specified class. The concrete shall be well rammed and compacted to ensure that all cavities are filled and the concrete is everywhere in contact with the ground. Where permitted by the Engineer, any extensive patches of over-break may first be filled with concrete belonging to the appropriate Class as directed by the Engineer.

Where concrete is required to be placed against a metal surface to which it is required to adhere, care shall be taken to work the concrete well into the re-entrant angles and to ensure contact by hammering the metal part on its free side provided that this is done without damaging the metal or its protective coating, if any.

Concrete shall not be dropped through a height greater than 1200mm except with the approval of the Engineer who may order the use of bankers and the turning over of the deposited concrete by hand before being placed.

When placing operations would involve dropping the concrete more than 1200mm, it shall be deposited through sheet metal or other approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcement bars, which are projected.

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 clean.

The laying of concrete shall be carried out in such a way that the exposed faces of concrete shall be plain, smooth, sound and solid, free from honeycomb and excrescences. After compaction the exposed concrete surface shall be struck off smooth with hand held steel floats. No plastering of imperfect concrete faces will be allowed. Any concrete that is defective in any way shall, if so ordered by the Engineer, be cut out and replaced to such depth or be made good in such manner as the Engineer may direct.

Construction joints shall be formed in the work where indicated on the Drawings or as previously approved by the Engineer. Where necessary, the Contractor shall allow for working beyond ordinary working hours to allow each section of concrete to be completed in a continuous pour with the placing of concrete carried up to each construction joint.

#### **9.1.12.5 DEPOSITING CONCRETE UNDER WATER**

Concrete shall not be deposited in water except with the approval of the Engineer and under his immediate supervision and in this case the method of placing shall be as defined in this portion.

Concrete deposited in water shall be with 10 percent excess cement. It shall be carefully placed in a compact mass in its final position by means of Tremie, a bottom opening bucket or other approved methods and shall not be disturbed after being deposited. Special cares must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. The method of depositing concrete shall be so regulated as to produce approximately horizontal surfaces. The forms under water shall be watertight.

The discharge end of the Tremie shall be closed at the start of work so as to prevent water entering the tube and shall be entirely sealed 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, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed. Concrete slump shall be in between 100mm and 150mm.

Depositing of concrete by the opening bucket method shall conform to the following specifications. 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. When discharged, it shall be withdrawn slowly until it goes well above the concrete.

#### **9.1.12.6 COMPACTION OF CONCRETE**

Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions:

The vibration shall be internal unless special authorizations of other methods are given by the Engineer or as provided herein.

Mechanical vibrators of the capacity as approved by the Engineer shall be used in conjunction with or without hand rammers, pokers or any other means as directed by the Engineer.

Vibrators shall be of a type and design as approved by the Engineer. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute.

The intensity of vibration shall be such as to visibly affect a mass of concrete of 20mm slump over a radius of at least 450mm.

Vibrators must be operated by skilled workmen engaged/appointed by the Contractor mainly for this job.

Surface vibrators of the type of Pan-vibrators, or vibrating screens shall be used for compacting castings of shallow depth as directed by the Engineer.

The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. Spare vibrators shall be readily on hand in case of breakdown.

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.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn from the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point, to the extent that localized areas of grout are formed.

While using immersion vibrators in walls, these should be lowered to the bottom of the wall before depositing of concrete is started and pulled up as it proceeds. When using vibrators, concrete can be placed from bottom to top

of wall in one process, provided it is laid in regular layers. Cares should be taken to ensure that vibrators are not trapped under a great depth of concrete.

Application of vibrators shall be at points uniformly spaced and not further apart than twice the radius over which the vibration is visibly effective.

Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete, which 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 in the forms.

Vibration shall be supplemented by such spading as is necessary to ensure smooth surface and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

In columns, deep beams and walls mild striking by mallets at the outer faces of the form works should also be done simultaneously during use of vibrator for compaction.

The provisions of this Sub-section shall also apply to pre-cast piling, concrete cribbing and other pre-cast members except that the manufacturer's methods of vibration may be used, if approved by the Engineer.

#### **9.1.13 PROTECTION OF CONCRETE FROM ADVERSE CONDITIONS GENERAL**

Concrete shall be protected from damage from the effects of sunshine, dry wind, rain, running water or mechanical damage for a continuous period, until the concrete has reached at least three quarters of its 28-days strength, but for not less than 10-days. Temperature of the concrete mixture shall require to be maintained between 10°C and 32°C unless otherwise provided herein. The Contractor shall submit his proposals to achieve this protection for the Engineer's approval.

Damaged concrete shall be removed and replaced generally. However, it may be repaired to an acceptable condition if found appropriate by the Engineer.

#### **PROTECTION FROM RAIN**

During rainy weather, proper protection shall be given to ingredients, production methods, handling and placing of concrete. If required in the opinion of the Engineer, the concrete depositing operation shall be postponed and newly placed concrete shall be protected from rain after forming proper construction joint for future continuation.

#### **PROTECTION FROM HOT WEATHER**

During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure.

Under a temperature above 32°C surfaces of forms, reinforcing steel, steel beam flanges etc. that remain in contact with the mix shall be cooled down below this temperature by means of water spray or by any other appropriate methods.

**PROTECTION FROM COLD WEATHER**

Under a cold weather condition, temperature of the concrete shall be maintained not below 7°C during the curing period for the first six days on placement of concrete unless pozzolan cement or fly ash cement is used. Periods to be followed in the latter case have been shown in the table given below:

| % of cement replaced by weight with pozzolans | Required period of controlled temperature |
|---|---|
| 10%   | 8 days                                    |
| 11-15%  | 9 days                                    |
| 16-20%  | 10 days                                   |

However, this requirement may be waived in the case the compressive strength of 65% of the specified 28-days design strength is achieved in 6-days.

If external heating is used in maintaining the requisite temperature, heat shall be applied and withdrawn gradually and uniformly so that the concrete surface is not heated more than 32°C.

Temperature of concrete at the time of placement in sections less than 300mm in thickness shall not be less than 16°C when the air temperature is below 2°C.

**SPECIAL REQUIREMENTS FOR ROOF SLABS**

Prior to the application or curing, concrete being placed and finished for roof slabs shall be protected from damage due to rapid evaporation when the weather is low humid, windy or having high temperature. Such protection shall be adequate to prevent premature crusting of the surface or an increase in dry cracking. In providing such protection the humidity of the surrounding air shall be raised with fog sprayers operated upwind of the deck.

**CONCRETE EXPOSED TO SALT WATER**

Unless otherwise specifically provided, concrete for structures exposed to salt water shall be mixed for a period of not less than 2 minutes and water content of the mixture shall be carefully controlled and regulated so as to produce concrete of maximum impermeability. The concrete shall be thoroughly consolidated as necessary to produce maximum density and a complete lack of rock pockets. Unless otherwise shown on the Drawings, the clear distance from the face of the concrete to the reinforcing steel shall not be less than 100mm. No construction joints shall be formed between levels of extreme low water and extreme high water or the upper limit of wave action as determined by the Engineer. Between these levels the forms shall not be removed, or other means provided to prevent salt water from coming in direct contact with the concrete for a period of not less than 30 days after placement. Except for the repair of any rock pockets and the plugging of form tie holes, the original surface, as the concrete comes from the forms, shall be left undisturbed. Special handling shall be provided for pre-cast members to avoid even slight deformation cracks.

**9.1.14 PERFORATIONS AND EMBEDDING OF SPECIAL DEVICES**

The Contractor is responsible for determining in advance of making any concrete pours, all requirements for perforation of concrete sections or embedding therein of special devices of other trades, such as conduits, pipes, weep holes, drainage pipes, fastenings, etc. Any concrete, poured without prior provision having been made, shall be subject to correction at the Contractor's own expenses.

Devices to be embedded in the concrete shall be shown on the Drawings or directed by the Engineer.

Conduits, pipes and sleeves of any material not harmful to concrete and within the limitations specified herein shall be permitted to be embedded in concrete with the approval of the Engineer, provided they are not considered to replace structurally the displaced concrete.

Conduits and pipes of aluminium shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminium concrete reaction or electrolytic action between aluminium and steel.

Conduits, pipes, and sleeves passing through a slab, wall, or beam shall not impair significantly the strength of the construction. Conduits and pipes, with their fittings, embedded within a column, shall not displace more than 4% of the area of cross-section on which strength is calculated or which is required for fire protection.

Except when the Engineer approves Drawings for conduits and pipes, embedded conduits and pipes within a slab, wall or beam (other than those merely passing through) shall satisfy the following:

They shall not be larger in outside dimension than  $\frac{1}{3}$ rd the overall thickness of slab, wall, or beam in which they are embedded.

They shall not be spaced closer than 3 diameters or widths on centers.

They shall not impair significantly the strength of the construction.

Conduits, pipes and sleeves shall be permitted provided that they are not exposed to rusting or other deterioration, have nominal inside diameter not over 50mm and are spaced not less than 3 diameters on centers. Pipes and fittings shall be designed to resist effects of the material, pressure, and temperature to which they will be subjected.

No liquid, gas, or vapor excepting water, not exceeding 30°C nor 0.3 N/mm<sup>2</sup> pressure, shall be placed in the pipes until the concrete has attained its design strength.

Piping in solid slabs, unless it is for radiant heating, shall be placed between the top and bottom reinforcements.

Concrete cover for pipes, conduits, and fittings shall be not less than 40mm for concrete exposed to earth or weather nor 20mm for concrete not exposed to weather or in contact with the ground.

Reinforcement with an area not less than 0.002 times the area of concrete section shall be provided normal to piping.

Piping and conduit shall be so fabricated and installed that cutting, bending, or displacement of reinforcement will not be required.

#### **9.1.15 CURING OF CONCRETE GENERAL**

In order to prevent loss of water, all newly placed concrete shall be cured by use of one or more of the methods specified herein. The Engineer shall select the method that should be followed for curing a concrete of particular type of work or member. Curing shall commence immediately after the free water has left the surface and finishing operations are complete. In the case the concrete surface begins to dry before the selected cure method is applied, the surface of the concrete shall be kept moist by a fog spray application so as to prevent any damages to the surfaces.

Curing by other than steam or radiant heat methods shall continue uninterrupted for at least 7 days except that when pozzolans in excess of 10 percent, by weight, of the Portland cement are used in the mix. When such pozzolans are used, the curing period shall be at least 10 days. For other than top slabs of structures, the above curing periods may be reduced and curing may be terminated

when test cylinders, cured under the same conditions as the structure, indicate that concrete strength of at least 70 percent of that specified has been reached.

High early strength concrete shall be maintained above 10°C and in a moist condition for at least the first three days, except when cured in accordance with Accelerated Curing Method.

During periods of hot weather, water shall be applied to the concrete surfaces being cured by the liquid membrane method or by the forms-in-place method, if considered necessary by the Engineer. The process shall continue for a period that the Engineer determines a cooling effect is no longer required.

## **MATERIALS**

### **WATER**

Water used in curing of concrete shall be subject to approval and shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other injurious substances. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T 26. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other foreign materials.

### **LIQUID MEMBRANES**

Liquid membrane forming compounds for curing concrete shall conform to the requirements of ASTM C 309.

### **WATERPROOF SHEET MATERIALS**

Waterproof paper, polyethylene film, and white burlap polyethylene sheet shall conform to the requirements of ASTM C 171.

## **METHODS**

### **Forms-in-place method**

Formed surfaces of concrete may be cured by retaining the forms in place for the required time.

### **Water method**

Concrete surface shall be kept continuously wet by ponding, spraying or covering with materials that are kept continuously and thoroughly wet. Such materials may consist of cotton mats, multiple layers of burlap or other approved materials, which do not discolour or otherwise damage the concrete.

### **Liquid membrane curing compound method**

The liquid membrane method shall not be used on surfaces where a rubbed finish is required or on surfaces of construction joints unless it is removed by sand blasting prior to placement of concrete against the joint. Type 2 white pigmented liquid membranes may be used only on the surfaces that will not be exposed to view in the completed works or on surfaces where their use has been approved by the Engineer.

When membrane curing is used, the exposed concrete shall be thoroughly sealed immediately after the free water has left the surface. Formed surfaces shall be sealed immediately after the forms are removed and necessary finishing has been done. The solution shall be applied by power-operated atomizing spray equipment in one or two separate applications. Hand-operated sprayers may be used for coating small areas. Membrane solutions containing pigments shall be thoroughly mixed prior to use and agitated during application. If the solution is applied in two increments, the second application shall follow the first application within 30 minutes. Satisfactory equipment shall be provided, together with means to properly control and assure the direct application of the curing

solution on the concrete surface so as to result in a uniform coverage at the rate of 4.5 liters for each 14 square meter of area.

If the film is damaged by inclement weather condition or in any other manner during the curing period and before the film has dried sufficiently, a new coat of the solution shall be applied to the affected portions equal in curing value to that specified above.

#### **Waterproof cover method**

This method shall consist of covering the surface with a waterproof sheet material so as to prevent moisture loss from the concrete. This method may be used only when the covering can be secured adequately to prevent moisture loss.

The concrete shall be wet at the time the cover is installed. The sheets shall be of the widest practicable width and adjacent sheets shall overlap a minimum of 150mm and shall be tightly sealed with pressure sensitive tape, mastic, glue, or other approved methods to form a complete waterproof cover of the entire concrete surface. The paper shall be secured so that wind will not displace it. Should any portion of the sheets be broken or damaged before expiration of the curing period, the broken or damaged portions shall be immediately repaired. Sections that have lost their waterproofing qualities shall not be used.

#### **Accelerated curing**

Curing by high-pressure steam, steam at atmospheric pressure, heat and moisture or other accepted processes, shall be permitted to accelerate strength gaining and reduce time of curing.

Accelerated curing shall provide a compressive strength of the concrete at the load stage considered, at least equal to the required design strength at that load stage.

Curing process shall be such, as to produce concrete with a durability at least equivalent to that obtained for concrete cured by the above methods.

The use of accelerated curing method for concrete containing other types of cement or any admixture shall be subject to the Engineer's acceptance.

#### **Field cured specimens**

The Engineer may require strength tests of cylinders cured under field conditions to check adequacy of curing and protection of concrete in the structure.

Field cured cylinders shall be cured under field conditions in accordance with "Practice for Making and Curing Concrete Test Specimens in the Field" (ASTM C 31).

Field cured test cylinders shall be moulded at the same time and from the same samples as laboratory cured test cylinders.

Procedures for protecting and curing concrete shall be improved when the strength of field cured cylinders at the test age designated for determination of  $f'_c$  is less than 85% of that of companion laboratory cured cylinders. The 85% limitation shall not apply, if field cured strength exceeds  $f'_c$  by more than  $3.5 \text{ N/mm}^2$ .

#### **9.1.16 FINISH AND FINISHING GENERAL**

Surface irregularities shall be classified as "abrupt" or "gradual". Offsets caused by displaced or misplaced form sheathing or lining of form sections, or loose knots in forms or otherwise defective formwork, will be considered as "abrupt" irregularities. All other irregularities will be considered as gradual irregularities.

Where a surface is partly below and partly above the final ground level, the finish for the exposed surface shall extend for 0.15m below the ground level.

The formed surfaces, which will be permanently buried under earth, will require no treatment for abrupt or gradual irregularities. However, repair of defective concrete and filling of holes left by the removal of fasteners from the ends of tie rods shall be undertaken.

All abrupt and gradual irregularities on all exposed surfaces shall be removed by sack rubbing or sand blasting or grinding or by all these methods or any other methods approved by the Engineer, which is not harmful to the concrete. The permissible surface irregularities shall not exceed 6mm for abrupt irregularities and 13mm for gradual irregularities. The permissible irregularities may be reduced at places of the surface where, in the opinion of the Engineer, the formed finish does not provide the desired effect and no extra payment shall be permissible for such work.

Holes, honeycombs, or other defects left by forms shall be promptly repaired in accordance with the relevant Sub-section of this Specification.

All surfaces such as blinding concrete, opening for second stage concrete etc. on which concrete is to be placed subsequently, shall not be finished for abrupt or gradual irregularities.

Generally, concrete surface shall remain as cast and no plastering work will be performed on it. The formwork shall be lined with a material approved by the Engineer to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source throughout any one structure. The Contractor shall repair any imperfections in the resulting finish as required by the Engineer for which no extra payment shall be made to him. Internal ties and embedded metal parts will be allowed only with the Engineer's specific approval.

#### **CONCRETE SURFACE FINISHING**

Skilled workmen shall perform finishing of concrete surfaces to the satisfaction of the Engineer. Exposed flat concrete surfaces shall be screed to produce an even and uniform surface and then they shall be given a trowel finish unless otherwise specified on the Drawings. All exposed and unprotected edges shall be given 20mm x 20mm chamfers.

The Concrete surface finish on upward facing, horizontal or sloping faces shall be, except for blinding concrete or otherwise stated on the Drawings, a "fair" surface. A 'fair' surface shall be obtained by screeding and trowelling with a wood float.

Screeding shall be carried out following compaction of the concrete by the slicing and tamping action of a screed board running on the top edges of the formwork or screeding guides to give a dense concrete skin true to line and level.

Wood float trowelling shall be carried out after the concrete has stiffened and the film moisture has disappeared. Working should be kept to the minimum compatible with a good finish and the surface shall be true to the required profile to fine tolerance. Whenever necessary, the Contractor shall provide and erect overhead covers to prevent the finished surfaces from being marred by rain drops or dripping water.

The surface of blinding concrete shall be obtained by screeding as described above. Where a "fine" surface is indicated on the Drawings, this shall be obtained in a similar manner to "fair" surface except that a steel float shall be used in lieu of the wood float.

Formed surface for painting exposed to view shall be smooth and free from projections and shall be rubbed smooth immediately after the forms are removed. Formed surfaces shall be classified as follows:



Unexposed concrete surfaces upon or against which backfill or concrete is to be placed, require no treatment except the removal and repair of defective concrete.

Exposed surfaces shall have a very smooth, sound surface by control of formwork, concrete placement and repair of abrupt surface irregularities by grinding or rubbing of high spots and filling of voids.

#### **ORDINARY FINISH**

An ordinary finish is defined as the finish left on a surface after the removal of the forms when all holes left by form ties have been filled and all irregular projections and any other minor surface defects have been mended. The surface shall be true and even, free from depression fins or projections.

The concrete shall be struck off with a straight edge and floated to true grade. Under no circumstance, the use of mortar topping for concrete surfaces shall be permitted.

#### **GROUT CLEANING**

Grout cleaning may be called for on the Drawings or required by the Engineer because of unsatisfactory appearance. The operation requires that the surface is wetted and uniformly covered with a grout consisting of 1 part cement to 1.5 parts fine sand. White cement shall be used for all or part of the cement in the grout to give the colour required to match the concrete. The grout shall be uniformly applied with brushes or a spray gun and all air bubbles and holes shall be completely filled. Immediately after the application of the grout, the surface shall be vigorously scoured with a cork or other suitable float.

While the grout is still plastic, the surface shall be finished with a sponge rubber or other suitable float removing all excess grout. This finishing shall be done at the time when grout will not be pulled from the holes or depressions. After being allowed to be thoroughly dry, the surface shall be vigorously rubbed with a dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining on the surface after this rubbing and the entire cleaning operation of any area must be completed on the day it is started. If any dark spot or steak remains after this operation, they shall be removed with a fine-grained silicon carbide stone, but the rubbing shall not be as much to change the texture of the surface. Unless it is required by the Drawings or directed by the Engineer, grout cleaning should be delayed until the final cleanup of the Work.

#### **RUBBED FINISH**

On removal of forms, the rubbing of concrete shall be started as soon as its condition permits. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of 3 hours. Sufficient time shall elapse before wetting down to allow the mortar used in patching to have thoroughly set. A medium coarse carborundum stone shall be used for rubbing a small amount of mortar on the face. The mortar used shall be composed of cement and fine aggregate mixed in the same proportions as that used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time. The final finish shall be obtained by rubbing with a fine carborundum stone and water until the entire surface is of a smooth texture and uniform colour.

After the final rubbing has been completed and the surface has dried up, burlap shall be used to remove loose powder. The final surface shall be free from unsound patches, paste, powder and objectionable marks.



Any surface that has been given a rubbed finish shall be protected from subsequent construction operations. Any surface not protected, shall be cleaned and again rubbed, if necessary to secure a uniform and satisfactory surface at the own expenses of the Contractor.

On completion of initial rubbing, curing shall be continued.

#### **TOOLED FINISH**

Tooled finishing shall be carried out by treating the surface with an approved heavy duty power hammer fitted with a multi-point tool, which shall be operated over the surface to remove 5mm to 6mm of concrete and expose maximum areas of coarse aggregate.

Aggregate left embedded shall not be fractured or loose. 25mm wide bands at all corners and arises shall be left as cast. The finished surfaces shall have even and of uniform appearance and shall be washed with water upon completion.

#### **SANDBLASTED FINISH**

Sandblasted finishing will be carried out on a thoroughly cured concrete surface with hard, sharp sand to produce an even fine-grained surface in which the mortar has been cut away, leaving the aggregate exposed.

#### **WIRE BRUSHED OR SCRUBBED FINISH**

Wire brushed or scrubbed finish will be performed as soon as the forms are removed and while the concrete is yet comparatively green. The surface shall be thoroughly and evenly scrubbed with stiff wire or fiber brushes, using a solution of muriatic acid. The proportion of the solution shall constitute of one part acid to four parts water. This shall be continued until the cement film or surface is completely removed and the aggregate particles are exposed, leaving an even-pebbled texture presenting an appearance grading from that of fine granite to coarse conglomerate, depending upon the size and grading of aggregate used. When the scrubbing has progressed sufficiently to produce the texture desired, the entire surface shall be thoroughly washed with water to which a small amount of Ammonia has been added in order to remove all traces of acid.

#### **INSPECTION AND MAKING GOOD**

Concrete surface shall be inspected for defects and for conformity with the Specifications and where appropriate, for comparison with approved sample finishes. Subject to the strength and durability of the concrete being unimpaired, the making good of surface defects may be permitted but the standard of acceptance shall be appropriate to the type and quality of the finish specified to ensure satisfactory performance and durability. On permanently exposed surfaces, great care is essential in selecting the materials and the mix proportions to ensure that the final colour of the faced area blends with the parent concrete in the finished structure.

Voids can be filled with fine mortar, preferably incorporating Styrene Butadiene Rubber (SBR) or Polyvinyl Acetate (PVA), while the concrete is still green or when it has hardened. Fine cracks can be filled by wiping a cement grout, a SBR, PVA or latex emulsion, a cement/SBR or a cement/PVA slurry across them. Fins and other projections shall be rubbed down.

#### **PROTECTION**

High quality surface finishes are susceptible to damage during subsequent construction operations and temporary protection may have to be provided in vulnerable areas. The protective measures, among others, include the strapping of laths to arrises and the prevention of rust being carried from exposed starter bars to finished surfaces.

**9.1.17 SECOND STAGE CONCRETE**

Unless shown on the Drawings or otherwise instructed by the Engineer, second stage concrete shall be of class for major RCC structures.

Block-outs for second stage concrete and the specifications and locations of the embedded parts shall be in accordance with the Drawings.

The surface against which the second stage concrete are to be placed shall be thoroughly cleaned to make the surface free from all loose particles, organic substances, oil, grease, rust, plastic materials, wood and defective concrete.

The projected parts of the embedded items or the parts that will remain embedded shall be thoroughly cleaned of oil, grease and rust. All such parts shall be true to dimensions, plumb and levels as shown on the Drawings and directed by the Engineer.

**9.1.18 FACTORY MADE PRE-CAST CONCRETE ELEMENTS**

The Engineer shall approve in writing any supplies of pre-cast concrete elements. The Engineer, if he so desires, may withdraw the approval later on.

All concrete works of such elements shall fully conform all requirements of this Specification.

The supplier shall maintain standard laboratory facilities.

Concrete members, specified to be fabricated as pre-cast concrete units, shall be fabricated with concrete of the specified class placed into a grout tight mould. If so required, the mould shall be laid on a vibrating table and vibration should be applied while concrete is placed.

Members, structurally dependent on a rigid fixing with the adjoining structures, should not in general be permitted to be pre-cast.

Unless otherwise approved by the Engineer, pre-cast concrete members shall neither be moved from the casting position until the concrete has attained a compressive strength of 80% of the specified 28-days strength, nor transported until it has gained a strength of 90% of the specified 28-days strength.

Extreme cares shall be taken in handling and moving pre-cast concrete members. Pre-cast girders and slabs shall be transported in an upright position. Shock shall be avoided and the points of support and directions of the reactions with respect to the member shall be approximately the same during transportation and storage as and when the member would be in its final position. If the Contractor finds it expedient to transport or store pre-cast units in other than this position, it shall be done at his own risks after notifying the Engineer of his intention to do so. Any units rejected shall be replaced at the Contractor's own expenses by an acceptable unit.

All details on the handling and transportation of pre-cast members shall be submitted in writing to the Engineer for his approval.

Each pre-cast member is to be uniquely and permanently marked so as to show its type, date of casting and reinforcement.

**HANDLING AND STACKING OF PRE-CAST UNITS**

The Contractor shall give the Engineer full details of his proposed methods of handling, transportation and stacking of pre-cast concrete units. The Engineer will examine these in details and will either approve the methods or order modifications to ensure that the units are not subject to excessive stresses.

The finally approved methods are to be adhered to at all times and the Contractor shall be deemed to have included in his rates for all measures required to handle, transport and stack the units safely and without undue stressing. However, such approval by the Engineer shall neither relieve the Contractor from his full responsibilities and liabilities of safe transportation and installation of any

pre-cast units at the designated location as shown on the Drawings or as directed by the Engineer without any damage nor to make any deviation from the Specifications in fabricating the unit.

#### **9.1.19 CONTROL OF HEAT IN STRUCTURES**

The Contractor shall establish measures to control the heat deriving from the hydration of the concrete in structures of major dimensions. Temperature gradients introducing risks of cracking shall not occur and the temperature shall not exceed 70°C.

The Contractor shall also establish measures to avoid harmful excessive heat generation in massive structures, such as cooling down aggregates before mixing.

The Contractor shall submit in due time a proposal for the establishment of the aforementioned measures to the Engineer for his approval. The measures shall immediately be changed, if requested by the Engineer even later.

#### **9.1.20 BACK-FILL TO STRUCTURES**

All spaces, which have been excavated but are not occupied by the concrete structure shall be back-filled and compacted with materials acceptable to the Engineer or as shown on the Drawings and/or as per the directions of the Engineer.

#### **9.1.21 CLEANING UP**

Upon completion of structure and before final acceptance, the Contractor shall remove all forms and scaffoldings, etc. down to 0.5m below the finished ground line. Excavated or garbage materials, rubbish etc. shall be removed from the Site, which shall be left in a neat condition satisfactory to the Engineer.

#### **9.1.22 MEASUREMENT**

The concrete of the several different grades and types completed in place in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer and accepted by the Engineer shall be measured by either the cubic meter for each class of concrete included in the BOQ or by the unit for each type of pre-cast concrete member listed in the BOQ. In computing quantities, the dimensions used shall be those shown on the Drawings or ordered by the Engineer; but the measurement shall not include any concrete used for the construction of temporary works or which is included in other billed items. No deduction from the measured quantity shall be made for drainage openings and pipes of less than 300mm in diameter, conduits, chamfers, reinforcement bars and expansion joint filler materials. However, deduction will be made for the volume of concrete displaced by piles embedded in the concrete.

The quantities of reinforcing steel and other related items as shown in the Contract Documents, which are included in the completed and accepted structure shall be separately measured for payment as per the provisions made under the Section on 'Reinforcing Steel' of this Specification.

Formwork and false work shall not be measured separately but shall be deemed to be an integral part of the concrete items.

Surface finishes shall not be measured separately but shall be deemed to be an integral part of the concrete items.

Joints including fillers and expansion joints shall not be measured separately unless they are specified as separate items in the BOQ.

The number of pre-cast concrete members of each type listed in the BOQ will be the number of acceptable members of each type furnished and installed in the work.

### **9.1.23 PAYMENT**

The cubic meters of concrete and the number of pre-cast concrete members, measured as provided above will be paid for at the Contract unit prices per cubic meter or the Contract unit prices per each member for each type or class as would be applicable as per the BOQ.

Payment for concrete of the various classes and for pre-cast concrete members of the various types shall be considered to be the full compensation for the costs for furnishing all materials including their transportation and storage, providing all equipment, labourers and incidentals and for doing all works involved in constructing the concrete work complete in place as shown on the Drawings and as specified. Such payment shall also include the full compensation for placing of rod in position, mixing the concrete mixture, concrete pouring, compacting by vibrator machine and curing, furnishing and placing expansion joint fillers, sealed joints, water-stops, drains, vents, miscellaneous metal devices and the drilling of holes for dowels and the grouting of dowels in drilled holes, unless payment for such works would be specified under another item of the BOQ.

Payment for all types of concrete work shall be considered to be the full compensation for the costs of furnishing and installing and removal of all temporary works like staging, formwork, working platforms, cranes, transporting, placing, compaction, finishing, curing and rendering of the concrete as specified till the concrete work becomes self-supporting and can perform its intended functions.

The Contractor's rates shall be fully inclusive of all costs of all laboratory tests to be carried out as specified under different sub-items unless any payment is separately specified under the BOQ.

The payment shall be the full compensation of all incidentals necessary to complete the Work.

Payment for pre-cast units shall include all concrete, formwork, transport and erection and where applicable any bolts or other devices and bedding necessary to fix them in their permanent positions, all incidentals and all other works that will be necessary for full completion from transportation to safe erection of the members at the designated locations as shown on the Drawings or as directed by the Engineer.

| <b>Item of Payment</b>  | <b>Unit</b>  |
|---|--|
| Concrete Class as detailed and as specified in the BOQ.                             | Cubic meter / Cubic feet                           |
| Pre-cast concrete elements as detailed on the drawings and as specified in the BOQ. | Number / Linear meter<br>/Cubic meter / Cubic feet |

## **9.2 FALSE WORK AND FORMS**

### **9.2.1 SCAFFOLDING (FALSE WORK)**

Scaffolding is defined to be any temporary structure required to support structural elements of concrete, steel, masonry, or other materials at the time of their construction or erection.

Plans, Drawings and structural calculations in details shall be submitted to the Engineer for approval, but in no case shall the Contractor be relieved of his responsibilities for results obtained by using this Document.

All scaffolding shall be designed and constructed to provide the necessary rigidity and strength to safely support all loads imposed and produced in the finished structure, the lines and grades indicated on the Drawings. The supports shall be designed to withstand the worst combination of self-weight, formwork weight, formwork forces, reinforcement weight, wet concrete weight, construction and wind loads, together with all incidental dynamic effects caused by placing, vibrating

and compacting the concrete. No harmful cracking should occur in the placed concrete. The Engineer may require the Contractor to employ screw jacks or hardwood wedges to take up any settlement in the formwork either before or during the placing of concrete.

All scaffolding, exceeding 20m or six storeys in height, shall be constructed of noncombustible or fire-retardant materials.

Scaffolding shall be founded on a solid base, which is safe against undermining, protected from softening and capable of supporting the loads imposed on it. Scaffolding which cannot be founded on a satisfactory footing shall be supported on piling, which shall be spaced, driven and removed in a manner approved by the Engineer.

Horizontal and inclined bracings shall be provided for posts higher than 3m. Spans of beam bottoms shall be supported by posts with maximum 1m apart when steel is used and instructions from the manufacturer/supplier shall be strictly followed. Spacing of the props under beams shall consider the increased load and shall be posted closer than those under the floor slab.

Scaffolding can, in certain cases, be supported on structures already constructed. In that case, the Contractor shall submit in due time to the Engineer in writing all information on the loading from the scaffolding as requested. The Engineer shall consider the loading and submit his approval in writing.

Scaffolding shall be set to give the finished structure the camber shown on the Drawings or specified by the Engineer. If any weakness develops or the scaffolding shows undue settlement or distortion during construction, the work shall be stopped and any structure affected thereby shall be removed and the scaffolding shall be further strengthened before work is resumed. Suitable screw jacks, pairs of wages or other devices shall be used at each post to adjust scaffolding to grade.

All materials used in the construction of the scaffolding shall conform to the corresponding ASTM or BS Standards or any other equivalent International Standards. Material tests and certificates may be required by the Engineer. Examinations of welding may also be requested. Test loading of the scaffoldings may be requested for the determination of the flexibility and the strength. All expenses of the tests and examinations of scaffoldings shall be borne by the Contractor on non-reimbursable basis.

Scaffolds shall be made from strong bamboo poles, wooden posts, steel pipes or any other suitable materials. They shall be adequately tied to vertical members resting on firm floor. Strong ropes shall be used to tie up bamboo poles. In addition, cross-bracing with bamboo or wooden posts shall be provided along with ties or guys of steel wire or rod not less than 6mm in diameter.

Good, sound and uniform bamboo shall be collected in sufficient quantities for providing scaffolding, propping, temporary staging, ramp etc. The bamboos shall be free from any defects, firmly tied to each other and joints made smooth. Joining members only with nails shall be prohibited. Bamboos for vertical support shall not be less than 75mm in diameter and shall be straight as far as possible. Bamboos may be used as vertical support for up to a height of 4m, if horizontal bracings are provided at the centre. Splicing shall be prohibited.

After stripping the formwork, the bamboo posts shall be cleaned and stacked vertically in shade protected from rain and sun. Defective or damaged bamboo posts shall be removed from the Site.

Timber posts shall be used in supporting formwork up to a height of 6m. The posts shall not be less than 80mm in diameter at any place and shall spread to at least 150mm in diameter at the top. The timber posts shall be supported on timber planks at the bottom. Either the bottom or the top of the posts shall be wedged with a piece of triangular wood peg for easy removal. Adequate horizontal and inclined braces shall be used for all timber centering. All timber posts shall be carefully inspected before use and members with cracks and excessive knots and crookedness shall be discarded. The joints shall normally be made with bolts and nuts. No rusted or spoilt threaded bolts and nuts shall be used.

When steel scaffoldings are used, it shall be painted in a manner that no mark of corrosion shall appear on the permanent concrete structures.

The Engineer shall only select the type of scaffolding. Bamboo scaffolding will only be used, if agreed and allowed by the Engineer. All scaffoldings shall remain in place for a period, which shall be determined by the Engineer.

Scaffold shall be dismantled after use piece by piece. Holes in the wall shall be filled up with the same materials as that of the wall. Filled up holes shall have uniformity in texture and colour with the surrounding surface. Crash striking shall not be allowed.

Triangular wooden wedges shall be put under the posts for easy dismantling of the members. Timber planks or steel sheets shall be placed at a time below the vertical or inclined posts covering several posts.

Materials and joints in scaffolding shall be inspected from time to time both before and after erection for the soundness, strength, damage due to weathering etc. Inspections shall be made for spillage of material or liquids, loose material lying on the gangways and proper access to the platform.

The scaffold shall be secured to the building at enough places; no ties shall be removed. Warning sign, prohibiting the use of any defective or incomplete scaffold and working in bad weather and high wind, shall be posted in a prominent place. Inspections shall be made for the observance of these requirements.

|   |           |
|---|-----------|
| <b>10.0 FORMWORK .....</b>  | <b>87</b> |
| <b>10.1 MATERIALS .....</b>                                       | <b>87</b> |
| <b>10.2 CONSTRUCTION METHOD .....</b>                             | <b>87</b> |
| <b>10.3 FORMWORK FOR EXPOSED CONCRETE SURFACES .....</b>          | <b>88</b> |
| <b>10.4 FORMWORK FOR NON-EXPOSED CONCRETE SURFACES .....</b>      | <b>89</b> |
| <b>10.5 FORMED SURFACES AND FINISH .....</b>                      | <b>89</b> |
| <b>10.6 SIZES OF TIMBER AND OTHER SECTIONS FOR FORMWORK .....</b> | <b>89</b> |
| <b>10.7 QUALITY OF SHUTTERING .....</b>                           | <b>90</b> |
| <b>10.8 TOLERANCES .....</b>                                      | <b>90</b> |
| <b>10.9 FIXING OF FORMWORK .....</b>                              | <b>90</b> |
| <b>10.10 REMOVAL OF FORMS .....</b>                               | <b>91</b> |
| <b>10.11 OPENINGS .....</b>                                       | <b>92</b> |
| <b>10.12 DEFECTS IN FORMED SURFACES .....</b>                     | <b>92</b> |
| <b>10.13 HOLES TO BE FILLED .....</b>                             | <b>93</b> |
| <b>10.14 APPROVAL OF SCAFFOLDINGS AND FORM .....</b>              | <b>93</b> |
| <b>10.15 MEASUREMENT .....</b>                                    | <b>94</b> |
| <b>10.16 PAYMENT .....</b>  | <b>94</b> |
| <b>10.17 WATER PROOFING POLYTHENE SHEET .....</b>                 | <b>94</b> |
| <b>10.17.1 DESCRIPTION .....</b>                                  | <b>94</b> |
| <b>10.17.2 CONSTRUCTION REQUIREMENT .....</b>                     | <b>94</b> |
| <b>10.17.3 MEASUREMENT .....</b>                                  | <b>94</b> |
| <b>10.17.4 PAYMENT .....</b>                                      | <b>94</b> |

## **10.0 FORMWORK**

### **Definition**

Formwork is defined to be an enclosure or panel, which contain the fluid concrete and withstand the forces due to its placement and consolidation. Forms in turn be supported on scaffolding.

### **General**

The work to be performed under this Sub-section includes the furnishing and installing and removing of forms for all cast-in-places concrete work as shown and noted on the Drawings and as specified herein or as directed by the Engineer.

Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Forms shall be of sufficient rigidity to prevent objectionable distortion of the formed concrete surface due to pressure of the concrete and other loads incidental to construction operations. They shall be properly braced or tied together to maintain position and shape. Forms and their supports shall be so designed as not to damage previously placed structure.

Relevant provisions of the American Concrete Institute (ACI) issue of ACI 347 on 'Recommended Practice for Concrete Formwork' or some other generally accepted Standards shall apply for the structural designing of the formwork, except as they may be modified herein.

## **10.1 MATERIALS**

Formwork shall be constructed from sound materials of sufficient strength, properly braced, struted and shored as to ensure rigidity throughout the placing and compaction of the concrete without visible deflection. The materials used to be of wood, steel or other approved materials and shall be mortar-tight. Formwork shall be so constructed that it can be removed without shock or vibration to the concrete.

Formwork for concrete, permanently exposed to public inspection, shall be faced with plain 28/26-gauge steel sheet fitted over 38mm thick wooden plank panels suitably braced or steel framing faced with minimum 12/14 BWG mild steel sheet. Formwork for cement concrete blocks shall be fabricated from M.S. sheet of sufficient thickness to prevent any distortion.

Where metal forms are used, all bolts and rivets shall be countersunk and well-grounded to provide a smooth plane surface.

Where timber is used, it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mark the surface of concrete.

Form ties shall be prefabricated rod, flat band, or wire type, or threaded internal disconnected type, of sufficient tensile capacity to resist all imposed load of freshly placed concrete and having external holding devices of adequate bearing area. Ties shall permit tightening and spreading of forms and shall leave no metal closer than 25mm from surface. Ties shall fit tight to prevent mortar leakage at holes in forms. Removable ties shall be coated with non-staining bond breaker. All ties shall be protected from rusting at all times. No wire ties or wood spreaders shall be permitted. Cutting ties back from concrete face will not be permitted. Ties for exposed Architectural Concrete shall be plastic cone snap ties.

## **10.2 CONSTRUCTION METHOD**

The Contractor shall submit for the approval of the Engineer details of the methods and materials proposed for formwork to each section of the Work. Details of all proposed wrought formwork and formwork to produce special finishes are to be submitted for approval in writing to the Engineer before any material is hauled at Site. If the Engineer so requires, samples of formwork shall be constructed and concrete be placed so that the proposed methods and finish effect can be demonstrated.



All joints shall be close fitting to prevent leakage of grout. At construction joints the formwork shall be tightly secured against previously cast or hardened concrete in order to prevent stepping or ridges to exposed surfaces.

Where the Contractor proposes to make the formwork from standard sized manufactured formwork panels, the dimensions of such panels shall be approved by the Engineer before they are used for construction of the Work. The finished appearance of the entire elevation of the structure and the adjoining structures shall be considered when planning the patterns of joint lines caused by the formwork and by construction joints to ensure continuity of horizontal and vertical lines.

Formwork shall be constructed to provide the correct shape, lines and dimensions of the concrete shown on the Drawings. Due allowance shall be made for any deflection, which will occur during the placing of concrete within the formwork. Panels shall have true edges to permit accurate alignment and provide a neat line with adjacent panels and at all construction joints. All panels shall be fixed with their joints either vertical or horizontal, unless otherwise specified or approved.

Formwork shall be provided for the top surfaces of sloping work where the slope exceeds 15° with the horizontal and shall be anchored to enable the concrete to be properly compacted and prevent floating. Care shall be taken to prevent air being entrapped. Openings for inspection of the inside of the formwork and for the removal of water used for washing shall be provided and so formed as to be easily closed before placing concrete.

### **10.3 FORMWORK FOR EXPOSED CONCRETE SURFACES**

All exposed concrete surfaces are to be 'form finish' and shall be cast in any approved formwork and shall be free from honeycomb, fins, projections and air holes. All external angles to form finish concrete surfaces shall be chamfered as directed.

Forms for concrete surfaces exposed to view shall produce a smooth surface of uniform texture and color substantially equal to that which would be obtained with the use of plywood conforming to the National Institute of Standards and Technology Product Standard PSI for Exterior B-B Class I Plywood. Panels lining such forms shall be arranged so that the joint lines form a symmetrical pattern conforming to the general lines of the structure. The same type of form lining material shall be used throughout each element of a structure. Such forms shall be sufficiently rigid so that the undulation of the concrete surface shall not exceed 3mm when checked with a 1.5m long straight edge or template.

The Contractor shall submit shuttering Drawings and details of pattern and the method of forming joints in the exposed (form finish) concrete to the Engineer for his approval. All changes and modification made by the later shall be appropriately incorporated by the former and final approval whereof be obtained from the Engineer.

Unless otherwise stated on the Drawings, wrought formwork shall be used for all permanently visible concrete surfaces. Wrought formwork shall be such as to produce a smooth and even surface free from perceptible irregularities. Tongues and grooved paneled boards, plywood or steel forms shall have their joints flushed with the surface. The formwork shall be formed with approved standard size panels. The panels shall be arranged in a uniform approved pattern, free from defects likely to be detected in the resulting concrete surface.

In all types of formwork to form finished exposed concrete, only non-staining mold oil shall be used as approved by the Engineer.

The respective usage of the same formwork to cast form-finished exposed concrete shall be as decided by the Engineer and in no case the formwork, not guaranteed to produce the required form-finish to the satisfaction of the Engineer, shall be used.

The exposed concrete shall have a uniform finish. The finish of the concrete when shuttering and formwork are removed will generally be without any blemish and will be such as will not require touch up. Slight touch up for a small spot or two, if necessary shall be carried out skillfully so as to be synonymous with the entire surfaces.

The finished surfaces shall be within the specified tolerances and full cover to the reinforcement steel shall be maintained.

#### **10.4 FORMWORK FOR NON-EXPOSED CONCRETE SURFACES**

Unless otherwise stated on the Drawings, rough formwork may be used for all surfaces, which are not permanently exposed. Rough formwork may be constructed of plain butt-joined sawn timber. But the Contractor shall ensure that all joints between boards shall be grout-tight.

The finished surfaces shall be within the specified tolerances and full cover to the reinforcement steel shall be maintained.

#### **10.5 FORMED SURFACES AND FINISH**

The formwork shall be lined with a material approved by the Engineer so as to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and so joined and fixed to its backing as not to impart any blemish. It shall be of the same type and obtained from only one source throughout the construction of any individual structure. The Contractor shall make good any imperfection in the finish as required by the Engineer. Internal ties and embedded metal parts will be allowed only with the specific approval of the Engineer.

#### **10.6 SIZES OF TIMBER AND OTHER SECTIONS FOR FORMWORK**

Scaffolds, formwork and components thereof shall be capable of supporting without failure, at least two times the maximum intended load. The following types of loading shall be considered in designing the formwork:

Weight of wet concrete: 20 KN/m<sup>3</sup>.

Live load due to workmen and impact of ramming or vibrating: 15-40 kPa (light duty for carpenter and stone setters, medium duty for brick layers and plasterers, heavy duty for stone masons).

Allowable bending stress (flexural tensile stress) in soft timbers: 8,000 kPa.

The sizes for formwork elements specified in the Table given below are applicable for spans of up to 5m and height of up to 4m. In case of longer span and height, formwork and support sizes shall be determined by calculating the load and approved by the Engineer before use.

#### **Sizes of timber and other sections for formwork**

| <b>Types of Formwork</b>                               | <b>Members Size in mm</b> |
|--|---------------------------|
| Flat sheeting for slab bottoms, columns and beam sides | 25 to 50                  |
| Beam bottoms   | 75x100 to 150x150         |
| Vertical posts   | 75x100 to 150x150         |
| Bamboo posts   | Minimum 75 dia            |

|   |   |
|---|---|
| Timber posts  | Not less than 100 dia at mid-length and 80dia at thin end |
| Joist and ledgers supporting sheeting of slab                       | 50x100 to 75x200  |
| Studs for supporting vertical wall sheeting                         | 50x100 to 150x150   |
| Columns yokes-horizontal cross, pieces supporting vertical sheeting | 50x100 to 100x100   |

### **10.7 QUALITY OF SHUTTERING**

#### **GENERAL**

The shuttering shall have smooth and even surface and its joints shall not permit leakage of cement grout.

Ply-board shuttering material shall be well seasoned free from projecting nails, splits or other defects that may mark the surface of concrete. It shall not be so dry as to absorb water from concrete and swell and bulge, nor so green or wet as to shrink after erection.

The timber shall be accurately sawn and plain on the sides and the surface coming in contact with concrete.

Wooden formwork with metal sheet lining or steel plates stiffened by steel angles shall also be permitted. Where metal forms are used, all bolts and nuts shall be countersunk and well-grounded to provide a smooth plain surface.

The chamfers, leveled edges and moldings shall be made in the formwork itself. Opening for fixture and other fittings connected with the services shall be provided in the shuttering as directed by the Engineer.

Clamps shall be used, to its practicality, to hold the forms together. Where use of nails is unavoidable, it shall be kept to minimum number and these shall be left projected so that they can easily be withdrawn. Use of double-headed nails shall be preferred.

### **10.8 TOLERANCES**

The formwork shall be made so as to produce a finished concrete true to shape, lines, levels, plumb and dimensions as shown on the Drawings subject to the following tolerances unless otherwise specified in this document or Drawings or as directed by the Engineer.

- i. Sectional dimension       $\pm 5\text{mm}$
- ii. Plumb                       $\pm 1$  in 1000 of height
- iii. Levels                      $\pm 3\text{mm}$  before any deflection has been taken place

Tolerances given above are specified for local aberrations in the finished concrete surface and should not be taken as tolerance for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Errors, if noticed in any lift/tilt of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

### **10.9 FIXING OF FORMWORK**

#### **GENERAL**

The formwork shall be arranged in a manner as to readily be dismantled and removed from the cast concrete without shock, disturbance or damage. Where necessary, the formwork shall be so arranged

that the soffit form, properly supported on props only, can be retained in position for such period as may be required by maturing conditions or Specification.

The surfaces of formwork shall be free from foreign matters, projecting nails and the like, splits or other defects, and all formwork shall be cleaned and made free from standing water, dirt, shavings, chippings or other foreign matter before concrete is placed.

Before placing concrete, all built-in reinforcement bars, anchoring, steel beams, cables, fixing truss, bolts, pipes or conduits or any other fixtures shall be fixed in their correct positions. The cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut in any concrete without the approval of the Engineer.

All exterior and interior angles on the finished concrete of 900 or less shall be given 12mm – 20mm chamfers unless otherwise shown on the Drawings or directed by the Engineer. When chamfers are to be formed, the fillets shall be accurately cut to size to provide a smooth and continuous chamfer.

No ties or bolts or other devices shall be built into the concrete for the purpose of supporting formwork without the prior approval of the Engineer. The whole or part of any such support embedded in the Reinforced Concrete shall be capable of removal so that no part, remaining embedded in the concrete, shall be nearer than 75mm from the surface. Holes left after removal of such supports shall be neatly filled with well-reamed dry-pack mortar following the procedures described in the relevant Sub-section of this Specification.

All rubbish shall be removed from the interior of the forms before the concrete is placed. After cleaning and prior to placement of reinforcing steel, the formwork in contact with the concrete shall be treated with a suitable non-staining mold oil or suitable approved release agent to prevent sticking of the concrete. Such works shall not discolor or otherwise injure the surface of the concrete. Care shall be taken to prevent the oil from coming in contact with the reinforcement or mixing with the concrete. At construction joints, surface-retarding agents shall be used only where ordered by the Engineer.

All formwork shall be inspected and approved by the Engineer before concrete is placed in it. However, this shall not relieve the Contractor from the requirements as to soundness, finish and tolerances of the concrete specified in this Specification or elsewhere acknowledged as Standard. If, at any period of the work during or after placing the concrete, the forms show signs of sagging or bulging, the concrete shall be removed to the extent directed by the Engineer, the forms brought to the proper position and new concrete placed. No allowance shall be made to the Contractor for such extra works.

#### **10.10 REMOVAL OF FORMS**

Forms shall not be removed without the approval of the Engineer. In the determination of the time for the removal of forms, consideration shall be given to the location and character of the structure, the weather, the materials used in the mix and other conditions influencing the early strength of the concrete. Extreme cares shall be taken to ensure that the method of removal shall not cause overstressing of the concrete or damage to its surface.

Forms shall be removed in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

Forms shall not be removed in the cases of footing forms where the removal would endanger the safety of the cofferdams, forms from enclosed cells where access is not provided, deck forms in the cells that do not interfere with the future installation of utilities shown on the Drawings, or other works.

Except for concrete being post-tensioned, no concrete shall be subjected to loading which will induce a compressive stress in it exceeding one-third of its compressive strength at the time of loading, or

one- third of the specified characteristic strength whichever is less. It may be possible to use shorter periods before striking forms by determining the strength of the concrete in the structural element.

Forms supporting cast-in-situ concrete in flexure may be struck when the strength of the concrete in the element is  $10 \text{ N/mm}^2$  or twice the stress to which it will be subjected, whichever is greater provided that striking at this time will not result in an unacceptable deflection. This strength may be assessed by test on cylinder/cube cured under the same conditions as the concrete in the element as far as possible.

Forms on upper sloping faces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any repair or treatment required on such sloping surfaces shall be performed at once.

If the floor is to be used to support construction loads, props should be retained for 28 days unless the Contractor can prove the requisite concrete strength by tests.

The form shall be removed slowly, as the sudden removal of wedges is equivalent to a shock load on the partly hardened concrete.

Materials and plants shall not be stacked on any newly constructed floor unless sufficient support is maintained to withstand such loads without damaging the floor.

The following table is a guide to the minimum periods that must elapse between the completion of the concreting operations and the removal of formwork. No formwork shall be removed without the permission of the Engineer and such permission shall not relieve the Contractor of his responsibilities regarding the safety of the structure.

| Type and position of Formwork               | Approximate period (days) |
|---|---------------------------|
| Side of beams, walls and columns (unloaded) | 5                         |
| Slab soffits (props supporting)             | 14                        |
| Removal of props to slabs                   | 21                        |
| Beam soffits (props supporting)             | 21                        |
| Removal of props to beams                   | 28                        |

Notwithstanding the foregoing, the Contractor shall be held responsible for any damages arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

#### **10.11 OPENINGS**

Temporary and permanent openings in concrete shall be framed neatly with provisions for keys or reinforcing steel as shown on the Drawings or as directed by the Engineer.

#### **10.12 DEFECTS IN FORMED SURFACES**

Workmanship in formwork along with concrete placing shall be such that concrete shall normally require no repair to surfaces being perfectly compacted and smooth. If any blemish is revealed after removal of formwork, the Contractor shall obtain immediately the Engineer's decision concerning remedial measures to be undertaken. Notwithstanding the specifications and provisions stated under the Sub-section on 'Finish and Finishing' of this Specification, such measures may include but shall not be limited to the following:

Fins, pinholes, bubbles, surface discoloring and mirror defects may be rubbed down with sacks immediately on removal of the form.

Abrupt and gradual irregularities may be rubbed down with carborundum stone and water after concrete has been fully cured.

Deep honeycombed concrete shall be repaired within 24 hours of striking the formwork by cutting back to sound concrete. The concrete shall be cut back at least 50mm behind face reinforcement. Cut edges shall be regular and not feathered. Recasting shall be with the same concrete as the original casting. The Engineer shall approve the formwork and its method of placing in this case also.

Under some circumstances, abrupt and gradual irregularities of shallow honeycombed concrete may be repaired by cutting back and reforming with an approved epoxy resin or mortar in accordance with the manufacturer's instructions.

Regardless of the above repairing measures, any structure containing excessive honeycomb, as would be termed by the Engineer, shall be subject to rejection by the Engineer. The Contractor, on receipt of written orders from the Engineer, shall remove and rebuild such portions of the structure at his own expenses.

#### **10.13 HOLES TO BE FILLED**

Holes on the concrete surfaces formed by formwork supports or the like shall be filled with dry pack mortar made from one part by weight of ordinary Portland cement and three parts of specified fine aggregate approved by the Engineer. The mortar shall be mixed with sufficient water only to make the materials stick together when being molded in the hands. All construction materials shall conform to the requirements as described previously and under the relevant Sub-sections of the Section on 'Construction Materials' of this Specification.

The Contractor shall thoroughly clean any hole that is to be filled and break out any loose, broken or cracked concrete or aggregate and remove any dry cement from the hole. The surrounding concrete shall be soaked until the whole surface that will come into contact with the dry pack mortar has been covered and darkened by absorption of the free water by the cement. The surface shall then be dried so as to leave a small amount of free water on it.

The dry pack material shall then be placed and packed in layers having a compacted thickness of not more than 10mm. Compaction shall be carried out by using a hardwood stick and a hammer and shall extend over the full area of the layer. Special cares should be taken to compact the dry pack against the sides of the holes.

After compaction, the surface of each layer shall be scratched before further loose material is added. The holes shall be slightly overfilled. The surface shall be finished by laying a hardwood block against the dry pack fill and striking the block several times.

#### **10.14 APPROVAL OF SCAFFOLDINGS AND FORM**

Plans, Drawings and structural calculations shall be submitted to the Engineer on time so that no construction of such scaffoldings and forms shall take place before the Engineer's approval is accorded in writing. Such approval shall not relieve the Contractor of his responsibilities for the involved structure.

The Engineer shall have reasonable time for his examination of the Contractor's plans and calculations, if scaffoldings are introducing temporary loading on new structures in particular. For this purpose, the Contractor shall not be allowed any extension of time beyond the stipulated period of the Contract.

Before concrete is placed, the Engineer shall inspect all formworks and scaffoldings. No concrete shall be placed until inspection is made and approval is given by the Engineer. Such approval shall not relieve the Contractor of any of his responsibilities under the Contract for the successful completion and the soundness of the structure.

**10.15 MEASUREMENT**

Formwork and false work shall not be measured separately but shall be deemed to be an integral part of the concrete items.

**10.16 PAYMENT**

The Contractor's rates for concrete work, inter-alia, shall be inclusive of all costs of all formwork, false work and centering and for their subsequent removal. No additional payment will be made to the Contractor for these works.

**10.17 WATER PROOFING POLYTHENE SHEET**

**10.17.1 DESCRIPTION**

Works covered under this item shall consist of supplying and laying in place one layer of polythene sheet of weight in accordance with the applicable Drawings, BOQ and these specifications and/or as directed by the Engineer.

**10.17.2 CONSTRUCTION REQUIREMENT**

Sheets shall be laid covering the entire inside area under the Cement Concrete. Before laying the sheets, the surface shall be cleaned to give a surface free from damage, tear or other imperfections and shall be laid such that there is a minimum of 300mm overlap of the adjacent strips.

**10.17.3 MEASUREMENT**

Measurement shall be taken for payment in square meter of the actual area covered by the sheets and accepted by the Engineer. No allowance shall be made for overlaps.

**10.17.4 PAYMENT**

The amount of completed and accepted work measured as provided above shall be made at the Contract unit price per square meter and the payment shall constitute full compensation for furnishing all materials, equipment including their storage, handling and transport and all labors, cleaning, preparing, cutting, laying, fixing and all incidentals necessary to complete the work. No additional payment shall be made for the overlaps.

| <b>Item of Payment</b>                  | <b>Unit</b>                |
|---|----------------------------|
| Supplying and laying of polythene sheet | Square meter / Square feet |

|   |            |
|---|------------|
| <b>11.0 JOINTS IN CONCRETE .....</b>                            | <b>95</b>  |
| <b>11.1 CONSTRUCTION JOINTS .....</b>                           | <b>95</b>  |
| <b>11.1.1 BONDING .....</b>                                     | <b>95</b>  |
| <b>11.1.2 BONDING AND DOWELING TO EXISTING STRUCTURES .....</b> | <b>96</b>  |
| <b>11.1.3 FORMS AT CONSTRUCTION JOINTS .....</b>                | <b>96</b>  |
| <b>11.2 EXPANSION AND CONTRACTION JOINTS .....</b>              | <b>96</b>  |
| <b>11.2.1 EXPANSION JOINTS .....</b>                            | <b>96</b>  |
| <b>11.2.2 CONTRACTION JOINTS .....</b>                          | <b>97</b>  |
| <b>11.3 POURABLE JOINT SEALANTS .....</b>                       | <b>97</b>  |
| <b>11.4 COMPRESSIVE FILLER .....</b>                            | <b>97</b>  |
| <b>11.5 WATER STOPS .....</b>                                   | <b>98</b>  |
| <b>11.5.1 POLYVINYL CHLORIDE (PVC) WATER STOPS .....</b>        | <b>98</b>  |
| <b>11.5.2 RUBBER WATER STOPS .....</b>                          | <b>98</b>  |
| <b>11.5.3 INSTALLATION .....</b>                                | <b>99</b>  |
| <b>11.6 MEASUREMENT .....</b>                                   | <b>100</b> |
| <b>11.7 PAYMENT .....</b>                                       | <b>100</b> |



## **11.0 JOINTS IN CONCRETE**

### **11.1 CONSTRUCTION JOINTS**

#### **GENERAL**

Construction joints are defined as concrete surfaces upon or against which concrete is to be placed and to which new concrete is to be placed, that have become so rigid that the new concrete cannot be incorporated integrally with that previously placed. Construction joints shall be formed wherever there is a discontinuity in placing concrete in external elements of concrete structures. Formed vertical or inclined construction joints as well as unformed joints, which are due to interruption of concrete placement, shall be made only where located on the Drawings or shown in the pouring schedule or as directed by the Engineer. All exposed faces of construction joints shall be made absolutely straight, leveled or plumbed and normal to the finished surface.

Spacing of construction joints shall be in accordance with good concreting practice as defined in BS 8110 or equivalent and enabling adequate precautions to be taken against shrinkage cracking. Placing of concrete shall be carried out continuously. The joints shall be at right angle to the general direction of the member and shall take due account of shear and other stresses.

All planned reinforcing steel shall extend uninterrupted through joints. Additional reinforcing steel dowels shall be placed across the joints, if and when directed by the Engineer. Such additional steel shall be furnished and placed at the Contractor's expenses.

#### **11.1.1 BONDING**

Unless otherwise shown on the Drawing, horizontal joints may be made without keys and vertical joints shall be constructed with shear keys. Surfaces of fresh concrete at horizontal construction joints shall be rough floated sufficiently to thoroughly consolidate the surface and intentionally left in a rough condition. Shear keys shall consist of formed depressions in the surface covering approximately one-third of the contact surface. The forms for keys shall be beveled so that removal will not damage the concrete.

Surfaces of construction joints shall be prepared as early as possible after casting. The preparation shall consist of the removal of all laitance, loose or defective concrete coatings, sand and other deleterious materials. Preparation shall be carried out preferably when the concrete has set but not hardened by jetting with a fine spray of water or brushing with a stiff brush, just sufficient to remove the outer mortar skin and to expose the larger aggregate without it is being disturbed. Where this treatment is impracticable and work is resumed on a surface, which has set, the whole surface shall be thoroughly roughened or scrapped with suitable tools so that no smooth skin of concrete that may be left from the previous work is visible.

The prepared joint face shall be thoroughly cleaned by compressed air and water jets or other approved means and brushed and watered immediately before depositing concrete. The cleaned and saturated surfaces that also include vertical and inclined surfaces, shall first be thoroughly covered with a thin coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

The placing of concrete shall be carried 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.

Construction joints in floors shall be located within the middle third of spans of slabs, beams and girders. Joints in girders shall be offset a minimum distance of two times the width of intersecting beams.

### **11.1.2 BONDING AND DOWELING TO EXISTING STRUCTURES**

When reinforcing dowels grouted into the holes drilled in the existing concrete is required at such construction joints, the holes shall be drilled by methods that will not damage the concrete around the holes. The diameters of the holes shall be 6mm larger than the nominal diameter of the dowels unless shown otherwise on the Drawings. The dowel bars shall be round mild steel bar of the diameter and length as indicated on the Drawings and/or as per the directions of the Engineer. The grout shall be a neat cement paste of Portland cement and water or an epoxy. Immediately prior to placing the dowel bars, the holes shall be cleaned off dust and other deleterious materials, shall be thoroughly saturated with water, have all free water removed and shall be dried to a saturated surface dry condition. Sufficient grout or an epoxy shall be placed inside the holes so as not to remain any void after the dowels are inserted. Grout shall be cured for a period of at least 3 (three) days or until dowel bars are encased in concrete. When an epoxy is used, the mixing and placing shall conform to the manufacturer's recommendations.

### **11.1.3 FORMS AT CONSTRUCTION JOINTS**

When forms at construction joints overlap previously placed concrete, they shall be re-tightened before depositing new concrete. Exposed face edges of all joints shall be neatly formed with straight bulkheads or grade strips, or otherwise properly finished true to line and elevation.

## **11.2 EXPANSION AND CONTRACTION JOINTS**

### **11.2.1 EXPANSION JOINTS**

#### **GENERAL**

Expansion joints are intended to accommodate relative movement between adjoining parts of a structure. Compressible filler shall be placed between the joint faces to provide freedom for expansion for the two adjacent concrete masses. Care shall be taken to ensure that the material fills the joint completely and that no concrete or hard material is left in the joint after the second face of the joint has been cast.

#### **Material**

One of the following specifications shall be used as pre-mould fillers:

Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction, ASTM 1751.

Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction ASTM D 1752. Type-II (cork) shall not be used when resiliency is required.

Specification for Preformed Expansion Joint Filler for Concrete, ASTM D 994.

The bitumen sheet, laid on the horizontal top surface of the expansion joint keys, shall be a 10mm thick material approved by the Engineer.

#### **Metal Armour**

Expansion joint armor assemblies shall be fabricated from steel with the following materials:

Steel bars, plates and shapes shall conform to the requirements of ASTM A 36.

Bolts and nuts shall conform to the requirements of ASTM A 307.

High strength bolts, nuts and washers shall conform to the requirements of ASTM A 325.

Steel castings shall conform to the requirements of ASTM A 486 or ASTM A 27.

Grey iron castings shall conform to the requirements of ASTM A 48.

Sheet metal shall be of commercial quality.

### **Armour Assemblies**

All assemblies shall be accurately fabricated and straightened at the workshop, as necessary to conform to the concrete sections. The assemblies shall be installed so that their top surface matches the plane of the adjacent finished concrete surface throughout the length of the assembly. Appropriate methods shall be followed in placing the assemblies to keep them in correct position during the placing of concrete. The opening at expansion joints shall be that designated on the Drawings at normal temperature or as directed by the Engineer for other temperatures. Cares shall be taken to avoid impairment of the clearance in any manner.

### **11.2.2 CONTRACTION JOINTS**

#### **GENERAL**

Joints placed in structures or slabs to provide for volumetric shrinkage of monolithic unit or movement between monolithic units are defined as contraction joints. Contraction joints shall be constructed so that there will be no bond between the concrete surface forming the joints.

#### **Material**

Material placed in contraction joints shall consist of asphalt saturated felt paper or other approved bond- breaking materials.

### **11.3 POURABLE JOINT SEALANTS**

Pourable sealants shall be placed along the top edges of contraction or filled expansion joints. It shall conform to the following considerations:

Unless otherwise shown on the Drawings and/or ordered by the Engineer, joint sealants shall be a hot poured rubber bitumen compound for horizontal joints and either a bituminous compound or an elastomeric two parts polysulphide sealant for sloping, vertical and soffit joints.

Bituminous compounds shall comply with BS 2499 for horizontal joints and BS 2499 Type A1 for sloping or vertical joints. Polysulphide compound shall comply with BS 4254.

Joint sealants and the requisite priming materials shall be obtained from manufacturers approved by the Engineer. The application of joint sealant shall not be commenced without the Contractor obtains its approval by the Engineer.

### **11.4 COMPRESSIVE FILLER**

Unless otherwise specified, the joint filler shall be of resin or bituminous bonded corks such as 'Hydrocor' manufactured by Expandite Ltd. The filler shall be obtained from a manufacturer approved by the Engineer and shall be stored and fixed in accordance with the manufacturer's instructions.

### **11.5 WATER STOPS**

#### **GENERAL**

Water stops shall be of the type, size and shape shown on the Drawings and/or as directed by the Engineer. They shall be dense, homogeneous and without holes or other defects.

#### **Types**

Water stops to be used may be of the following types:

##### **11.5.1 POLYVINYL CHLORIDE (PVC) WATER STOPS**

Where shown on the Drawings, construction (as required and approved by the Engineer), contraction and expansion joints shall be made watertight by the provision of a continuous Water Stop strip of Poly Vinyl Chloride (PVC) manufactured by the extrusion process from an elastomeric plastic compound, the basic resin of which shall be Poly Vinyl Chloride. Unless otherwise specified or ordered, a two bulb dumbbell section PVC. Water Stop shall be used in construction joints and a three bulb section PVC Water Stop shall be used in expansion joints.

Water Stops shall be of high grade PVC, containing no filler or reclaimed or scrap material. PVC shall comply with the requirements of BS 2571 for PVC Type A, Class 1. The quality of Water Stops shall comply with the following major requirements:

Specific gravity..... 1.30 (maximum)

Hardness .....80 (minimum)

Tensile strength..... 138 kg/cm<sup>2</sup> (minimum)

Elongation duro..... 225% (minimum)

##### **11.5.2 RUBBER WATER STOPS**

Rubber Water Stops shall be manufactured with synthetic rubber made exclusively from neoprene, reinforcing carbon black, zinc oxide, polymerization agents and softeners. The quality shall conform the following major requirements:

Neoprene content..... 70% by volume (minimum)

Hardness..... 50-60 duro

Tensile strength..... 193 kg/cm<sup>2</sup> (minimum)

Elongation..... 600% (minimum)

Rubber Water Stops shall be formed with an integral cross section in suitable molds so as to produce a uniform section with a permissible variation in dimension of 0.8mm plus or minus. No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured in a manner such that any cross section shall be dense, homogeneous, and free from all porosity. Junctions in the special connection pieces shall be full molded. During the vulcanizing period, the joints shall be securely held by suitable clamps. The material at the splices shall be dense and homogeneous throughout the cross-section.

### **11.5.3 INSTALLATION**

#### **Open joints**

Open joints shall be constructed by the insertion and subsequent removal of a wood strip, metal plate, or other approved material. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. When not protected by metal armour, open joints in slabs shall be finished with an edging tool. Upon completion of concrete finishing work, all mortars and other debris shall be removed from the open joints.

#### **Filled joints**

When filled joints are shown on the Drawings or asked by the Engineer, pre-mold type fillers shall be used unless Poly Styrene board is specifically called for. Filler for each joint shall consist of as few pieces of material as possible. Abutting edges of filler material shall be accurately held in alignment with each other and tightly fit or taped as necessary to prevent the intrusion of grout. Joint filler material shall be anchored to one side of the joint by waterproof adhesive or other methods so as to prevent it from working out of the joint but not interfere with the compression of the material.

#### **Sealed joints**

Prior to installation of the pourable joint sealants, all foreign materials shall be removed from the joint. The filler material shall be cut back to the depth shown or approved and the surface of the concrete, in contact with the sealant, be cleaned by light sand blasting. When required, a Poly Ethylene foam strip shall be placed in the joint to retain the sealant and isolate it from the filler material. The sealant materials shall then be mixed and installed in accordance with the manufacturer's directions. Any material that fails to bond the sides of the joint within 24 hours after placement shall be removed and replaced.

#### **Water stops**

Water Stops shall be obtained from a manufacturer approved by the Engineer, and shall be fixed and joined according to the manufacturer's instructions. All strips shall be stored in a place as cool as practicable and shall in no case be exposed to the direct sun light.

Water Stops shall be installed with approximately half of the width of the material embedded in the concrete on either side of the joint. It shall be firmly supported by split stop-end shuttering and in no case shall Water Stop be pierced to assist in fixing. Special care shall be taken to ensure that the concrete is well worked against the embedded parts of the strips and is free from honeycomb. Precautions are to be taken to protect any projected portions of the strips from damage during the progress of the works and from sunlight and heat.

If, after placing concrete, Water Stops are moved out of position or shape, the surrounding concrete shall be removed, the Water Stop reset, and the concrete replaced at the Contractor's own expenses. Two 9mm diameter reinforcing bars shall be provided to support the Water Stops and shall be securely held in position by the use of spacers, supporting wires, or other approved devices.

Flexible Water Stops shall be fully supported in the formwork, free from nails and clear of reinforcement and other fixtures. Damaged Water Stops shall be replaced and care shall be taken to place the concrete so that Water Stops do not bend or distort.

Splicing of Poly Vinyl Chloride Water Stop shall be performed in accordance with the manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not to char the plastic. Splices shall develop at least 90% of the tensile strength of un-spliced materials and shall withstand bending 180o around a 50mm diameter pin without cracking or separating.

The Contractor, at least before the commencement of concrete work, shall submit to the Engineer for his approval details of the Contractor's proposals for the installation of water stops. These shall show where joints in the Water Stops are to be located and details of the intersections and changes of direction to a scale that shows the position of any joint or shape of any mould section.

As far as possible, jointing of PVC Water Stops on Site shall be confined to the making butt joints in straight runs of Water Stops. Where it is agreed with the Engineer that it is necessary to make an intersection or change of direction of any joint other than a butt joint in a straight run, a preliminary joint, intersection or change of direction piece shall be made and subjected to such tests as the Engineer may require.

Precautions shall be taken so that the Water Stops shall neither be displaced nor damaged by construction operations or other means. All surfaces of the Water Stops shall be kept free from oil, grease, dried mortar or any other foreign matters while the Water Stop is being embedded in concrete. Means shall be used to ensure that all portions of the Water Stop designed for embedding shall be tightly enclosed by dense concrete.

#### **11.6 MEASUREMENT**

Construction Joints shall not be measured. Expansion and Contraction joints shall be measured in linear meter of the joints considered satisfactory by the Engineer and accepted by him. There will be no additional measurement for joint fillers, sealed joints, Water Stops, miscellaneous metal devices etc.

#### **11.7 PAYMENT**

Payment for construction joints shall be deemed included in the items of concrete and there will be no extra payment for it. For expansion and Contraction joints the amount of completed and accepted works measured as provided above shall be paid at the Contract Unit Price per linear meter and the payment shall constitute the full compensation for furnishing and placing joint fillers, sealed joints, Water Stops, drains, vents, miscellaneous metal devices including all labour and incidentals for full completion of the Work as per Specifications.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| Expansion joints       | Linear meter / Linear feet |
| Contraction joints     | Linear meter / Linear feet |

|  |            |
|--|------------|
| <b>12.0 REINFORCING STEEL .....</b>                                | <b>101</b> |
| <b>12.1 REINFORCEMENT FOR RCC .....</b>                            | <b>101</b> |
| <b>12.1.1 DESCRIPTION .....</b>                                    | <b>101</b> |
| <b>12.1.2 MATERIALS REINFORCEMENT .....</b>                        | <b>101</b> |
| <b>12.1.3 CHEMICAL COMPOSITION .....</b>                           | <b>102</b> |
| <b>12.1.4 PROCESS .....</b>  | <b>102</b> |
| <b>12.1.5 DIMENSIONAL REQUIREMENTS .....</b>                       | <b>102</b> |
| <b>12.1.6 TENSILE PROPERTIES .....</b>                             | <b>103</b> |
| <b>12.1.7 BEND TEST REQUIREMENT .....</b>                          | <b>103</b> |
| <b>12.1.8 ASTM CODE REQUIREMENTS FOR DEFORMATIONS .....</b>        | <b>103</b> |
| <b>12.1.9 BINDING WIRE .....</b>                                   | <b>104</b> |
| <b>12.1.10 WIRE MESH .....</b>                                     | <b>104</b> |
| <b>12.1.11 ORDERING MATERIAL .....</b>                             | <b>104</b> |
| <b>12.1.12 TESTS .....</b>   | <b>105</b> |
| <b>12.1.13 CONSTRUCTION METHODS OF REINFORCING BAR .....</b>       | <b>105</b> |
| <b>12.1.14 LATERAL REINFORCEMENT FOR COLUMNS .....</b>             | <b>108</b> |
| <b>12.1.15 SPACING OF REINFORCEMENT .....</b>                      | <b>109</b> |
| <b>12.1.16 SPLICING .....</b>                                      | <b>110</b> |
| <b>12.1.17 SUBSTITUTIONS .....</b>                                 | <b>113</b> |
| <b>12.1.18 CONCRETE COVER TO REINFORCEMENT .....</b>               | <b>113</b> |
| <b>12.1.19 PROTECTIVE COATING .....</b>                            | <b>114</b> |
| <b>12.1.20 BUNDLED BARS .....</b>                                  | <b>114</b> |
| <b>12.1.21 INSPECTION .....</b>                                    | <b>115</b> |
| <b>12.1.22 MEASUREMENT .....</b>                                   | <b>115</b> |
| <b>12.1.23 PAYMENT .....</b>                                       | <b>115</b> |
| <b>12.2 WELDING .....</b>  | <b>115</b> |
| <b>12.2.1 GENERAL .....</b>  | <b>115</b> |
| <b>12.2.2 WORKMANSHIP AND VISUAL QUALITY REQUIREMENTS .....</b>    | <b>116</b> |
| <b>12.2.3 WELDING REPAIRS .....</b>                                | <b>116</b> |
| <b>12.2.4 PEENING .....</b>  | <b>116</b> |
| <b>12.2.5 ELECTRODES .....</b>                                     | <b>116</b> |
| <b>12.2.6 CUTTING AND EDGE PREPARATION .....</b>                   | <b>117</b> |
| <b>12.2.7 GRINDING WHEELS .....</b>                                | <b>117</b> |
| <b>12.2.8 QUALIFICATION OF WELDERS AND WELDING OPERATORS .....</b> | <b>117</b> |
| <b>12.2.9 WELDING METHODS .....</b>                                | <b>117</b> |
| <b>12.2.10 DEFECTS IN WELDED JOINTS .....</b>                      | <b>118</b> |
| <b>12.2.11 INSPECTION AND TESTING OF WELDS .....</b>               | <b>119</b> |
| <b>12.2.12 MEASUREMENT AND PAYMENT .....</b>                       | <b>119</b> |

## **12.0 REINFORCING STEEL**

### **12.1 REINFORCEMENT FOR RCC**

#### **12.1.1 DESCRIPTION**

Works covered by this item shall consist of supplying and placing of steel reinforcement in different types of concrete structures including board cast-in-situ piles and pre-cast concrete piles but not includes reinforcement for pre-stressed concrete. The works shall conform to the specifications, the types, sizes and positions of reinforcement requirements shown on the Drawings and this specification.

#### **12.1.2 MATERIALS REINFORCEMENT**

Reinforcing bars discussed under this Section shall be made of Mild Steel or High yield Steel, plain or deformed, for all Reinforced Concrete Works but excluding Pre-stressing Concrete.

Bars shall be rolled and produced from steel in the form of new and clean billets directly reduced from ingot of properly identified heats of open hearth, basic oxygen or electric arc furnace steel or lots of acid besmear steel.

#### **Reference Standards**

##### **Deformed reinforcement**

Deformed and Plain Billet Steel Bars for Concrete Reinforcement – ASTM A 615

Rail Steel Deformed and Plain Bars for Concrete Reinforcement – ASTM A 616

Axle Steel Deformed and Plain Bars for Concrete Reinforcement – ASTM A 617

Low Alloy Steel Deformed Bars for Concrete Reinforcement – ASTM A 706

Deformed Steel Wire – ASTM A 496

Welded Deformed Steel Wire Fabric – ASTM A 497

Zinc Coated (Galvanized) Steel Bars – ASTM A 767

Epoxy – Coated Reinforcing Steel – ASTM A 775

##### **Plain reinforcement**

ASTM A 615 M, ASTM A 616 M, ASTM A 617 M, ASTM A 185

##### **Smooth steel wire**

Cold – Drawn Steel Wire - ASTM A 82

##### **Cold – worked steel reinforcement**

IS 1786: 1985, BS 4461: 1978

##### **Mild steel plain round bar**

This is a type of bar plain and round in shape of a structural or intermediate grade with yield strength of not less than 280 MPa (N/mm<sup>2</sup>) i.e. 40 grade.

##### **Deformed bars**

Reinforcing steel under this type comprises Mild Steel Grade 40 and High Strength Grade 60 Deformed re-bars with yield strength of not less than 280 MPa (N/mm<sup>2</sup>) in case of Grade 40 and with yield strength of not less than 410 MPa (N/mm<sup>2</sup>) in case of Grade 60.



#### Other bars

Steel welded wire, fabric plain reinforcement conforming to ASTM A 185 may be used, except that for wire with specified yield strength  $f_y$  exceeding 410 MPa ( $\text{N/mm}^2$ ),  $f_y$  will be the stress corresponding to a strain of 0.35 percent.

Smooth steel wire conforming to ASTM A 82 may be used in concrete except that for a wire with a specified yield strength  $f_y$  exceeding 410 MPa ( $\text{N/mm}^2$ ),  $f_y$  will be the stress corresponding to a strain of 0.35 percent.

Fabricated deformed steel bar mats conforming to ASTM A 184 and deformed steel wire complying with ASTM A 496 may be used. Deformed wire for concrete reinforcement shall not be smaller than a nominal diameter of 5.72mm, and for a wire with specified yield strength ( $f_y$ ) exceeding 410 MPa ( $\text{N/mm}^2$ ),  $f_y$  shall be the stress corresponding to a strain of 0.35 percent.

Welded deformed steel wire fabric conforming ASTM A 497 may be used for a wire with specified yield strength exceeding ( $f_y$ ) 410 MPa ( $\text{N/mm}^2$ ),  $f_y$  will be the stress corresponding to a strain of 0.35 percent.

#### 12.1.3 CHEMICAL COMPOSITION

The structural grade shall be made from billets. The ends of the bar shall be machine sheared perpendicular to the axis of the bar. The bars shall be free from injurious defects and shall have a workman like finish.

The chemical composition should conform to the requirements of ASTM 706-82.

#### 12.1.4 PROCESS

The steel shall have been made by one or more of the following processes:

- open-hearth
- basic oxygen
- electric furnace
- acid besmear

#### 12.1.5 DIMENSIONAL REQUIREMENTS

The nominal diameter, cross sectional areas and perimeter of a deformed bar are equivalent to that of a plain bar having the same standard weight per unit length. Dimensional requirements of such bars have been shown in the Table given below:

| Bar Designation No.* | Nominal Dimensions**  |  |                        | Nominal weight, lb/ft<br>[Nominal mass, kg/m] |
|----------------------|-----------------------|--|------------------------|---|
|                      | Diameter, in.<br>[mm] | Cross Sectional Area, in. <sup>2</sup><br>[mm <sup>2</sup> ] | Perimeter, in.<br>[mm] |   |
| 3 [10]               | 0.375 [9.5]           | 0.11 [71]  | 1.178 [29.9]           | 0.376 [0.560]                                 |
| 4 [13]               | 0.500 [12.7]          | 0.20 [129]   | 1.571 [39.9]           | 0.668 [0.994]                                 |
| 5 [16]               | 0.625 [15.9]          | 0.31 [199]   | 1.963 [49.9]           | 1.043 [1.552]                                 |
| 6 [19]               | 0.750 [19.1]          | 0.44 [284]   | 2.356 [59.8]           | 1.502 [2.235]                                 |
| 7 [22]               | 0.875 [22.2]          | 0.60 [387]   | 2.749 [69.8]           | 2.044 [3.042]                                 |
| 8 [25]               | 1.000 [25.4]          | 0.79 [510]   | 3.142 [79.8]           | 2.670 [3.973]                                 |
| 9 [29]               | 1.128 [28.7]          | 1.00 [645]   | 3.544 [90.0]           | 3.400 [5.060]                                 |
| 10 [32]              | 1.270 [32.3]          | 1.27 [819]   | 3.990 [101.3]          | 4.303 [6.404]                                 |
| 11 [36]              | 1.410 [35.8]          | 1.56 [1006]  | 4.430 [112.5]          | 5.313 [7.907]                                 |
| 14 [43]              | 1.693 [43.0]          | 2.25 [1452]  | 5.32 [135.1]           | 7.65 [11.38]                                  |
| 18 [57]              | 2.257 [57.3]          | 4.00 [2581]  | 7.09 [180.1]           | 13.60 [20.24]                                 |

\*Bar numbers are based on the number of eighths of an inch including in the nominal diameter of the bars [bar numbers approximate the number of millimeters of the nominal diameter of the bar]

The nominal dimension of a deformed bar are equivalent to those of a plain round bar having the same weight [mass] per foot [meter] as the deformed bar.

### 12.1.6 TENSILE PROPERTIES

The tensile properties of the Grade 40 and Grade 60 steel have been shown in the Table given below:

| Item                                   | Requirements    |                |
|--|-----------------|----------------|
|  | Grade 40 [300]* | Grade 60 [420] |
| Tensile strength, min, psi [MPa]       | 70,000 [500]    | 90,000 [620]   |
| Yield strength, min, psi [MPa]         | 40,000 [300]    | 60,000 [420]   |
| Elongation in 8 in. [203.2 mm], min, % |                 |                |
| Bar Designation No.                    |                 |                |
| 3 [10]                                 | 11              | 9              |
| 4, 5 [13, 16]                          | 12              | 9              |
| 6 [19]                                 | 12              | 9              |
| 7, 8 [22, 25]                          | -               | 8              |
| 9, 10, 11 [29, 32, 36]                 | -               | 7              |
| 14, 18 [43, 57]                        | -               | 7              |

\* Grade 40

[300] bars are furnished only in sizes 3 through 6 [10 through 19].

### 12.1.7 BEND TEST REQUIREMENT

The pin diameter required for performing bend tests shall conform to ASTM A 615. The following table contains such requirements:

| Bar Designation No.    | Pin Diameter for Bend Tests * |                |
|------------------------|-------------------------------|----------------|
|                        | Grade 40 [300]                | Grade 60 [420] |
| 3, 4, 5 [10, 13, 16]   | 3.5d                          | 3.5d           |
| 6 [19]                 | 5d                            | 5d             |
| 7, 8 [22, 25]          | -                             | 5d             |
| 9, 10, 11 [29, 32, 36] | -                             | 7d             |
| 14, 18 [43, 57] (90°)  | -                             | 9d             |

\* Test bends

1800 unless noted otherwise.

d = Nominal diameter of specimen

#### Permissible variation

For lots from standard weights + 5% for 6mm dia  
+ 3.5% for 10mm dia and above  
Individual + 6% for all sizes

#### Length

Length of the bar shall be maximum possible, but each bar shall not be less than 12m in length or 45.36 kg in weight whichever is greater.

### 12.1.8 ASTM CODE REQUIREMENTS FOR DEFORMATIONS

Deformations shall be spaced along the bar at substantially uniform distances. The deformations on the opposite sides of the bar shall be similar in size and shape.

The deformations shall be placed with respect to the axis of the bar so that the included angle is not less than 45°. Where the line of deformation forms an included angle with the axis of the bar from 45° to 70° inclusive, the deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the line of deformation is over 70°, a reversal in direction is not required.

Average spacing or distance between deformations on each side of the bar shall not exceed 17 (seventeen) times of the nominal diameter of the bar.

Overall length of deformations shall be such that the gap between the ends of the deformations on the opposite sides of the bar shall not exceed 12.5% of the nominal perimeter of the bar. Where the ends terminate in a longitudinal rib, the width of the longitudinal rib shall be considered as the gap. Where more than two longitudinal ribs are involved, the total width of all longitudinal ribs shall not exceed 25% of the nominal perimeter of the bar. Furthermore, the summation of gaps shall not exceed 25% of the nominal perimeter of the bar. Nominal perimeter of the bar shall be 3.14 times the nominal diameter ( $d_b$ ).

Spacing, height and gap of deformations as to be conformed have been shown in the following table:

**Deformation requirements, in. [mm]**

| Bar designation | Maximum average spacing | Minimum average height | Maximum gap (Chord of 12.5% of Nominal Perimeter) |
|-----------------|-------------------------|------------------------|---|
| 3 [10]          | 0.262 [6.7]             | 0.015 [0.38]           | 0.143 [3.6]                                       |
| 4 [13]          | 0.350 [8.9]             | 0.020 [0.51]           | 0.191 [4.9]                                       |
| 5 [16]          | 0.437 [11.1]            | 0.028 [0.71]           | 0.239 [6.1]                                       |
| 6 [19]          | 0.525 [13.3]            | 0.038 [0.97]           | 0.286 [7.3]                                       |
| 7 [22]          | 0.612 [15.5]            | 0.044 [1.12]           | 0.334 [8.5]                                       |
| 8 [25]          | 0.700 [17.8]            | 0.050 [1.27]           | 0.383 [9.7]                                       |
| 9 [29]          | 0.790 [20.1]            | 0.056 [1.42]           | 0.431 [10.9]                                      |
| 10 [32]         | 0.889 [22.6]            | 0.064 [1.63]           | 0.487 [12.4]                                      |
| 11 [36]         | 0.987 [25.1]            | 0.071 [1.80]           | 0.540 [13.7]                                      |
| 14 [43]         | 1.185 [30.1]            | 0.085 [2.16]           | 0.648 [16.5]                                      |
| 18 [57]         | 1.58 [40.1]             | 0.102 [2.59]           | 0.864 [21.9]                                      |

Note: Any bar that fails to satisfy the aforementioned all requirements is to be treated as plain reinforcement.

#### **12.1.9 BINDING WIRE**

Reinforcement binding wire shall be the best black annealed mild steel wire and not less than 1.6mm in diameter in approximation/18 - 22 BWG or 26 BWG galvanized iron wire.

#### **12.1.10 WIRE MESH**

Wire mesh shall conform to the requirements of AASHTO Standard Specification M 55 Welded Steel Wire Fabric for Concrete Reinforcement.

#### **12.1.11 ORDERING MATERIAL**

The name of the proposed supplier of the reinforcement shall be submitted as soon possible to the Engineer for his approval. The Contractor shall submit necessary information concerning the supplier as requested by the Engineer.

Copies of orders placed shall be submitted to the Engineer.

The manufacturer shall submit all requested relevant data on the steel, i.e. breaking strength, yield strength, characteristics on elongation, chemical composition etc., to the Engineer for his approval.

No steel shall be delivered without a certificate guaranteeing the yield stress.

The steel shall be stored and marked in a way that it enables identification of the steel corresponding to each certificate later on.

#### **12.1.12 TESTS**

Test results in addition to those to be submitted by the Contractor and specified above shall be required.

The Contractor shall cut out samples as directed by the Engineer.

The samples shall be tested according to the Engineer's instructions by an approved Testing Institution. Approximately three samples shall be tested from each 10 tons of reinforcement delivered at the Site. Expenses incurred in connection with cutting, carrying and testing the samples shall be borne by the Contractor at his own costs.

#### **12.1.13 CONSTRUCTION METHODS OF REINFORCING BAR**

##### **Storage and care**

All reinforcing steel when received at the Site, prior to its use, shall be stacked off the ground on platforms, skids or any other support and shall be kept free from dirt, oil and grease. All cares shall be taken to prevent the steel reinforcement from any mechanical injury and surface loss resulting from its exposition to weather conditions that produce rust. It shall be clean and kept free from loose rust and loose mill scale at the time of fixing in position and subsequent pouring of concrete. However, reinforcement steel may not be rejected on the ground of bonded rust, surface seams, surface irregularities and mill scale so long minimum dimensions, cross-sectional area and tensile properties of a hand wire brushed specimen meet the specified physical requirements for the size and grade of steel.

Reinforcement shall be handled and stored in a manner that will prevent bending out of the desired shape and any accumulation of dirt, oil and paint. When placed in the works, it shall be free from dirt, oil, grease, paint, mill scale and loose or thick rust.

Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Codes of Practice of the Concrete Reinforcing Steel Institute.

##### **Fabrication**

All bars shall be fabricated following Specifications, methods and procedures stated below.

Fabrication tolerances shall be in accordance with ACI 315.

##### **Cutting and bending**

All reinforcement bars shall be cut and bent cold to the specified shape and pertinent dimensions shown on the Drawings using a proper bar bender, operated by hand or power to attain proper radii of bends. The equipment used and methods followed for this purpose shall get the approval of the Engineer.

Bars shall not be bent or straightened in a manner that will injure the material.

Bars partially embedded in concrete shall not be field bent unless otherwise shown on the Drawings or directed by the Engineer.

Errors in alignment of reinforcement partially embedded in hardened concrete shall not be corrected by bending in place, except as permitted by the Engineer.

Bars bent during transportation or handling shall be straightened before being used in work. It shall not be heated to facilitate bending.

Fabrication tolerances shall be in accordance with ACI 315.

All plain bars shall have standard hooks at the end, which shall meet the following requirements unless otherwise specified on the Drawings. When the dimensions of hooks or the diameter of bends are not prescribed, they shall be in accordance with ACI 318 'Building Code requirements for Reinforced Concrete'. Some of the standard requirements have been specified below:

180° turn plus an extension of at least 4 bar diameters but not less than 60mm at the free end of the bar.

90° turn plus an extension of at least 12 bar diameters at the free end of the bar.

For stirrup and the anchorage only:

For 16 mm dia bar and smaller      90° bend plus an extension of at least 6 bar diameters or 75mm whichever is greater at the free end of the bar.

For 20mm and 25mm dia bar      90° bend plus an extension of at least 12 bar diameters or 150mm whichever is greater at the free end of the bar.

For 25mm dia bar and smaller      135° bend plus an extension of at least 6 bar diameters at the free end of the bar.

For closed ties and continuously wound ties      135° bend plus an extension of at least 6 bar diameters, but not less than 75mm.

The minimum diameter of bend measured on the inside of the bar, for standard hooks other than for stirrups and ties in sizes 10mm  $\Phi$  thorough 16mm  $\Phi$ , shall not be less than the values shown in the table given below.

**Minimum diameters of Bend**

| Bar size                                | Minimum diameter of bend |
|---|--------------------------|
| $10\text{mm} \leq d_b \leq 25\text{mm}$ | $6d_b$                   |
| $25\text{mm} \leq d_b \leq 40\text{mm}$ | $8d_b$                   |
| $40\text{mm} \leq d_b \leq 55\text{mm}$ | $10d_b$                  |

\*  $d_b$  is the nominal diameter of bar, mm

For stirrups and tie hooks, inside diameter of bend shall not be less than 4 bar diameters for 16mm  $\Phi$  bar and smaller. For bars larger than 16mm  $\Phi$ , diameter of bend shall be in accordance with the specifications shown in the above table.

Bends for other bars, where full tension in the bar may occur, shall be made around a pin having a diameter not less than 20 bar diameters. Hooks shall conform to American Concrete Institute Standard Building Code Requirements for reinforced concrete ACI 316-89, or as shown on the Drawings or as directed by the Engineer.

**Placing, supporting and fastening**

All bar reinforcement shall be accurately placed, supported and secured in position as shown on the Drawings using approved spacer blocks and chairs prior to any concrete pouring. Displacement tolerance may be allowed within the permissible tolerance limit as shown in the table given below unless otherwise specified by the Engineer. The reinforcement shall be checked and approved by the Engineer before pouring of concrete.

**Tolerance for Placing Reinforcement**

|                       | <b>Tolerance for depth (d)</b> | <b>Tolerance for Minimum Concrete Cover</b> |
|-----------------------|--------------------------------|---|
| $d \leq 200\text{mm}$ | $\pm 10\text{mm}$              | - 10mm                                      |
| $d \leq 200\text{mm}$ | $\pm 12\text{mm}$              | - 12mm                                      |

Notwithstanding the above provisions, tolerance for the clear distance to formed soffits shall be minus 6mm and tolerance for cover shall not exceed minus one-third the minimum concrete cover required in the design Drawings or specifications.

Tolerance for longitudinal location of bends and ends of reinforcement shall be  $\pm 50\text{mm}$ , except at discontinuous ends of members where tolerance shall be  $\pm 12\text{mm}$ .

Welding of crossing bars shall not be permitted for assembly of reinforcement unless authorized by the Engineer.

The Contractor shall be responsible for the accuracy of cutting, bending and placing of the reinforcement. Reinforcement will be inspected for compliance with the requirements as to grade, size, shape, length, splicing locations, overlapping length and position after it has been placed.

Before the reinforcement is placed, the surfaces of the bars and the surfaces of any metal bar supports shall be cleaned of heavy rust, loose mill scale, dirt, grease and other objectionable foreign substances. Heavy flaky rust, which can be removed in firm rubbing with hessian or equivalent treatment, shall be considered objectionable. After being placed, the reinforcing bars shall be maintained in a clean condition until they are completely embedded in the concrete.

Reinforcement shall be accurately placed in the position shown on the Drawings and/or as directed by the Engineer and shall be securely held by blocking against the forms, by supporting on concrete or approved metal or plastic chairs or by using metal hangers and by wiring together at intersections using annealed wire of specified diameter with the ends turned in to the main body of concrete. Bars shall be tied at all intersections except where spacing is less than 300mm in any direction when alternate intersections shall be tied. Wire ties shall be securely tied and folded so that they do not project beyond the planes formed by the reinforcing bars. The adequacy of the supports and ties to secure the reinforcement properly shall be subject to the approval of the Engineer.

Reinforcement supports shall be strong enough to withstand the imposed loads without movement of the reinforcement. They shall be positively attached to the reinforcement and of such size and number as to maintain the specified cover.

There shall be a clear distance of at least 25mm between the bars and any adjacent embedded metal works. The Contractor shall ensure that there is no disturbance of the reinforcing bars in concrete that has already been placed.



Reinforcement binding wire shall be best black annealed mild steel wire and not less than approximately 1.6mm in diameter/18 - 22 BWG galvanized iron wire.

Cover blocks required for ensuring that the reinforcement is correctly positioned shall be as small as possible, consistent with their purpose, or a shape and material acceptable to the Engineer and designated so that they will not overturn when the concrete is placed. The concrete cover blocks or space blocks shall be made of concrete having 1 part cement, 1 part sand and 2 part coarse aggregate. The coarse aggregate would be 6mm downgraded. The blocks would be cast in mould and continuously cured for 21 days before use. Wire shall be cast in the block for the purpose of tying it to the reinforcement. The wire must not be closer than 30mm from the concrete surface. The use of small stones or wood blocks shall not be permitted.

If concrete cylinder blocks are used for proper spacing of vertical bars in column, the height shall be 2.54cm and radius shall be equal to the distance of the centre line of the bar from column face.

Top reinforcement in slabs shall be maintained in position by means of chairs made out of ferrous metal and shall conform to industry practice as described in the Manual on 'Standard Practice of the Concrete Reinforcing Steel Institute'. The diameter and quantity being sufficient to ensure security of the reinforcement shall be used to support access ways, working platforms, or the placing equipment or for conducting of an electric current.

Platforms for the support of workers and equipment and machines shall be placed directly on the forms without any disturbance of the reinforcing steel during concrete placement.

Before any steel reinforcement is embedded in the concrete, any loose mill scale, loose rust and any oil, grease or other deleterious matter shall be removed. Partially set concrete, which may adhere to the exposed bars during concrete placing operations, shall also be removed.

#### **12.1.14 LATERAL REINFORCEMENT FOR COLUMNS**

##### **Spirals**

Spiral reinforcement for columns shall conform to the following:

Spirals shall consist of evenly spaced continuous bar or wire of such size and so assembled as to permit handling and placing without distortion from designed dimensions.

Size of spirals shall not be less than 10mm diameter for cast-in-place construction.

The minimum and maximum clear spacing between spirals shall be 25mm and 75mm respectively.

Anchorage of spiral reinforcement shall be provided by 1.5 extra turns of spiral bar or wire at each end of a spiral unit.

Splices in spiral reinforcement shall be lap splices of 48 spiral diameter, but not less than 300mm.

Spirals shall extend from the top of footing or slab in any story to the level of the lowest horizontal reinforcement in members supported above.

Spirals shall extend above termination of spiral to bottom of slab or drop panel, where beams or brackets do not frame in to all sides of a column.

Spirals shall extend to a level at which the diameter or width of capital is 2 times that of the column, in case of columns with capitals.

Spirals shall be held firmly in place and true to line.

#### **Ties**

Tie reinforcement for compression members shall conform to the following:

All bars shall be enclosed by lateral ties, at least 10mm diameter in size for longitudinal bars 30mm diameter or smaller, and at least 12mm diameter in size for 35mm diameter to 55mm diameter and bundled longitudinal bars.

Vertical spacing of ties shall not exceed 16 longitudinal bar diameters or 48 tie diameters, or the least dimension of the compression members.

Ties shall be arranged such that every corner and alternate longitudinal bar shall have lateral support provided by the corner of a tie with an included angle of not more than 135°. No vertical bar shall be farther than 150mm clear on each side along the tie from such a laterally supported bar. Where longitudinal bars are located around the perimeter of a circle, a complete circular tie is allowed.

The lowest tie in any story shall be placed within one-half the required tie spacing from the top most horizontal reinforcement in the slab or footing below. The uppermost tie in any story shall be within one-half the required tie spacing from the lowest horizontal reinforcement in the slab or drop panel above.

Where beams or brackets provide concrete confinement at the top of the column on all (four) sides, the top tie shall be within 75mm of the lowest horizontal reinforcement in the shallowest of such beams or brackets.

#### **Lateral reinforcement for beams**

Compression reinforcement in beams shall be enclosed by ties or stirrups satisfying the size and spacing limitations as stated above. Such ties or stirrups shall be provided throughout the distance where compression reinforcement is required.

Lateral reinforcement for flexural framing members subject to stress reversals or to torsion at supports shall consist of closed ties, closed stirrups, or spirals extending around the flexural reinforcement.

Closed ties or stirrups shall be formed in one piece by overlapping standard stirrup or tie end hooks around a longitudinal bar, or formed in one or two pieces laps, spliced with a lap of development length.

#### **12.1.15 SPACING OF REINFORCEMENT**

The minimum clear spacing between parallel bars in a layer shall be equal to one bar diameter, but not less than 25mm.

Where parallel reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above those in the bottom layer with clear distance between layers not less than 25mm.

For compression members, the clear distance between longitudinal bars shall be not less than 1.5 bar diameters or 35mm.

Clear distance limitation between bars shall apply also to the clear distance between a contact lap splice and adjacent splices or bars.



In walls and one-way slabs, the maximum bar spacing shall be three times the wall or slab thickness (h) but not more than 450mm.

For two-way slabs, maximum spacing of bars shall be 2h but not more than 450mm.

For temperature steel only, maximum spacing shall be 5h but not more than 450mm.

#### **12.1.16 SPLICING**

##### **General**

All reinforcement shall be furnished in the full lengths indicated on the Drawings unless otherwise permitted by the Engineer. Except for splices shown on the Drawings and splices for No. 5 or smaller bars, splicing of bars shall not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible.

Where the Drawings do not detail laps that will be necessary, the Contractor shall furnish working Drawings to the Engineer for his approval.

If such additional lap splices are approved, the extra weight occasioned by such lap splices shall not be included in the measurement of reinforcement for payment unless provided for in these Specifications.

##### **Lapped splices**

All splices for high yield strength steel bars shall have a lap length as shown on the Drawings or if not shown therein shall be in accordance with the American Concrete Institute Building Code Requirements for Reinforced Concrete (ACI 318-89).

All splices for mild steel shall have a lap length as shown on the Drawings or if not shown therein, of not less than 40 diameters of the smaller bar when hooks are used and 50 diameters for bars without hooks.

Lap splices shall not be used for 35mm diameter bars and larger, except when bars of different diameters are lap spliced in compression, the splice length shall be the larger development length of the larger bar, or the splice length of the smaller bar.

Lap splices of bundled bars shall be based on the lap splice length required for individual bars within the bundle, increased in accordance with development of bundled bars. Individual bar splices within a bundle shall not overlap. Entire bundles shall not be lap spliced.

Bars spliced by non-contact lap splices in flexural members shall not be spaced transversely farther apart than one-fifth the required lap splice length, nor 150mm.

Lap splices shall generally be located at points of minimum tension in bars. Except where otherwise shown on the Drawings, lap splices shall be made with the bars placed in contact and securely wired together.

##### **Welded splices**

Welding on Site shall be avoided wherever possible, but where suitable safeguards and techniques are employed and provided that the types of steel including high-yield steels to SS 2 have the required welding properties, it may be undertaken with the acceptance of the Engineer. Before welding any reinforcement, the Contractor shall supply to the Engineer a Welding Procedure Specification (WPS) and an example of the weld for the type of steel, connection and weld being proposed. If such evidence is not available, the Contractor shall demonstrate satisfactory performance by means of testing as agreed by the Engineer. Unless satisfactory performance of the proposed welded connection is established by either of the two methods described above, approval for use of the welded connection shall not be given.

In addition, and as required by the Engineer, the competence of the operators shall be demonstrated prior to and periodically during welding operations by submission of independent Welder Qualification Records (WQR) for each welder to be used on Site.

Welding may be used in fixing reinforcement in position, for example, by welding between crossing or lapping reinforcement, or between bars and other steel members.

Welded intersections shall not be spaced farther apart than 300mm in the direction of calculated stress, except for wire fabric used as stirrups.

Structural welding shall not be carried out unless specifically shown on the Drawings.

Notwithstanding the above, the Engineer will not permit tack welding of bars, which will be subject to fluctuating stresses in the completed structure.

Welding shall conform to the Structural Welding Code, Reinforcing Steel, AWS D 1.4 of the American Welding Society and applicable special provisions.

Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength  $f_y$  of the bar. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yield strength  $f_y$  of the bar. Welded splices and mechanical connections not meeting the above requirements are allowed where area of reinforcement is at least twice that required by analysis shall meet the following:

Splices shall be staggered at least 600mm and in such manner as to develop at every section at least twice the calculated tensile force at the section but not less than  $140 \text{ N/mm}^2$  for total area of reinforcement provided.

Spliced reinforcement may be rated at the specified splice strength, in computing tensile force developed at each section. Non-spliced reinforcement shall be rated at that fraction of  $f_y$  defined by the ratio of the shorter actual development required to develop the specified yield strength ( $f_y$ ).

#### **Splices of deformed bars in tension**

The minimum length of lap for tension splices shall be as required for Class A or B splice, but not less than 300mm, where the classification shall be as follows:

Class A splice.....  $1.0L_d$

Class B splice.....  $1.3L_d$

\*  $L_d$  is the development length

Lap splices of deformed bars in tension, shall be Class-B splices except that Class-A splices are allowed when the area of reinforcement provided is at least twice that required by analysis over the entire length of the splice, and one-half or less of the total reinforcement is spliced within the required lap length. Where area of reinforcement provided is less than twice that required by analysis, welded splices or mechanical connections used shall meet the following requirements. This is also applicable in case of splices in tension tie members those shall be made with a full welded splice or full mechanical connection.

Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength  $f_y$  of the bar.

A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yield strength  $f_y$  of the bar.

Welded splices or mechanical connections used where area of reinforcement provided is at least twice that required by analysis shall meet the following:

Splices shall be staggered at least 600mm and in such manner as to develop at every section at least twice the calculated tensile force at the section but not less than  $140 \text{ N/mm}^2$  for total area of reinforcement provided.

Spliced reinforcement may be rated at the specified splice strength, in computing tensile force developed at each section. Non-spliced reinforcement shall be rated at that fraction of  $f_y$  defined by the ratio of the shorter actual development length to  $l_d$  required to develop the specified yield strength  $f_y$ .

Splices in adjacent bars shall be staggered at least 750mm.

#### **Splices of deformed bars in compression**

The minimum length of lap for compression splice shall be  $0.07 f_y d_b$  for  $f_y$  equal to  $410 \text{ N/mm}^2$  or less or  $(0.13 f_y - 24)d_b$  for  $f_y$  greater than  $410 \text{ N/mm}^2$ , but not less than 300mm. For  $f'_c$  (specified compressive strength of concrete,  $\text{N/mm}^2$ ) less than  $20 \text{ N/mm}^2$ , length of lap shall be increased by one-third.

When bars of different diameters are lap spliced in compression, the splice length shall be the larger of the development length of the larger bar, or the splice length of the smaller bar. Welded splices or mechanical connections used in compression shall also satisfy the following requirements:

Welded splices shall be butted and welded to develop in tension at least 125 percent of the specified yield strength  $f_y$  of the bar.

A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of the specified yield strength  $f_y$  of the bar.

#### **End bearing splices**

Compression splices for bars required to transmit compressive stress only, may consist of end bearing of square cut ends held in concentric contact by a suitable device.

Bar ends shall terminate in flat surfaces within  $1.5^\circ$  of a right angle to the axis of the bars, and shall be fitted within  $3^\circ$  of full bearing after assembly.

End bearing splices shall be used only in members containing closed ties, closed stirrups or spirals.

#### **Special splice requirements for columns.**

Lap splices, butt-welded splices, mechanical connections, or end-bearing splices shall be used with the limitations as stated below. A splice shall satisfy the requirements for all load combinations for the column.

### **Lap splices in columns**

Lap splices shall conform to the first two requirements stated above under the Sub-section on 'Splices of Deformed Bars in Compression' and where applicable to (d) or (e) below where the bar stress due to factored loads is compressive.

Where the bar stress due to factored loads is tensile and does not exceed  $0.5f_y$  in tension, lap splices shall be Class B tension lap splices, if more than one half of the bars are spliced at any section, or Class A tension lap splices, if half or fewer of the bars are spliced at any section and alternate lap splices are staggered by  $l_d$  (development length).

Where the bar stress due to factored loads is greater than  $0.5f_y$  in tension, lap splices shall be Class B tension lap splices.

If spiral reinforcement confines the splice, the lengths required may be multiplied by 0.75, but lap length shall not be less than 300mm.

### **Welded splices or mechanical connectors in columns**

Welded splices or mechanical connectors in columns shall also meet the following requirements.

Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength  $f_y$  of the bar.

A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yield strength  $f_y$  of the bar.

### **End bearing splices in columns**

End bearing splices complying with the requirements stated above under Sub-section on "End Bearing Splices" may be used for column bars stressed in compression provided that the splices are staggered or additional bars are provided at splice locations. The continuing bars in each face of the column shall have a tensile strength at least  $0.25f_y$  times the area of the vertical reinforcement in that face.

### **Splices of plain bars**

For plain bars, the minimum length of lap shall be twice that of deformed bars.

### **Mechanical anchorage**

Any mechanical device capable of developing the strength of reinforcement without damage to concrete is allowed as anchorage.

Mechanical device may be used only when its adequacy can be proven by test results to the satisfaction of the Engineer.

Development of reinforcement may consist of a combination of mechanical anchorage plus additional embedded length of reinforcement between the point of maximum bar stress and the mechanical anchorage.

#### **12.1.17 SUBSTITUTIONS**

Substitutions of different size bars shall be permitted only with specific authorization by the Engineer and at no additional cost to the Employer. If bars are substituted, they shall have a cross sectional area equivalent to the design area or larger.

The Contractor shall also provide, also in the case of substitutions, at his own expenses and to the approval of the Engineer, such necessary detailing of the reinforcement as he requires for the execution of the work to the Engineer's satisfaction.

**12.1.18 CONCRETE COVER TO REINFORCEMENT**

Unless specified on the Drawings, the clear concrete cover to reinforcement shall be as tabulated below:

| Description of Concrete Element | Clear Cover (mm) |              |
|---------------------------------|------------------|--------------|
|                                 | Normal Exposure  | Saline Water |
| Wall and footing                |                  |              |
| a) Contact with earth           | 60               | 75           |
| b) Expose to weather and water  | 50               | 60           |
| Piles                           |                  |              |
| a) Cast-in-place                | 75               | 100          |
| b) Pre-cast                     | 40               | 50           |
| Beam, Girder, Column            | 40               | 50           |
| Building roof and floor slab    | 25               | 25           |

**12.1.19 PROTECTIVE COATING**

All exposed reinforcing steel at construction joints shall be protected with a brush coat of neat cement mixed to a consistency of thick paint within one week after the placing of the initial concrete, unless it is definitely known that the steel will be embedded within 30 days. This coating shall be entirely removed, by light tapping with a hammer or other tools, not more than one week before the placing of the final pour.

**12.1.20 BUNDLED BARS**

Groups of parallel reinforcing bars bundled in contact to act as one unit, shall be limited to four in any one bundle.

Bundled bars shall be enclosed within stirrups or ties.

Bars larger than 35mm diameter shall not be bundled in beams.

Individual bars within a bundle terminated within the span of flexural members shall terminate at different points with at least 40 times the nominal diameter of bar staggered.

Where spacing limitations and minimum concrete cover are based on nominal bar diameter, a unit of bundled bars shall be treated as a single bar of a diameter derived from the equivalent total area.

Minimum concrete cover shall be equal to the equivalent diameter of the bundle, but need not be greater than 50mm.

#### **12.1.21 INSPECTION**

The Contractor shall notify the Engineer when the steel has been placed in position and ready for concrete placing. No concrete shall be placed until the Engineer inspected the steel and given his approval in writing.

#### **12.1.22 MEASUREMENT**

The quantity of reinforcement to be measured under this Section shall be the computed weight in kilogram of material used and accepted as shown on the Drawings provided that the quantity shall not include the reinforcement in any item of works. In computing the weight to be measured, the theoretical weights of bars of the cross section shown in this Specification shall be used.

The computed weight shall not include the extra materials incurred, when bars larger than those specified are used or the extra materials necessary for splices, when bars shorter than those specified are used even with the permission of the Engineer. It shall not also include the weight of any devices used to support or fasten the reinforcement in correct position.

#### **12.1.23 PAYMENT**

This work measured as provided above, shall be paid for at the Contract unit price per kilogram of reinforcement for the particular Bill of Item. The payment shall be considered to be the full compensation for furnishing, fabricating, splicing and placing of the reinforcing steel, supports and binding wire, cutting and bending, all labours, equipment, tools and incidentals necessary to complete the works prescribed in this Section.

No separate payment shall be allowed for chairs, laps, splices, separators etc. The costs of these shall be considered included in the unit rate.

| <b>Item of Payment</b>            | <b>Unit</b> |
|-----------------------------------|-------------|
| Mild steel reinforcing bars       | Kilogram    |
| High yield steel reinforcing bars | Kilogram    |

### **12.2 WELDING**

#### **12.2.1 GENERAL**

All welding shall be performed by certified welders and in accordance with the American Welding Society (AWS) D1.1 'Structural Welding Code' or similar approved standard.

The principal forms of welding metals are as follows:

- Electric arc welding
- Gas welding

The electric arc welding process is the most important and is most extensively used for mild steels ranging from light articles with a wall or thickness of 16 gauge to heavy fabrications. This is a process whereby the metal of the two members to be welded is fused together through heat generated by an electric arc. Fusion should be complete over the whole area of the joint surface.

Gas welding is done using oxy-acetylene flame and is not adapted to structural steel works, but is generally used for small jobs. The flame produced by burning oxy-acetylene is fed through a blowpipe, which is ignited at its tip. The flame is played on the two pieces to be welded until the metal becomes hot enough to fuse together adding additional metal to the joint as necessary by melting in to it a suitable electrode.

Unless otherwise specified, all welding shall be performed following the Shielded Metal Arc Process with low hydrogen electrodes for manual welding.

The Contractor shall be responsible for the quality of the welding performed by his welding organization. All welding by the Contractor shall be carried out by the electric arc method using coated electrodes or other means whereby the air is excluded from the molten metal and where applicable, automatic machines with correct procedure control shall be used.

#### **12.2.2 WORKMANSHIP AND VISUAL QUALITY REQUIREMENTS**

In addition to conforming with the procedural and quality requirements set forth in the Structural Welding Code and/or these Specifications, all manual welding shall meet the following requirements for workmanship and visual quality.

Each weld shall be uniform in width and size throughout its full length and each layer of welding shall be smooth, free of slag, cracks, pinholes and undercut and shall be completely fused to the adjacent weld beads and base metal. In addition, the cover pass shall be free of coarse ripples, irregular surface, non-uniform bead pattern, high crown, deep ridges or valleys between beads and shall blend smoothly and gradually into the surface of the base metal.

Butt Welds shall be slightly convex, of uniform height and shall have full penetration.

Fillet Welds shall be of specified size with full throat and with each leg of uniform length.

Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the base metal thickness.

#### **12.2.3 WELDING REPAIRS**

All weld defects which are determined unacceptable, shall be removed by chipping, grinding, arc or flame gouging, following which the area shall be properly prepared for welding, repaired by an approved qualified welding procedure and re-tested as necessary. The Contractor shall establish the cause of all defects and show that such defects have been corrected before welding will be permitted. All repairing shall be done by and at the expenses of the Contractor.

#### **12.2.4 PEENING**

The Contractor shall not be allowed to peen welds without prior approval of the Engineer.

#### **12.2.5 ELECTRODES**

All electrodes shall be purchased in sealed containers and shall be thoroughly dry when used. Electrodes, taken from sealed containers, shall be used within four hours. Electrodes not used within four hours shall be stored in electrode storage ovens. The electrode storage oven temperature shall be in accordance with the electrode manufacturer's recommendations. Electrodes with wet or damaged coatings shall not be used.

A simple test indicates the quality of an electrode or welding or welding wire can be made by laying the wire flat on a clean surface and applying the welding flame to it for a distance of about 8 - 10cm by moving the flame backward and forward until the wire becomes red and then slowly melting the wire, moving the flame in such a manner so that the wire melts only half-way through its diameter. If the flame is withdrawn as soon as the rod metal begins to melt, the impurities can readily be seen being thrown off in the form of sparks, or a boiling action in the case of inferior metal. When cold, an inferior metal will contain numerous spongy, volcano-like irregularities. A good metal welding rod will melt and flow evenly without any disturbing actions.

Cracks may occur in welding alloy steels owing to the rapidity with which these harden. This may largely be avoided by preheating the parent metal at 300oC or above in advance of welding to lower the normal cooling rate.

The maximum diameters of electrodes for welding have been shown in the following table:



| Average thickness of plate or section | Maximum gauge or diameter of electrode to be used |
|---------------------------------------|---|
| Less than 5mm                         | 3.2mm – 10 SWG                                    |
| 5mm to Less than 8mm                  | 4mm – 8 SWG                                       |
| 8mm to Less than 10mm                 | 5mm – 6 SWG                                       |
| 10mm to Less than 16mm                | 6mm – 4 SWG                                       |
| 16mm to Less than 25mm                | 9mm   |
| 25mm and over                         | 9mm   |

The maximum width of any bead of welding, other than a cover pass, shall not exceed 3 times the diameter of the electrode being used.

Subject to the approval of the Engineer, electrodes shall be carefully selected in order to provide metal welds with mechanical properties similar to those of the metal being welded, except that for welding higher strength steel to lower strength steel, the electrodes shall be chosen to provide metal welds with mechanical properties comparable to those of the lower strength material.

#### **12.2.6 CUTTING AND EDGE PREPARATION**

Members of structural steel and miscellaneous metal works, which are to be joined by welding shall be cut accurately to size and where required, shall be rolled or pressed to the proper curvature in accordance with dimensions shown. The edges of these members shall be sheared, flame-cut or machined to suit the required type of welding and to allow thorough penetration. The cut surfaces shall expose sound metal, free from laminations, surface defects caused by shearing or flame-cutting operations, or other injurious defects. The surface to be welded shall be free from rust, grease, paint and other foreign matter for a distance of at least 150mm back from the edge of the weld.

#### **12.2.7 GRINDING WHEELS**

Grinding wheels, which leave a deposit detrimental to subsequent welding will not be permitted. Grinding wheels, which are determined by the Engineer to be detrimental to welding shall not be used.

#### **12.2.8 QUALIFICATION OF WELDERS AND WELDING OPERATORS**

All welders and welding operators assigned to the work shall have passed the qualification test for welding operators as specified in the AWS Structural Welding Code. If, as determined by the Engineer, the work of any welder appears questionable, such welder will be required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. Such additional qualification tests for welders and the physical tests of the welded specimens shall be made in the presence of the Engineer. If required, the Contractor shall furnish to the Engineer a certified copy of reports of the results of physical tests of specimens welded in the qualification tests. Fulfillment of such qualification shall be at the expenses of the Contractor.

#### **12.2.9 WELDING METHODS**

##### **GENERAL**

Methods which are essentially required to be followed while welding are as follows:

Welds should be made in the flat position as far as practicable.



Freedom of movement of one member should be allowed as far as possible.

The work should be securely held in position by means of spot welds, service bolts, clamps or jigs before commencing welding so as to prevent any relative movement due to distortion, wind or other causes.

The parts to be welded must be thoroughly cleaned and proper flux used. Any paint or rust and loose mill scales, etc. should be removed from the surfaces to be welded and surrounding materials for a distance of at least 12mm from the weld. A coating of boiled linseed oil may be permitted. Steel to be welded should not be painted or oiled until after erection, unless all ends to be welded are left bare.

The sequence of welding should be such that when possible the members, offering the highest resistance to compression, are welded first.

Extreme care shall be taken to ensure that correct welding sequences and procedures are observed to avoid any strains and internal stresses arising in welding.

#### **Welding of stainless steel**

Unless otherwise specified, all welding shall conform with AWD D1.1. Electrodes used for welding of stainless steel shall be Series E308 and electrodes used for welding of stainless steel to carbon steel shall be Series E309.

Welders and welding operators assigned to the work shall have passed the qualification test for welding operators as specified above under 'Qualification of Welders and Welding Operators' of this Sub-section.

#### **Welding of reinforcement**

Electric Arc Butt-welding is most suitable for bars of diameter greater than 20mm and lap welding for smaller diameters and lap welding with longitudinal beads for 6mm to 40mm diameters. However, reinforcement, specified to be welded, shall be welded by any process the Contractor can demonstrate by bend and tensile tests, which will ensure that the strength of the parent metal is not reduced and that the weld possesses a strength no less than that of the parent metal. The welding procedure established by the successful weld tests shall be maintained and no departure from this procedure shall be permitted. Following the establishment of a satisfactory welding procedures, each welder to be employed on the work shall carry out welder performance qualification tests on reinforcing bars of the same metal and size as those on the works.

Welds in positions other than those shown on the Drawings and/or as directed by the Engineer shall not be permitted.

##### **12.2.10 DEFECTS IN WELDED JOINTS**

The usual defects in welded joints are:

Lack of penetration or fusion of the metal to the bottom of the joint or welded members.

Laps in the metal of the weld not properly fused together.

Defects are most likely to occur at the root of the weld and in this position they are liable to have the maximum effects in reducing the strength of the weld.

#### **12.2.11 INSPECTION AND TESTING OF WELDS**

The metal in a good weld when cold should show its original color. If the metal has a rusty or dull red color or appears crystallized, it is an indication that the heat has become too high and the metal has been burnt. A good weld will show an evenness of ripples or waves and well-formed beads with good fusion along the edges of the welds. There should be no unfilled cavities, small pockets of slags or burnt metal and small air or gas pockets. The strength of a welded joint may be taken only about 75 per cent of the stress usually allowed for common works, although tests have shown that if the welding is properly done it is possible to develop the full strength of the members jointed. The following tests shall be carried out on the procedure, qualification, test plates and production test plates:

Tensile and bend tests: all welds shall be subject to visual inspection.

The procedures of visual examination shall conform to the requirements of the ASME Boiler and Pressure Vessels Code.

The following defects are unacceptable unless otherwise noted:

Dimensional defects such as insufficient throat or leg length, excess convexity, excess or insufficient reinforcement.

Undercuts, overlap, blowholes, slag inclusion, seams and excess weave.

Any crack or liner indication.

Plates with laminations discovered during gas cutting, welding or any other time shall be rejected, unless approval to repair the plate is obtained from the Engineer. Welds may also be subject to anyone or a combination of the examinations as may be required to establish the soundness of welds. The inspection procedures for testing of all welds shall be prepared on the above basis by the Contractor and submitted to the Engineer for approval before any fabrication work is started.

#### **12.2.12 MEASUREMENT AND PAYMENT**

Welding shall not be measured and no direct payment shall be made. All costs of welding shall be deemed included in the related items of the Bill of Quantities unless otherwise it has been specifically mentioned in the BOQ.

|   |            |
|---|------------|
| <b>13.0 SUB-SOIL BORING AND TESTING .....</b>         | <b>120</b> |
| <b>13.1 GENERAL .....</b>                             | <b>120</b> |
| <b>13.2 BORING .....</b>                              | <b>120</b> |
| <b>13.3 DISTURBED SAMPLES.....</b>                    | <b>120</b> |
| <b>13.4 UNDISTURBED SAMPLES .....</b>                 | <b>120</b> |
| <b>13.5 HANDING AND LABELING OF SAMPLES .....</b>     | <b>120</b> |
| <b>13.6 STANDARD PENETRATION TEST .....</b>           | <b>121</b> |
| <b>13.7 DISPATCH OF SAMPLES.....</b>                  | <b>121</b> |
| <b>13.8 LABORATORY TESTS.....</b>                     | <b>121</b> |
| <b>13.8.1 PREPARATION OF THE TEST SPECIMENS .....</b> | <b>121</b> |
| <b>13.8.2 UNCONFINED COMPRESSION TEST .....</b>       | <b>122</b> |
| <b>13.8.3 TRIAXIAL TEST .....</b>                     | <b>122</b> |
| <b>13.8.4 CONSOLIDATION TEST .....</b>                | <b>122</b> |
| <b>13.8.5 ROUTINE TEST .....</b>                      | <b>122</b> |
| <b>13.8.6 REPORT AND RECORDS.....</b>                 | <b>122</b> |
| <b>13.9 MEASUREMENT .....</b>                         | <b>123</b> |
| <b>13.10 PAYMENT .....</b>                            | <b>123</b> |

### **13.0 SUB-SOIL BORING AND TESTING**

#### **13.1 GENERAL**

Confirmatory Sub-Soil investigation shall be carried out at the actual locations of each foundation. The objective of the subsoil investigation is to ascertain the actual soil strata at the location, the engineering properties at each stratum and to ascertain the level at which the foundation can be laid. The investigation shall be carried out as per the following specifications and as directed by the Engineer.

#### **13.2 BORING**

Boring shall be carried out in accordance with the specifications of ASTM D 1586 and D 1587. The bore holes shall have a minimum diameter of 100mm and shall be lined throughout. Minimum depths shall be 20m unless otherwise directed by the Engineer. The toe of the lining shall at no time be more than 1m above the level to which the soil has been removed from the bore hole.

Before taking any undisturbed sample or making any in-situ test, the lining shall be carried down to the bottom of the bore hole at the test depth.

Auger of proper size shall be used in very soft to soft clays and silts to avoid suction. The use of shell shall only be restricted to moderately stiff to very stiff and hard clays and also in sandy strata below water table. The use of a chisel would be permitted only in case of boulder or rock formation or through local obstructions or other situation demanding its use as would be decided by the Engineer.

Uncased bore holes may be permitted only upto a depth where the sides of the hole can stand unsupported. In case of side fall or squeezing, steps shall be taken immediately to stabilize the sides of the bore hole by casing pipes as directed by the Engineer. Use of Bentonite slurry of 5% concentration may be permitted to stabilize the bore hole.

No water shall be added while boring through cohesive soils and non-cohesive soils above the water table. While boring through non-cohesive soil below water table, water level in the casing shall always be maintained at or above the water table.

The cutting brought up by the auger shell or the split-spoon or undisturbed sampler shall be carefully examined and the soil description duly recorded after performing field identification tests.

On completion of boring at any bore hole, a bore log shall be prepared in an approved standard format in consultation with the Engineer and submitted to the Engineer in triplicate. Position of the water table shall be observed after 24 hours and back filling of the bore hole shall be carried out with approved materials in a manner as directed by the Engineer.

#### **13.3 DISTURBED SAMPLES**

Disturbed samples shall be taken from bore hole cuttings and split-spoon for visual classification tests at the Site. The samples shall be taken at 1.5m interval or at every identifiable change of strata, whichever is met earlier to give a reliable record of the variation in the conditions of the soils. Disturbed samples shall be sent to the laboratory in airtight plastic container with proper label for the purpose of record and laboratory testing.

#### **13.4 UNDISTURBED SAMPLES**

Collection of undisturbed samples from cohesive soil layers shall be conducted as per ASTM D 1587 and/or any other equivalent.

#### **13.5 HANDLING AND LABELING OF SAMPLES**

The following conditions of handling and protection of undisturbed samples shall be undertaken on undisturbed sample.

Immediately after being taken from the bore hole, the ends of the sample shall be cut and removed to a depth of about 2.5cm (or more in the top to cover any obviously disturbed soil). Several layers of molten wax should then be applied to each end to give a plug about 2.5cm thick. If the sample is very porous, a layer of waxed paper should first be placed over the ends of the sample.

Any space left between the end of the sample tube and the top of the wax should be tightly packed with saw dust or other suitable materials and a close fitting lid or screwed cap shall be placed on each end of the sample tube.

The lids should, if necessary, be held in position by adhesive tape.

A label bearing the number of the sample, bore hole number, depth of sample, date, etc. preferably typed, shall be placed inside the container just under the lid. It shall be placed at the top of the sample. In addition, the number of the sample shall be painted on the outside of the container and the top or bottom of the sample shall be indicated.

Undisturbed soil sample tubes shall be placed in a strong wooden box and packed with moist saw dust, paper, etc. to prevent damage during dispatch to the laboratory.

### **13.6 STANDARD PENETRATION TEST**

Standard penetration test shall be conducted as per ASTM D 1586 at an interval of 1.5m or at every identifiable change of strata, whichever is earlier.

The driving of split-spoon shall be recorded for every 150mm penetration till the total penetration is 450mm.

Driving of the split-spoon shall be terminated when standard penetration resistance value,  $N > 100$  blows / 30cm of penetration is received, unless otherwise directed by the Engineer. The test shall be conducted after driving the casing to the bottom of the bore hole and after cleaning it. N-values, as observed in the field, shall be reported in the bore logs without any correction.

### **13.7 DISPATCH OF SAMPLES**

Samples shall be dispatched to the laboratory as soon as possible after being obtained and shall not be allowed to accumulate at Site. In the event a danger of sample's deterioration through further storage is noticed, the Contractor shall dispatch such samples immediately on receiving direction from the Engineer.

### **13.8 LABORATORY TESTS**

#### **GENERAL**

Laboratory tests shall be carried out as per relevant ASTM or BS Procedures or by any other procedures approved under equivalent recognized standards. The results of all tests shall be submitted in the format as approved by the Engineer.

#### **13.8.1 PREPARATION OF THE TEST SPECIMENS**

Preparation of test specimens for the various tests shall be carried out as per the procedures laid down in the various relevant ASTM or BS Codes or by any other procedures approved under equivalent recognized standards.

In case of soft to firm cohesive undisturbed soil samples, test samples for all types of shear tests shall be prepared strictly by hand trimming on soil lathe. Care shall be taken against bending of soil samples at the time of horizontal ejection of the samples from the sampling tubes. Samples shall be ejected

from the sampling tubes preferably in the same direction of travel in which the samples entered the sampling tubes.

Similarly test specimens for consolidation tests shall also be prepared to the required size by hand trimming only and the ring of the consolidation apparatus shall be inserted by pressing gently with the hands and carefully removing the material around the ring. In no case the ring should be forced into the soil. Great cares shall be taken during trimming of the sample from the top and the bottom of the ring. The test specimen shall be prepared in the same orientation as that to the actual strata so that the laboratory test load compresses the soil in the same direction relative to the soil strata as the applied load in the field.

#### **13.8.2 UNCONFINED COMPRESSION TEST**

Unconfined compression test shall be conducted both on natural and remolded soil samples. Remolded soil specimen shall be prepared by the dynamic method of compaction.

Each unconfined compression test (natural or remolded) shall comprise tests on minimum of three soil specimens, not less than 38mm diameter and a height to diameter ratio of 2 together with the determination of natural moisture content and density. Water content of the specimen shall be taken from the failure zone of the specimen. Test results shall be observed and reported as per the standard practice.

#### **13.8.3 TRIAXIAL TEST**

Triaxial test shall be conducted on the undisturbed samples selected by the Engineer. Each test shall be conducted on a minimum of three specimens tested at different cell pressures ( $0.5 \text{ kg/cm}^2$ ,  $1.0 \text{ kg/cm}^2$  and  $1.5 \text{ kg/cm}^2$ ). The moisture content before and after the test and the density shall be determined.

The stress-strain diagrams as well as the Mohr circle envelop for these tests shall be submitted.

#### **13.8.4 CONSOLIDATION TEST**

Consolidation tests shall be conducted on undisturbed samples selected by the Engineer. The coefficient of consolidation ( $C_v$ ), the coefficient of volume compressibility ( $M_v$ ), Laboratory Compression Index ( $C_{cl}$ ), Field Compression Index ( $C_{cf}$ ) including field virgin slope and the coefficient of permeability ( $k$ ) shall be determined and results shall be submitted.

The loading on the test specimens shall be applied at the stages of  $0.1 \text{ kg/cm}^2$ ,  $0.25 \text{ kg/cm}^2$ ,  $0.5 \text{ kg/cm}^2$ ,  $1.0 \text{ kg/cm}^2$ ,  $2.0 \text{ kg/cm}^2$ ,  $4.0 \text{ kg/cm}^2$  and  $8.0 \text{ kg/cm}^2$ . Unloading of the test specimens shall be done at suitable stages.

#### **13.8.5 ROUTINE TEST**

All routine tests like natural moisture content, bulk density, liquid and plastic limits, grain size distribution, specific gravity, shall be conducted on selected representative samples as directed by the Engineer.

#### **13.8.6 REPORT AND RECORDS**

On completion of each bore hole, three copies of a bore hole log shall be submitted to the Engineer together with one copy of the list of disturbed and undisturbed samples taken from the bore hole.

These bore logs shall show:

Ground level referred to the reduced level.

Locations of the bore holes on a plan.

Detailed description of each stratum.

Position, type and identification of each sample and SPT value.

Any other Site test results available.

Levels at which each separate ground water level is first encountered and at which it comes to rest (standing water level).

On completion of all field and laboratory tests, all results shall be submitted to the Engineer in 3 (three) copies in the form of reports with comments and views.

### **13.9 MEASUREMENT**

The work will be measured for payment as an item on a lump sum basis or as specified in the Schedule of Items and BOQ.

### **13.10 PAYMENT**

Payment shall only be admissible on implementation of the item as measured and provided above and on being certified by the Engineer that the investigations have been carried out as per specifications as contained herein. Payment shall be made as lump sum rate or as specified in the Schedule of Items and BOQ, which shall cover the full costs of boring, collection and dispatch of samples, standard penetration test and all necessary Laboratory tests, preparation and submission of records, cost of all labour, equipment, materials, tools, test fees and all incidentals required for undertaking the test and submission of requisite reports to the Engineer in its totality. No payment shall be made until the testing results and other information in the form of reports with requisite number of copies are submitted to the Engineer.

| <b>Item of Payment</b> | <b>Unit</b> |
|------------------------|-------------|
| Sub-soil investigation | Lump sum    |

|   |            |
|---|------------|
| <b>14.0 FLOOR</b>                             | <b>124</b> |
| <b>14.1 NON-SKID FLOOR TILES</b>              | <b>124</b> |
| <b>14.1.1 DESCRIPTION</b>                     | <b>124</b> |
| <b>14.1.2 MATERIALS</b>                       | <b>124</b> |
| <b>14.1.3 CONSTRUCTION METHODS</b>            | <b>124</b> |
| <b>14.1.4 MEASUREMENT</b>                     | <b>125</b> |
| <b>14.1.5 PAYMENT</b>                         | <b>125</b> |
| <b>14.2 CERAMIC TILES</b>                     | <b>125</b> |
| <b>14.2.1 GENERAL</b>                         | <b>125</b> |
| <b>14.2.2 PERFORMANCE REQUIREMENTS</b>        | <b>126</b> |
| <b>14.2.3 SUBMITTALS</b>                      | <b>126</b> |
| <b>14.2.4 QUALITY ASSURANCE</b>               | <b>127</b> |
| <b>14.2.5 DELIVERY, STORAGE, AND HANDLING</b> | <b>128</b> |
| <b>14.2.6 PROJECT CONDITIONS</b>              | <b>128</b> |
| <b>14.2.7 EXTRA MATERIALS</b>                 | <b>128</b> |
| <b>14.2.8 PRODUCTS GENERAL</b>                | <b>128</b> |
| <b>14.2.9 TILE PRODUCTS</b>                   | <b>129</b> |
| <b>14.2.10 MISCELLANEOUS MATERIALS</b>        | <b>129</b> |
| <b>14.2.11 MIXING MORTARS AND GROUT</b>       | <b>129</b> |
| <b>14.2.12 EXECUTION EXAMINATION</b>          | <b>130</b> |
| <b>14.3 PORCELAIN</b>                         | <b>130</b> |
| <b>14.3.1 GENERAL</b>                         | <b>130</b> |
| <b>14.3.2 PERFORMANCE REQUIREMENTS</b>        | <b>130</b> |
| <b>14.3.3 SUBMITTALS</b>                      | <b>130</b> |
| <b>14.3.4 QUALITY ASSURANCE</b>               | <b>131</b> |
| <b>14.3.5 DELIVERY, STORAGE, AND HANDLING</b> | <b>132</b> |
| <b>14.3.6 EXTRA MATERIALS</b>                 | <b>132</b> |
| <b>14.3.7 PRODUCTS GENERAL</b>                | <b>133</b> |
| <b>14.3.8 TILE PRODUCTS</b>                   | <b>133</b> |
| <b>14.3.9 FLOOR TILING</b>                    | <b>134</b> |
| <b>14.3.10 GROUTING MATERIALS</b>             | <b>134</b> |
| <b>14.3.11 ELASTOMERIC SEALANTS</b>           | <b>134</b> |
| <b>14.3.12 MISCELLANEOUS MATERIALS</b>        | <b>135</b> |
| <b>14.3.13 MIXING MORTARS AND GROUT</b>       | <b>135</b> |
| <b>14.3.14 EXECUTION EXAMINATION</b>          | <b>135</b> |



**14.0 FLOOR**

**14.1 NON-SKID FLOOR TILES**

**14.1.1 DESCRIPTION**

Works covered under this item shall consist of supplying, fitting and fixing approved foreign/local made homogeneous quartz/embossed, non-skid floor tiles or special quality fibrous floor tiles laid on cement mortar base of proportion in accordance with the applicable Drawings, requirements of the BOQ, and these Specifications and/or as directed by the Engineer.

**14.1.2 MATERIALS**

**Tiles**

Tiles shall be either homogeneous quartz/embossed non-skid or special quality fibrous. The tiles shall be local/foreign made and of the sizes as shown on the Drawings, described in the Schedule of Works and/or as directed by the Engineer. They should be free from all warpage blemishes and dimensional defects.

**Mortar**

Mortar for installation shall consist of 1-part cement and 2 parts sand (FM 1.2). The specification for cement and sand shall conform to those stated under the relevant Sub-sections of the Section on 'Construction Materials' of this Specification and/or as directed by the Engineer.

**Grout**

All grout for tile joints be prepared with white cement or colored with inert pigments as and where specified. The specification for white cement shall conform to those stated under the relevant Sub-sections of the Section on 'Construction Materials' of this Specification and/or as directed by the Engineer.

**Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other deleterious substances and shall not contain any visibly solid materials. All requirements shall be similar to what have been stated under the relevant Sub-section of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification. The Contractor shall get the water tested by comparing with water of known satisfactory quality, if requested by the Engineer.

**14.1.3 CONSTRUCTION METHODS**

The Contractor shall submit three sets of samples of all types of tiles to the Engineer for his approval before procuring the materials. One set will be kept in the office of the Engineer, one set at the Site office and the remaining set will be returned to the Contractor.

The Contractor shall prepare sample tile work and he should obtain its approval from the Engineer. Before such approval is received, no full-scale work shall start. The design of the floor layout shall conform to what have been shown on the Drawing and/or as directed by the Engineer.

The tiles shall be laid over previously roughened and wetted patent stone floor. The panels shall be of the size as shown on the Drawings and/or as indicated in the relevant item of the BOQ and/or as directed by the Engineer.

The sub-floor on which the tiles will be laid, shall be prepared in the same way as have been stated under the Sub-section on 'Patent Stone Floor' of this Section, but it will exclude the portion of neat cement finishing.

The tiles are to be fitted and fixed on the floor on a base of 20mm thick cement mortar prepared with 1 part ordinary Portland cement and 2 parts sand of FM 1.2. The mortar bed shall be cut through horizontally and vertically every 425mm to 600mm.

If the surface needs leveling, a scratch coat of plaster shall be applied, leveled and scratched for key and be allowed to dry out for 12 hours before installing tiles. The setting mortar shall be applied evenly and a neat cement paste to a thickness of about 2mm shall be troweled to the back of the tiles. The tiles will then be set on firmly tapped into place to ensure full contact. The joints shall be in specified pattern and shall not exceed 2mm in width. The joints shall be raked with grout prepared with white cement and colored pigment and damp-cured for at least 3 days.

The tiles shall be soaked in water for at least 6 hours before laying. Installation shall be controlled by strings, pages, spacers, levels or other suitable methods so as to ensure their correct laying and uniform leveled joints.

#### **14.1.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of finished tiled surface in place completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **14.1.5 PAYMENT**

The amount of completed and accepted works measured as provided above shall be paid at the Contract unit price per square meter, which shall constitute the full compensation for furnishing all materials, equipment and labor, including transport, storage and handling of materials, cleaning, preparing and laying bed with cement mortar and cutting and laying the tiles with neat cement paste, grouting and curing tiles ranking our joints, high quality finishing and all other works and all incidentals necessary to complete the Work as per requirements described under this item of work, the requirements of the BOQ, as shown on the Drawings and as directed by the Engineer. However, this item shall not include the costs for the item on Artificial Stone Floor.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| Non-skid floor tiles   | Square meter / Square feet |

### **14.2 CERAMIC TILES**

#### **14.2.1 GENERAL**

#### **RELATED DOCUMENTS**

Related Drawing and Detail.

#### **SUMMARY**

This Section includes the following:

Ceramic Tiles.

#### **DEFINITIONS**

**Module Size:** Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated

**Facial Dimension:** Actual tile size (minor facial dimension as measured per ASTM C 499).

**Facial Dimension:** Nominal tile size as defined in ANSI A137.1.

#### **14.2.2 PERFORMANCE REQUIREMENTS**

**Static Co-efficient of Friction:** For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

Level Surfaces: Minimum 0.6.

**Load-Bearing Performance:** Provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:

Heavy: Passes cycles 1 through 12. Use where indicated in finishing Schedules.

Moderate: Passes cycles 1 through 10. Use for other applications indicated on Schedule where heavy duty is not indicated.

#### **14.2.3 SUBMITTALS**

**Product Data:** For each type of tile, mortar, grout, and other products specified.

**Shop Drawings:** For the following:

Tile patterns and locations.

Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

Locate precisely each joint and crack in tile substrates, record measurements on shop drawings, and coordinate them with tile joint locations, as approved by Consultant.

**Tile Samples for Initial Selection:** Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

**Samples for Verification:** Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.

Each type and composition of tile and for each color and texture required, at least 400 mm square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Consultant.

Full-size units of each type of trim and accessory for each color required.

Stone thresholds in 150-mm lengths.

**Master Grade Certificates:** For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

**Product Certificates:** Signed by manufacturers certifying that the products furnished comply with requirements.

**Installer Experience:** List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product.

**Installer Experience:** List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of Consultants and Employers, and other any information required by Consultant.

**Test Reports:** Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile and tile setting and grouting products with requirements indicated.

**Setting Material Test Reports:** Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements.

#### **14.2.4 QUALITY ASSURANCE**

**Quality System:** Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.

**Installer Qualifications:** Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

**Source Limitations for Tile:** Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

**Source Limitations for Setting and Grouting Materials:** Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

**Source Limitations for Other Products:** Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

Stone thresholds.

Waterproofing.

Cementitious backer units.

Joint sealants.

**Mockups:** Before installing tile, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work.

Locate mockups in the location and of the size indicated or, if not indicated, as directed by Consultant.

Notify Consultant 7 days in advance of the dates and times when mockups will be constructed.

Demonstrate the proposed range of aesthetic effects and workmanship.

Obtain Consultant's approval of mockups before proceeding with final unit of Work.

Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

Approved mockups in an undisturbed condition as judged solely by the Consultant at the time of Substantial Completion may become part of the completed Work, otherwise demolish mockups, remove rubbles from site and install permanent works.

**Pre-installation Conference:** Conduct conference at Project site to comply with requirements of Project Management and Coordination.

#### **14.2.5 DELIVERY, STORAGE, AND HANDLING**

Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

#### **14.2.6 PROJECT CONDITIONS**

**Environmental Limitations:** Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

#### **14.2.7 EXTRA MATERIALS**

Deliver extra materials to Employer. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

#### **14.2.8 PRODUCTS**

##### **GENERAL**

Provide tile complying with Standard Grade requirements, unless otherwise indicated.

Retain below with appropriate definitions in referenced part 1 article.

For facial dimensions of tile, comply with standard requirements unless otherwise indicated.

Tiles are to be highest grade of production in manufacturer's quality grading system.

**ANSI Standards for Tile Installation Materials:** Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

**Colors, Textures, and Patterns:** Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

Provide Consultant's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.

**Factory Blending:** For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

**Mounting:** Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

**Factory-Applied Temporary Protective Coating:** Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

#### **14.2.9 TILE PRODUCTS**

**Wall Tile:** Provide flat tile complying with the following requirements:

Module Size: As indicated on Drawings.

Water Absorption: Less than 6% to ASTM C373.

Thickness: minimum 3 mm to 5 mm.

Face: Plain with modified square edges or cushion edges.

**Background/Base:** 15mm thick 1:4 cement/sand render on concrete or concrete blockworks.

**Bedding:** Thin cement based adhesive to be approved

**Grouting material:** Epoxy grout Nitotile 489 as supplied by Fosroc or equal approved to be used in accordance with manufacturer recommendations. Colour to architects approval.

**Movement joints:** All internal corners; Width: 6mm.

#### **14.2.10 MISCELLANEOUS MATERIALS**

**Trowel able Underlayment's and Patching Compounds:** Latex-modified, Portland-cement-based formulation provided or approved by manufacturer of tile- setting materials for installations indicated.

**Temporary Protective Coating:** Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.

Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 49 to 60 deg C per ASTM D 87.

**Tile Cleaner:** A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

#### **14.2.11 MIXING MORTARS AND GROUT**

Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

Add materials, water, and additives in accurate proportions.

Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

#### **14.2.12 EXECUTION EXAMINATION**

Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.

### **14.3 PORCELAIN**

#### **14.3.1 GENERAL**

#### **RELATED DOCUMENTS**

Related Drawing and Detail.

#### **SUMMARY**

This Section includes the following:

Porcelain Tiles.

#### **DEFINITIONS**

**Module Size:** Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

**Facial Dimension:** Actual tile size (minor facial dimension as measured per ASTM C 499).

**Facial Dimension:** Nominal tile size as defined in ANSI A137.1.

#### **14.3.2 PERFORMANCE REQUIREMENTS**

**Static Coefficient of Friction:** For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

Level Surfaces: Minimum 0.6.

**Load-Bearing Performance:** Provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:

Heavy: Passes cycles 1 through 12. Use where indicated in finishing Schedules.

Moderate: Passes cycles 1 through 10. Use for other applications indicated on Schedule where heavy duty is not indicated.

#### **14.3.3 SUBMITTALS**

**Product Data:** For each type of tile, mortar, grout, and other products specified.

**Shop Drawings:** For the following:

Tile patterns and locations.

Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

Locate precisely each joint and crack in tile substrates, record measurements on shop drawings, and coordinate them with tile joint locations, as approved by Consultant.



**Tile Samples for Initial Selection:** Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

**Samples for Verification:** Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.

Each type and composition of tile and for each color and texture required, at least 400 mm square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Consultant.

Full-size units of each type of trim and accessory for each color required.

Stone thresholds in 150-mm lengths.

**Master Grade Certificates:** For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

**Product Certificates:** Signed by manufacturers certifying that the products furnished comply with requirements.

**Installer Experience:** List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product.

**Installer Experience:** List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product  
**Qualification Data:** For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of Consultants and Employers, and other any information required by Consultant.

**Test Reports:** Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile and tile setting and grouting products with requirements indicated.

**Setting Material Test Reports:** Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements.

#### **14.3.4 QUALITY ASSURANCE**

**Quality System:** Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.

**Installer Qualifications:** Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

**Source Limitations for Tile:** Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.



**Source Limitations for Setting and Grouting Materials:** Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

**Source Limitations for Other Products:** Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

Stone thresholds.

Waterproofing.

Cementitious backer units.

Joint sealants.

**Mockups:** Before installing tile, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work.

Locate mockups in the location and of the size indicated or, if not indicated, as directed by Consultant.

Notify Consultant 7 days in advance of the dates and times when mockups will be constructed.

Demonstrate the proposed range of aesthetic effects and workmanship.

Obtain Consultant's approval of mockups before proceeding with final unit of Work.

Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

Approved mockups in an undisturbed condition as judged solely by the Consultant at the time of Substantial Completion may become part of the completed Work, otherwise demolish mockups, remove rubbles from site and install permanent works.

**Pre-installation Conference:** Conduct conference at Project site to comply with requirements of Project Management and Coordination.

#### **14.3.5 DELIVERY, STORAGE, AND HANDLING**

Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

#### **14.3.6 EXTRA MATERIALS**

Deliver extra materials to Employer. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

#### **14.3.7 PRODUCTS GENERAL**

i.

Provide tile complying with Standard Grade requirements, unless otherwise indicated.

Retain below with appropriate definitions in referenced part 1 article.

For facial dimensions of tile, comply with standard requirements unless otherwise indicated.

Tiles are to be highest grade of production in manufacturer's quality grading system.

**ANSI Standards for Tile Installation Materials:** Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

**Colors, Textures, and Patterns:** Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

Provide Consultant's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.

**Factory Blending:** For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

**Mounting:** Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

**Factory-Applied Temporary Protective Coating:** Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

#### **14.3.8 TILE PRODUCTS**

**General Characteristics:** Tiles are to comply with the following general requirements:

Floor Tiles:

Abrasive Hardness: Minimum Index 253 to ASTM C 501 (unglazed tiles), unless otherwise specified.

Bending Strength: Minimum 35 Kg/cm<sup>2</sup> to ASTM C 648.

Water Absorption: As specified.

Chemical Resistance: Unaffected with moderate acids.

5) **Tile Rating:** For heavy duty floor by a rating system acceptable to the Consultant.

**Background/Base:** 15mm thick 1:4 cement/sand render on concrete or concrete block works.

**Bedding:** Thin cement based adhesive to be approved

**Grouting material:** Epoxy grout Nitotile 489 as supplied by Fosroc or equal approved to be used in accordance with manufacturer recommendations. Colour to architects approval.

**Movement joints:** All internal corners; Width: 6mm.

**Accessories:** all exposed edges and corners to have preformed rounded edges.

#### **14.3.9 FLOOR TILING**

**Background/Base:** screed 1 in-situ concrete

**Screed:** 1:3:6 cement/sand/aggregate semi-dry screed laid to falls and towards floor drain outlets, overall thickness of flooring to be 75mm  
**Bedding:** Waterproof adhesive on cement 1 sand bed  
**Adhesive:** to be approved

**Waterproofing:** 2 coats Fosroc Nitoproof 10, or equal, to B.S. Standard. laid to manufacturer's recommendations, with necessary accessories

**Grouting material:** Epoxy grout Nitotile 489 as supplied by Fosroc or equal approved to be used in accordance with manufacturer recommendations. Colour to architects approval.

**Joint width:** 2 mm

**Movement joints:**

Location: At all perimeters including door thresholds;

Width: 2 mm

**Accessories:**

Skirting: Coved skirting tiles, 100mm high to match ceramic floor tiles, set flush with render, to be fixed on plastered walls, grouted with epoxy grout Nitotile 489 as supplied by Fosroc or equal approved, applied in accordance with manufacturer's recommendations.

#### **14.3.10 GROUTING MATERIALS**

**Sand-Portland Cement Grout:** ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

**Chemical-Resistant Epoxy Grout:** ANSI A 118.3, color as indicated.

Provide product capable of resisting continuous and intermittent exposure to temperatures of up to 60 deg C and 100 deg C, respectively, as certified by mortar manufacturer for intended use.

**Grout Colors:** Provide colors as selected by the Consultant from manufacturer's full range of standard and custom colors. Finish shall be smooth, unless otherwise specified or directed by the Consultant.

#### **14.3.11 ELASTOMERIC SEALANTS**

**General:** Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Joint Sealants.

**Colors:** Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

#### **14.3.12 MISCELLANEOUS MATERIALS**

**Trowelable Underlayments and Patching Compounds:** Latex-modified, Portland-cement-based formulation provided or approved by manufacturer of tile- setting materials for installations indicated.

**Temporary Protective Coating:** Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.

Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 49 to 60 deg C per ASTM D 87.

**Tile Cleaner:** A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

#### **14.3.13 MIXING MORTARS AND GROUT**

Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

Add materials, water, and additives in accurate proportions.

Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

#### **14.3.14 EXECUTION EXAMINATION**

Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.

|  |            |
|--|------------|
| <b>15.0 CEMENT PLASTER &amp; POINTING .....</b>                        | <b>136</b> |
| <b>15.1 12MM THICK CEMENT-SAND PLASTER ON BRICK MASONRY WALL .....</b> | <b>136</b> |
| 15.1.1 DESCRIPTION.....  | 136        |
| 15.1.2 MATERIALS.....  | 136        |
| 15.1.3 CONSTRUCTION METHODS.....                                       | 136        |
| 15.1.4 SCAFFOLDING.....  | 138        |
| 15.1.5 PROTECTION AND CURING .....                                     | 138        |
| 15.1.6 MEASUREMENT .....   | 138        |
| 15.1.7 PAYMENT .....   | 138        |
| <b>15.2 12MM THICK CEMENT-SAND PLASTER ON R.C.C SURFACES .....</b>     | <b>138</b> |
| 15.2.1 DESCRIPTION.....  | 138        |
| 15.2.2 MATERIALS.....  | 138        |
| 15.2.3 CONSTRUCTION METHODS.....                                       | 139        |
| 15.2.4 SCAFFOLDING.....  | 140        |
| 15.2.5 PROTECTION AND CURING .....                                     | 140        |
| 15.2.6 MEASUREMENT .....   | 140        |
| 15.2.7PAYMENT .....  | 140        |
| <b>15.3 12MM THICK CEMENT - SAND SKIRTING/DADO.....</b>                | <b>141</b> |
| 15.3.1DESCRIPTION .....  | 141        |
| 15.3.2 MATERIALS.....  | 141        |
| 15.3.3 CONSTRUCTION METHODS.....                                       | 141        |
| 15.3.4PROTECTION AND CURING .....                                      | 143        |
| 15.3.5 MEASUREMENT .....   | 143        |
| 15.3.6 PAYMENT .....   | 143        |
| <b>15.4 RULE POINTING ON BLOCK MASONRY WALL JOINTS .....</b>           | <b>143</b> |
| 15.4.1 DESCRIPTION.....  | 143        |
| 15.4.2 MATERIALS.....  | 144        |
| 15.4.3 CONSTRUCTION METHODS.....                                       | 144        |
| 15.4.4 SCAFFOLDING.....  | 145        |
| 15.4.5 PROTECTION AND CURING .....                                     | 145        |
| 15.4.6 RE-POINTING OF EXISTING BRICK MASONRY WORK JOINTS .....         | 145        |
| 15.4.7 MEASUREMENT .....   | 146        |
| 15.4.8 PAYMENT .....   | 146        |

**15.0 CEMENT PLASTER & POINTING**

**15.1 12MM THICK CEMENT-SAND PLASTER ON BRICK  
MASONRY WALL**

**15.1.1 DESCRIPTION**

This item of work shall consist of making 12mm or 19 mm thick cement plaster on Block masonry wall surfaces and at any other appropriate locations in cement mortar with specified proportion. The Work shall consist of furnishing all materials, its transportation and storage, supply of all labors, tools and equipment and the performance of all other allied works that would be required to complete the Work in all respect. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.

**15.1.2 MATERIALS**

**Cement**

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

**Fine aggregate**

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of plastering and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section of the Section on 'Construction Materials' of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

**Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other deleterious substances and shall not contain any visibly solid materials. All requirements shall be similar to what have been stated under the relevant Sub-section of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification. The Contractor shall get the water tested by comparing with water of known satisfactory quality, if requested by the Engineer.

**15.1.3 CONSTRUCTION METHODS**

**Preparation of mortar**

Unless otherwise specified on the Drawings or in the BOQ or instructed by the Engineer, cement mortar for plaster works on block masonry walls shall consist by volume of one part Ordinary Portland cement and six parts screened sand of specified F.M. In each mortar, requisite quantity of water shall be added and the components mixed and thoroughly incorporated together to give a workability, appropriate to its use.

Mortar shall be used whilst freshly mixed and no softening or re-tampering will be allowed. Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform. Cement and sand shall be first mixed dry in the required proportion to obtain a uniform color of the mixture. Water shall then be added sparingly, only to the minimum as would be necessary to produce

a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.

Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30 minutes after water is added. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of adding water at the time of initial mixing.

Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.

#### **Preparation of surface**

Before application of plaster, all joints in brick masonry walls shall be adequately raked out with a hooked tool made for the purpose whilst the mortar is still green and not later than 48 hours of the time of laying and smooth concrete surfaces shall be roughened to provide key. Joints should not be raked out with a trowel or a hammer to avoid the edges of the bricks getting chipped. The brickwork should be brushed down with stiff wire brush so as to remove all loose dust from the joints. Surfaces to be rendered shall also be scrubbed clean of all loose materials and be made free from all dust, grease, etc. and be well wetted with water and kept dampen for 24 hours before applying plaster (the walls should not be soaked but only damped evenly). On old walls it would be required to ensure a good key for the new rendering, to destroy the smooth surface of the brick masonry work with appropriate tools.

#### **Application of plaster**

Plaster shall consist of two coats when applied over brick masonry i.e. under and finish.

The under and finish coats shall be applied without an interval. The undercoat shall have a minimum thickness of 6mm and shall be leveled with straight edge and scratched for key. The finish coat shall be troweled over with care and leveled with a straight edge to obtain a flat smooth surface. All edges and corners, unless otherwise shown on the Drawings, shall be rounded or chamfered as directed by the Engineer. All moulds shall be neat, clean and true to template.

Plaster shall be floated and troweled to a true and plumbed surface and tested frequently during the progress of the work with a straight edge sufficiently long. There shall be no overlaps or construction joints in single unbroken surface unless the area is over 28 square meter or prior permission is taken from the Engineer for a deviation. Plaster shall be stopped only at corners, construction or expansion joints.

If any crack appears in the plaster or any part sound hollow when tapped, or found to be soft or otherwise defective after the plaster has dried, the defects shall be mended by cutting out and re-plastering at the Contractor's own costs. Such works should not leave any visible impression on the places mended.

The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or vehicles used for transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.

All plastering works shall be placed only after all brick masonry surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.

The plaster shall not be applied during rain sufficiently heavy or prolonged to wash the mortar. Mortar already applied, but becomes diluted by rain, shall be removed and replaced at the expenses of the Contractor before continuing any further works.

**15.1.4**  
**SCAFFOLDING**

The scaffolding shall be sound and strong enough to withstand all loads likely to be imposed upon it and subject to the Engineer's approval. Pole, going into the masonry should be at a place, which can be filled with a header brick. The holes, which provide resting space for horizontal members shall not be left in masonry under 1m in width or immediately near the skewbacks of arches. The holes left in the masonry work for supporting the scaffolding shall be filled, made good and to be properly finished with plaster.

**15.1.5 PROTECTION AND CURING**

All plasters shall be kept moist throughout the progress of work and protected for a minimum 10 days immediately following completion against harmful effects of weather by suitable covering. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the plaster.

On completion of works, all visible surfaces shall be free from damage or debris and shall look clean. All cares shall be taken so that the plaster surfaces are not stained or coated as the work proceeds. No rubbing of the faces to remove coating shall be allowed,

**15.1.6 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface of the finished plaster works completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

**15.1.7 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of plaster which price shall constitute full compensation for furnishing all materials including their transportation and storage, mixing of mortar, plastering surfaces and corners, rounding and/or chamfering preparing, cleaning and watering the surfaces to be plastered, watering and protecting the plaster after completion, providing scaffolding and its erection and removal, all other works and all incidentals necessary to complete the Work as per requirements described under this item of work, the BOQ, as shown on the Drawings and/or as directed by the Engineer.

| Item of Payment                | Unit                       |
|--------------------------------|----------------------------|
| 12mm thick cement-sand plaster | Square meter / Square feet |

**15.2 12MM THICK CEMENT-SAND PLASTER ON R.C.C SURFACES**

**15.2.1 DESCRIPTION**

This item of work shall consist of making 12 mm thick cement plaster on R.C.C surfaces and at any other appropriate locations in cement mortar with specified proportion. The Work shall consist of supply of all materials, labor, tools and equipment, carriage and the performance of all other allied works. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.



**15.2.2 MATERIALS****Cement**

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

**Fine aggregate**

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of plastering and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section of the Section on 'Construction Materials' of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

**Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other deleterious substances and shall not contain any visibly solid materials. All requirements shall be similar to what have been stated under the relevant Sub-section of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification. The Contractor shall get the water tested by comparing with water of known satisfactory quality, if requested by the Engineer.

**15.2.3****CONSTRUCTION METHODS****Preparation of mortar**

Unless otherwise specified on the Drawings, or in the BOQ or instructed by the Engineer, cement mortar for plaster works on R.C.C surfaces shall consist of one part Ordinary Portland cement and four parts screened sand of specified F.M. by volume. In each mortar, right quantity of water shall be added and the components mixed and thoroughly incorporated together to give a workability, appropriate to its use. Mortar shall be used whilst freshly mixed and no softening or re-tampering will be allowed.

Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform, Cement and sand shall be first mixed dry in the required proportion to obtain a uniform color of the mixture. Water shall then be added sparingly, only the minimum necessary to produce a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.

Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30 minutes after water is added. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of adding water at the time of initial mixing.

Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.

**Preparation of surface**

Before application of plaster, smooth concrete surfaces shall be roughened to provide key. The surfaces shall be scrubbed clean of all loose materials and soaked with water and kept dampen for 2 hours before plastering. A neat cement coat shall be applied on all concrete surfaces before application of plaster.

**Application of plaster**

Plaster shall consist of a grout application and a finish coat, when applied direct to concrete surface. The under and finish coats shall be applied without an interval.

All edges and corners, unless otherwise shown on the Plans, shall be rounded or chamfered as directed by the Engineer. All molds shall be neat, clean and true to template.

Plaster shall be floated and troweled to a true surface and tested frequently during the progress of the work with a straight edge sufficiently long. There shall be no overlaps or construction joints in single unbroken surface unless the area is over 28 square meter or prior permission is taken from the Engineer for a deviation. Plaster shall be stopped only at corners, construction or expansion joints.

If any crack appears in the plaster or any part sound hollow when tapped or found to be soft or otherwise defective after the plaster has dried, the defect shall be mended by cutting out and re-plastering at the Contractor's own costs.

The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.

All plastering works shall be placed only after all R.C.C surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.

The plaster shall not be applied during rain sufficiently heavy or prolonged to wash the mortar when the works are carried out under open sky. Mortar already applied, but becomes diluted by rain, shall be removed and replaced before continuing the work at the expenses of the Contractor.

**15.2.4 SCAFFOLDING**

The scaffolding shall be sound and strong enough to withstand all loads likely to be imposed upon it and subject to the Engineer's approval. If any place is left out or the plaster gets damaged by resting of poles, the places shall be made plastered or repaired before/on removal of the scaffolding at the expenses of the Contractor.

**15.2.5 PROTECTION AND CURING**

All plaster shall be kept moist throughout the progress of work and protected for a minimum 10 days immediately following completion against harmful effects of weather by suitable covering when the location is exposed under the open sky. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the plaster.

On completion of works, all visible surfaces shall be free from damage or debris and shall look clean. All cares shall be taken that the plaster surfaces are not stained or coated as the work proceeds. No rubbing of the faces to remove coating shall be allowed.

**15.2.6 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface of the finished plaster works completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

**15.2.7 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of plaster which price shall constitute full compensation for furnishing all materials including their transportation and storage, mixing of mortar, plastering surfaces and corners, rounding or chamfering preparing, cleaning and watering the surface to be plastered, watering and protecting the plaster after completion, providing scaffolding and its erection

and removal, all other works and all incidentals necessary to complete the Work as per requirements described under this item of work, the Bill of Quantities, as shown on the Drawings and/or as directed by the Engineer.

| Item of Payment               | Unit                       |
|-------------------------------|----------------------------|
| 6mm thick cement-sand plaster | Square meter / Square feet |

### **15.3 12MM THICK CEMENT - SAND SKIRTING/DADO**

#### **15.3.1 DESCRIPTION**

This item of work shall consist of providing 12mm thick cement-sand plaster with neat cement finishing in skirting/dado on brick masonry wall surfaces and at any other locations where necessary in cement mortar with specified proportion. The Work shall include supply of all labour, materials, tools and equipment, carriage and the performance of all necessary works. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.

#### **15.3.2 MATERIALS**

##### **Cement**

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or BS 12 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

##### **Fine aggregate**

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of plastering and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section(s) of the Section on 'Construction Materials' of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

##### **Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

### **15.3.3 CONSTRUCTION METHODS**

#### **Preparation of mortar**

Unless otherwise specified on the Drawings or in the BOQ or instructed by the Engineer, cement mortar for skirting/dado works on brick masonry walls shall consist by volume of one part Ordinary Portland cement and four parts screened sand of specified F.M. In each mortar, requisite quantity of water shall be added and the components mixed and thoroughly incorporated together to give a workability, appropriate to its use. Mortar shall be used whilst freshly mixed and no softening or re-tempering will be allowed.

Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform. Cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour of the mixture. Water shall then be added sparingly, only the minimum necessary to produce a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.

Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30 minutes after addition of water. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of addition of water at the time of initial mixing.

Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.

#### **Preparation of surface**

Before application of skirting/dado, wall plaster, if there be any, shall be removed along the floor to the required height and the joints in brick-walls shall be adequately raked out to provide key. The surfaces shall be scrubbed clean of all loose materials and soaked with water and kept damped for 24 hours before skirting/dado works start.

#### **Application of skirting/dado**

Skirting/dado shall consist of two coats i.e under and finish. The under and finish coats shall be applied without an interval to permit the undercoat to set.

The undercoat shall have a minimum thickness of 6mm and the total built-up thickness will be same as that of the plaster on the wall. A 3mm groove shall be formed where skirting/dado meets wall plaster.

The skirting/dado shall be installed flushed with the finished wall surface. The intersection with the floor shall be right-angled and the top of the skirting/dado shall be straight and sharp.

The under-bed shall be laid as uniformly as possible and allowed to become firm before scratching for key and subsequently allowed to become thoroughly dry before applying the second under-coat. A neat cement paste of 3mm thickness shall be spread evenly over the second coat and shall be steel troweled under firm pressure to produce a dense uniform smooth surface free from trowel marks.

The finish coat shall be troweled over with care and leveled with a straight-edge to obtain a flat smooth surface including neat cement finishing. All edges and corners unless otherwise shown on the Drawings shall be rounded or chamfered as directed by the Engineer. All moulds shall be neat clean and true to template.

Skirting/dado shall be floated and troweled to a true and plumb surface and tested frequently during the progress of the work with a straight edge sufficiently long. There shall be no overlaps or construction joints in single unbroken surface unless the area is over 28 square meter or prior permission is taken from the Engineer. Skirting/dado shall be stopped only at corners, sieves, construction or expansion joints.

If any crack appears in the skirting/dado, or any part sound hollow when tapped or found to be soft or otherwise defective after the skirting/dado has dried, the defect shall be made good by cutting out and re-plastering at the Contractor's own costs.

When the skirting/dado is applied on the plinth wall, it shall be plastered up to 150mm below the ground level.

The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.

All skirting/dado works shall be placed only after all brick-wall surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.

The skirting/dado shall not be applied during rain sufficiently heavy or prolonged to wash the mortar. Mortar already applied, but becomes diluted by rain shall be removed and replaced before continuing the work at the expenses of the Contractor.

#### **15.3.4 PROTECTION AND CURING**

All skirting/dado shall be kept moist throughout the progress of work and protected for a minimum 10 days immediately following completion against harmful effects of weather by suitable covering. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the skirting/dado.

On completion of works, all visible surfaces shall be free from damage or debris and shall look clean.

All cares shall be taken that the skirting/dado surfaces are not stained or coated as the work proceeds.

No rubbing of the faces to remove coating shall be allowed.

#### **15.3.5 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface of the finished skirting/dado works completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **15.3.6 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of skirting/dado which price shall constitute full compensation for furnishing all materials, mixing of mortar, plastering surfaces and corners, rounding and/or chamfering, preparing, cleaning and watering the surface to be skirted, watering and protecting the skirting/dado after completion, all other works and all incidentals necessary to complete the Work as per requirements described under this item of Work, the BOQ, as shown on the Drawings and/or as directed by the Engineer.

| <b>Item of Payment</b>   | <b>Unit</b>                |
|--------------------------|----------------------------|
| 12mm thick skirting/dado | Square meter / Square feet |

### **4 RULE POINTING ON BLOCK MASONRY WALL JOINTS**

#### **4.1 DESCRIPTION**

This item of work shall consist of making v-grooved pointing in the joints of the block masonry wall surfaces and at any other locations where necessary in cement mortar with specified proportion. The

Work shall include supply of all labor, materials, tools and equipment, carriage and the performance of all necessary works. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.

#### **15.4.2 MATERIALS**

##### **Cement**

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or BS 12 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

##### **Fine aggregate**

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of rule pointing and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section(s) of the Section on 'Construction Materials' of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

##### **Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

#### **15.4.3 CONSTRUCTION METHODS**

##### **Preparation of mortar**

Unless otherwise specified on the Drawings or in the BOQ or instructed by the Engineer, cement mortar for rule pointing works on brick masonry wall joints shall consist by volume of one part Ordinary Portland cement and two parts screened sand unless otherwise required by the Drawings or instructed by the Engineer. In each mortar, requisite quantity of water shall be added and the components mixed and thoroughly incorporated together to give a workability, appropriate to its use. Mortar shall be used whilst freshly mixed and no softening or re-tampering will be allowed.

Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform. Cement and sand shall be first mixed dry in the required proportion to obtain a uniform color of the mixture. Water shall then be added sparingly, only the minimum necessary to produce a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.

Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30 minutes after addition of water. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of addition of water at the time of initial mixing.

Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.



### **Preparation of surface**

Before rule pointing, the joints in brick-walls shall be adequately roughened. The surfaces shall be scrubbed clean of all loose materials and soaked with water and kept damped for 24 hours.

### **Making rule points**

Unless otherwise specified, mortar for rule pointing shall be prepared with one part of Portland cement and two parts of sand generally of F.M. 1.2. Lime in powder form passing 100 mesh in the proportion of 2% by weight of cement shall also constitute an ingredient of the mortar.

The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.

When all brick walls surfaces including the joints are well prepared as described earlier, mortar of specified proportion shall be applied at the joints and finished in rule or concave pointing as mentioned in the 'BOQ' or indicated on the Drawings or directed by the Engineer. The concave pointing shall be done with the help of rebar's wooden template to prepare semi-circular pointing intruding inside the brick wall joints. The Contractor shall remain very careful in maintaining the type of pointing as asked for in the Contract.

All rule-pointing works shall only start when all brick-wall surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.

The rule pointing works shall not be undertaken during rain sufficiently heavy or prolonged to wash the mortar. Mortar already applied, which becomes diluted by rain shall be removed and replaced before continuing the work at the expenses of the Contractor.

### **15.4.4 SCAFFOLDING**

The scaffolding shall be sound and strong enough to withstand all loads likely to be imposed upon it and subject to the Engineer's approval. Pole, going into the masonry should be at a place, which can be filled with a header brick. The holes, which provide resting, space for horizontal members shall not be left in masonry under 1m in width or immediately near the skewbacks of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

### **15.4.5 PROTECTION AND CURING**

All works shall be kept moist throughout the progress of work and protected for minimum 10 days immediately following completion against harmful effects of weather by suitable covering. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the plaster.

On completion of works, all visible surfaces shall be free from damage or debris and shall look clean. All cares shall be taken that the plaster surfaces are not stained or coated as the work proceeds. No rubbing of the faces to remove coating shall be allowed.

### **15.4.6 RE-POINTING OF EXISTING BRICK MASONRY WORK JOINTS**

The extent of re-pointing of existing brick masonry works shall be jointly surveyed by the Contractor and the Engineer at the start of the work and the location of all repairs needed shall be recorded and permanently marked in paint.

The defective mortar shall be carefully removed from the joints and the joints shall be cleaned immediately prior to re-pointing. The re-pointing shall be done with cement mortar of specified proportion to full depth, penetration and trimmed flush with the face of the brick masonry works.

Cracks in the existing brick masonry works shall be treated in the same way. Defective materials shall be carefully removed and the cracks shall be filled with cement mortar of specified proportion.

**15.4.7 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface of the brick masonry works with all joints have been finished by rule pointing in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

**15.4.8 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of brick masonry wall which price shall constitute full compensation for furnishing all materials, mixing of mortar, rule pointing of joints, cleaning and watering the surface to be rule pointed, watering and protecting the work after completion, providing scaffolding and its erection and removal, all other works and all incidentals necessary to complete the Work as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and/or as directed by the Engineer.

**Item of Payment**

**Unit**

Rules pointing of joints of brick masonry wall

Square meter / Square feet



|  |            |
|--|------------|
| <b>16.0 DAMP PROOF COURSE.....</b>       | <b>147</b> |
| <b>16.2 DAMP PROOF COURSE (DPC).....</b> | <b>147</b> |
| <b>16.2.1 DESCRIPTION.....</b>           | <b>147</b> |
| <b>16.2.2 MATERIALS.....</b>             | <b>147</b> |
| <b>16.2.3 CONSTRUCTION METHODS.....</b>  | <b>147</b> |
| <b>19.2.4 MEASUREMENT .....</b>          | <b>148</b> |
| <b>19.2.5 PAYMENT .....</b>              | <b>148</b> |

**16.0 DAMP PROOF COURSE**

**16.2 DAMP PROOF COURSE (DPC)**

**16.2.1 DESCRIPTION**

Works covered under this item shall consist of constructing a layer of cement concrete with specified proportion and in required thickness with top surface painted with Asphalt/Coal tar.

**16.2.2 MATERIALS**

**Cement**

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C150 Type 1 or BS 12 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

**Coarse aggregate**

Coarse aggregate shall conform to the requirements of ASTM C 330.

Coarse aggregate shall be hard, durable, clean, free from dust and other deleterious material to be obtained by crushing 1st class/picked jhama bricks. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce a workable concrete of maximum density which has been considered to be 10mm down graded in this case.

Materials shall also conform to the requirements specified in the relevant Sub-section of the Section titled 'Construction Materials' of this Specification.

**Fine aggregate**

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of DPC and conform to the requirement of ASTM C 33 and those stated under the relevant Sub-section(s) of the Section on 'Construction Materials' of this Specification. Sand, to be used for Damp Proof Course, will be of FM normally not below 1.8 or as directed by the Engineer.

**Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

**Asphalt**

Asphalt shall conform to the requirements of ASTM D 312. Type-1 shall be used below ground and Type- 2 shall be used above ground.

**16.2.3 CONSTRUCTION METHODS**

25mm to below 40mm thick cement concrete mixture prepared with 1 part cement, 2 parts sand and 4 parts brick chips is to be installed following the procedures stated under the Section on 'Concrete Work' of this Specification. In case of DPC designed with a 40mm thickness, the cement concrete mixture may be prepared with 1 part cement, 1½ parts sand and 3 parts brick chips. Two coats of hot asphalt should be applied over the cement concrete when the concrete has been fully cured and dried. The surface to be damp-proofed shall be primed and thoroughly mopped with asphalt. When the first mopping of asphalt has set sufficiently, the entire surface shall be mopped with second coating of hot asphalt. Special care shall be taken to see that there are no skips in the coatings and that all surfaces

are thoroughly covered. The asphalt used should not melt or soften in the hottest days and should not get squeezed due to pressure of the masonry over it.

All concrete surfaces, which are to be damp-proofed shall be reasonably smooth and free from foreign material that would prevent bond. The surface shall be dry and immediately before the application of the primer, the surface shall be thoroughly cleaned of dust and loose materials.

The damp-proof course should be laid flush with the floor surface and should not be carried across doorways or other openings. The upper layer of cement concrete floors should be continued over such openings and should be laid at the same time as the floors. The asphalt or tar layer should be laid under the concrete at the openings. Where concrete is laid on bitumen or tar, the surface of the bitumen or tar must be sprinkled with dry sand.

The position of the damp proof course is also an important factor and it should be laid at such a height that it is above the normal level to which water splashes from the ground when it is raining. A damp proof course should not be less than 15cm above the highest level of the ground.

#### **16.2.4 MEASUREMENT**

Damp proofing shall be measured in square meter of the works completed in place, in accordance with the Specifications stated herein and/or with the provisions of the Bill of Quantities and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **16.2.5 PAYMENT**

The amount of completed and accepted work as measured above shall be paid for at the Contract unit price per square meter. The payment shall constitute the full compensation for the cost of furnishing all equipment, materials, labour for preparation of concrete mixture and its casting, compacting, curing, including, asphalt painting including all storage, handling and transport and all incidentals necessary for the satisfactory completion of the damp-proofing as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| Damp-proofing          | Square meter / Square feet |

|  |            |
|--|------------|
| <b>17.0 PAINTING AND WHITEWASH .....</b>   | <b>149</b> |
| <b>17.1 SYNTHETIC ENAMEL PAINT .....</b>   | <b>149</b> |
| <b>17.1.1 DESCRIPTION .....</b>            | <b>149</b> |
| <b>17.1.2 MATERIALS .....</b>              | <b>149</b> |
| <b>17.1.3 STORAGE OF MATERIALS .....</b>   | <b>149</b> |
| <b>17.1.4 CONSTRUCTION METHODS .....</b>   | <b>149</b> |
| <b>14.1.5 MEASUREMENT .....</b>            | <b>151</b> |
| <b>17.1.6 PAYMENT .....</b>                | <b>151</b> |
| <b>17.2 PLASTIC PAINTING .....</b>         | <b>152</b> |
| <b>17.2.1 DESCRIPTION .....</b>            | <b>152</b> |
| <b>17.2.2 MATERIALS .....</b>              | <b>152</b> |
| <b>17.2.3 CONSTRUCTION METHODS .....</b>   | <b>152</b> |
| <b>17.2.4 MEASUREMENT .....</b>            | <b>154</b> |
| <b>17.2.5 PAYMENT .....</b>                | <b>154</b> |
| <b>17.3 DISTEMPERING .....</b>             | <b>154</b> |
| <b>17.3.1 DESCRIPTION .....</b>            | <b>154</b> |
| <b>17.3.2 MATERIALS .....</b>              | <b>154</b> |
| <b>17.3.3 CONSTRUCTION METHODS .....</b>   | <b>155</b> |
| <b>17.3.4 MEASUREMENT .....</b>            | <b>156</b> |
| <b>17.3.5 PAYMENT .....</b>                | <b>156</b> |
| <b>17.4 WHITE WASHING .....</b>            | <b>156</b> |
| <b>17.4.1 DESCRIPTION .....</b>            | <b>156</b> |
| <b>17.4.2 MATERIALS .....</b>              | <b>157</b> |
| <b>17.4.3 CONSTRUCTION METHODS .....</b>   | <b>157</b> |
| <b>17.4.4 MEASUREMENT .....</b>            | <b>159</b> |
| <b>17.4.5 PAYMENT .....</b>                | <b>159</b> |
| <b>17.5 COLOUR WASHING .....</b>           | <b>159</b> |
| <b>17.5.1 DESCRIPTION .....</b>            | <b>159</b> |
| <b>17.5.2 MATERIALS .....</b>              | <b>159</b> |
| <b>17.5.3 CONSTRUCTION METHODS .....</b>   | <b>160</b> |
| <b>17.5.4 MEASUREMENT .....</b>            | <b>162</b> |
| <b>17.5.5 PAYMENT .....</b>                | <b>162</b> |
| <b>17.6 COLOURED CEMENT PAINTING .....</b> | <b>162</b> |
| <b>17.6.1 DESCRIPTION .....</b>            | <b>162</b> |
| <b>17.6.2 MATERIALS .....</b>              | <b>163</b> |
| <b>17.6.3 CONSTRUCTION METHODS .....</b>   | <b>163</b> |
| <b>17.6.4 MEASUREMENT .....</b>            | <b>165</b> |
| <b>17.6.5 PAYMENT .....</b>                | <b>165</b> |

|  |            |
|--|------------|
| <b>17.7 WATER REPELLENT PAINTING .....</b> | <b>165</b> |
| <b>17.7.1 DESCRIPTION.....</b>             | <b>165</b> |
| <b>17.7.2 MATERIALS .....</b>              | <b>165</b> |
| <b>17.7.3 CONSTRUCTION METHODS.....</b>    | <b>165</b> |
| <b>17.7.4 MEASUREMENT .....</b>            | <b>167</b> |
| <b>17.7.5 PAYMENT .....</b>                | <b>167</b> |
| <b>17.8 VARNISHING .....</b>               | <b>167</b> |
| <b>17.8.1 DESCRIPTION.....</b>             | <b>167</b> |
| <b>17.8.2 MATERIALS .....</b>              | <b>167</b> |
| <b>17.8.3 CONSTRUCTION METHODS.....</b>    | <b>168</b> |
| <b>17.8.4 MEASUREMENT .....</b>            | <b>170</b> |
| <b>17.8.5 PAYMENT .....</b>                | <b>170</b> |

## **17.0 PAINTING AND WHITEWASH**

### **17.1 SYNTHETIC ENAMEL PAINT**

#### **17.1.1 DESCRIPTION**

Works covered under this item shall consist of painting metallic surface or wooden surface where water proofing is required or the places as directed by the Engineer. Synthetic enamel paint of any approved brand and colour shall be used in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers. Painting shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

#### **17.1.2 MATERIALS**

Paint shall consist of ready-mixed synthetic enamel of approved type supplied in original sealed containers bearing the name of the manufacturer of the paint.

All painting materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals.

Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

#### **17.1.3 STORAGE OF MATERIALS**

Materials and tools shall be stored in a single place at the Site as designated by the Engineer.

Storage area shall be maintained in a neat and clean condition with surroundings protected from damage.

Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day's work. Every precaution shall be taken to prevent fire.

Storage area shall be all time accessible to the Engineer.

#### **17.1.4 CONSTRUCTION METHODS General**

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of paints proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

#### **Colours and samples**

Colour scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.

For all painted finishes, samples shall be prepared as per direction of the Engineer on pieces of the same kind of material surface at least on an area of 150mm by 300mm. The finished sample shall be approved by the Engineer.

#### **Protection**

Drop cloths or other approved protection materials shall be furnished and laid on all areas where painting and finishing is being done so as to adequately protect floor and other places from all damages caused during the execution of the painting work.

### **Surface preparation**

#### **For metallic surface**

All metallic surfaces shall be prepared before application of paint.

For ferrous metal, the surfaces shall be cleaned by brushing with wire brush or sand paper to remove all rust, weld spatter and other foreign particles. Any grease and oil film shall be removed with a solvent, using a fine steel wood pad or a coarse cloth. All damages to shop coat caused by erection, repairing and cleaning shall be spot primed with the same materials used for the shop coat.

In case of galvanized metal, the surfaces shall be cleaned and dried. Any grease and oil film shall also be removed with a solvent, using a fine steel wood pad or a coarse cloth. It is considered that paint will adhere to galvanized iron if the surface is washed with vinegar or slaked lime and washing soda before painting.

In all cases manufacturer's instructions are to be strictly followed in preparing the surfaces to be painted.

#### **For wooden surface**

Wood, the surfaces, which are to be painted, shall be well seasoned and the surface to be painted shall be perfectly dry. The surfaces of woodwork to be painted or polished should be rubbed down perfectly smooth with medium and fine grade sandpaper. All rubbing to be done with the grain. Worked timber should be primed as soon as possible particularly on the cut end grain. New woodwork shall be knotted, primed and stopped before given coats of paint.

### **Application of paint**

#### **Wooden and ferrous metallic surfaces**

The workmanship for painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before painting or finishing is started.

All paint shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Paint shall be worked into all corners and crevices. Materials shall be applied in strict accordance with the manufacturer's directions. In particular, no prepared paint shall be thinned by any methods except as directed by the manufacturer. All paint shall be thoroughly mixed before being applied.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior paints and interior paints respectively. Each coat shall be thoroughly dry before application of subsequent coat.

All natural finished woodwork, painted woodwork and painted metal shall be slightly sanded between coats using No.'00' sandpaper. The finished surface must be smooth, evenly leveled and free from brush marks.

Natural finished woodwork only shall be rubbed with fine sandpaper after the last coat has received the desired finish as per approved sample.

All woodwork for natural finish shall be sealed on the back and all surfaces, which will be concealed after erection with two coats of an approved transparent sealer prior to installation.

After being fitted by the Carpenter, all edges of the doors and windows shall be finished in the same way as the faces.

All exposed piping (except PVC), if specified shall be painted to match the adjoining wall surfaces where such wall surfaces are either glazed tile or painted.

Painting around finish hardware of other removable items already in place shall not be allowed.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during painting.

#### **Galvanized Iron surfaces**

Galvanized iron should not be painted until it has been exposed to the weather for a year as paint adheres badly to new galvanized iron. If necessary to paint sooner, a coat composed of about 200 grams of copper acetate added to 5 litres of water, or 60 grams of muriatic acid added to a mixture of 60 grams each of copper chloride, copper nitrate and sal-ammoniac, dissolved in 5 litres of soft water, to which a small quantity of hydrochloric acid has been added, should be given. This will be sufficient for about a surface area of 250 square meter.

#### **Completion**

At completion of painting work, the Contractor shall remove any paint spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section and the Contractor shall repaint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.

All rubbish and accumulated painting materials shall be removed from the premises.

#### **14.1.5 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually painted with required quality in accordance with the provisions of the BOQ and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.1.6 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and paint and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>    | <b>Unit</b>                |
|---------------------------|----------------------------|
| Synthetic enamel painting | Square meter / Square feet |



## **17.2 PLASTIC PAINTING**

### **17.2.1 DESCRIPTION**

Works covered under this item shall consist of painting plastered wall or ceiling surfaces or the places as directed by the Engineer. Synthetic resin emulsion paint of any approved brand and colour shall be used in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers. Painting shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

### **17.2.2 MATERIALS**

Paint shall consist of ready-mixed synthetic emulsion resin base water-thinned approved products supplied in original sealed containers bearing the manufacturer's trade mark.

All painting materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals.

Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

#### **Storage of materials**

Materials and tools shall be stored in a single place at the Site as designated by the Engineer.

Storage area shall be maintained in a neat and clean condition with surroundings protected from damage.

Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day's work. Every precaution shall be taken to prevent fire.

Storage area shall be all time accessible to the Engineer.

### **17.2.3 CONSTRUCTION METHODS General**

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of paints proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

#### **Colours and samples**

Colour scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.

For all finished painting on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

#### **Protection**

Drop cloths or other approved protection materials shall be furnished and laid on all areas where painting and finishing is being done so as to adequately protect floor and other places from all damages caused during the execution of the painting work.

#### **Surface preparation**

All surfaces to be painted shall be thoroughly cleaned of all grit, grease, dirt, loose materials, mortar drippings and the like. It is better that some soap is added in the wash.

The surface shall be given a thorough rub down to remove all loose materials and all cracks and surface irregularities shall be prepared with patching plaster and filler to obtain a smooth and even surface to the satisfaction of the Engineer. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Brush shall always be cleaned after use. Filler shall be applied before priming and the surface shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.

The plastered surfaces shall be made smooth by sand papering and made free from marks before applying the first coat.

Voids and holes shall be filled after first the coat becomes dry by using filler compatible with the finishing specified and tinted, if required to camouflage repairs.

In the case of new cement plaster walls, a solution of 2 kg of zinc sulphate in 4 litres of water should be applied to the surface and when dry should be given a coat of pure raw linseed oil; or the surface can be treated with dilute sulphuric or hydrochloric acid (1 part acid to 50 parts water) and then washed down with water. Care shall be taken to ensure that acids are added to the water and not water to the acids.

#### **Application of paint**

The workmanship for painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before painting or finishing is started.

All paints shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Paint shall be worked into all corners and crevices.

Materials shall be applied in strict accordance with the manufacturer's directions. In particular, no prepared paint shall be thinned by any method except as directed by the manufacturer. All paint shall be thoroughly mixed before being applied.

Each coat shall be thoroughly dry before application of subsequent coat.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior painting respectively.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during painting.

#### **Completion**

At completion of painting work, the Contractor shall remove any paint spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section and the Contractor shall repaint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.

All rubbish and accumulated painting materials shall be removed from the premises.

#### **17.2.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually painted with required quality in accordance with the provisions of the BOQ and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.2.5 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and paint and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>                | <b>Unit</b>                |
|---------------------------------------|----------------------------|
| Plastic painting on plastered surface | Square meter / Square feet |

### **17.3 DISTEMPERING**

#### **17.3.1 DESCRIPTION**

Works covered under this item shall consist of distempering plastered wall or ceiling surfaces or the places as directed by the Engineer. Distemper of any approved brand and colour shall be used in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers.

Distempering shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

#### **17.3.2 MATERIALS**

Paint shall consist of approved ready-mixed distemper supplied in original sealed containers bearing the manufacturer's trademark.

All distempering materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals.

Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

#### **Storage of materials**

Materials and tools shall be stored in a single place at the Site as designated by the Engineer.

Storage area shall be maintained in a neat and clean condition with surroundings protected from damage.

Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day's work. Every precaution shall be taken to prevent fire.

Storage area shall be all time accessible to the Engineer.

### **17.3.3 CONSTRUCTION METHODS General**

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of distemper proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

#### **Colours and samples**

Colour scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.

For all finished distempering on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

#### **Protection**

Drop cloths or other approved protection materials shall be furnished and laid on all areas where distempering and finishing is being done so as to adequately protect floor and other places from all damages caused during the execution of the distempering work.

#### **Surface preparation**

All surfaces to be distempered shall be thoroughly cleaned of all grit, grease, dirt, loose materials, mortar drippings and the like.

The surface shall be given a thorough rub down to remove all loose materials and all cracks and surface irregularities shall be prepared with patching plaster and filler to obtain a smooth and even surface to the satisfaction of the Engineer. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Brush shall always be cleaned after use. Filler shall be applied before priming and the surface shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.

The plastered surfaces shall be made smooth by sand papering and made free from marks before applying the first coat.

Voids and holes shall be filled after first the coat becomes dry by using filler compatible with the finishing specified and tinted, if required to camouflage repairs.

In the case of new cement plaster walls, a solution of 2 kg of zinc sulphate in 4 litres of water should be applied to the plastered surface and when dry should be given a coat of pure raw linseed oil; or the surface may be treated with dilute sulphuric or hydrochloric acid (1 part acid to 50 parts water) and then washed down with water. Cares shall be taken to ensure that acids are added to the water and not water to the acids.

#### **Application of distemper**

The workmanship for painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before distempering or finishing is started.

All distemper shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Distemper shall be worked into all corners and crevices.

Materials shall be applied in strict accordance with the manufacturer's directions. In particular, no prepared distemper shall be thinned by any method except as directed by the manufacturer. All distemper shall be thoroughly mixed before being applied.

Each coat shall be thoroughly dry before application of subsequent coat.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior painting respectively.

Each coat applied, must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior distempering shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during distempering.

#### **Completion**

At completion of distempering work, the Contractor shall remove any distemper spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section and the Contractor shall repaint with distemper or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.

All rubbish and accumulated painting materials shall be removed from the premises.

#### **17.3.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually distempered with required quality in accordance with the provisions of the BOQ and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.3.5 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and distemper and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>         | <b>Unit</b>                |
|--------------------------------|----------------------------|
| Distempering plastered surface | Square meter / Square feet |

#### **17.4 WHITE WASHING**

##### **17.4.1 DESCRIPTION**

Works covered under this item shall consist of white washing on the plastered wall or ceiling surfaces or at locations as directed by the Engineer in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer. White washing shall be done in a manner to obtain an even, smooth finish without any mark of brush and joint.

##### **17.4.2 MATERIALS**

###### **Limestone**

Limestone is high calcium lime with about 6% material insoluble in acid, obtained by burning pure limestone or chalk in a kiln. Limestone shall be slaked as early as possible after it is burnt in a kiln. Stone lime should be stored in an enclosed space in large heaps and air excluded as far as possible. Un-slaked lime weighs 640 kilogram per cubic meter when fresh, increasing to about 800 kilogram per cubic meter after 10 days.

###### **Shell lime**

Shell lime is also high calcium lime with about 6% material insoluble in acid, obtained by burning seashells in a kiln.

###### **Gum arabic**

This is a kind of glue used as a binding agent between the white wash and the plaster surfaces.

###### **Robin blue**

Robin blue is a kind of manufactured ready-made blue available in packets from reputed manufacturer. This is required for maintaining the whiteness of the wash.

###### **Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

##### **17.4.3 CONSTRUCTION METHODS**

###### **Samples**

White washing scheme shall conform the Finish Schedule and as directed by the Engineer. All matching shall be to the satisfaction of the Engineer.

For all finished white washing on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be washed. The finished samples shall be approved by the Engineer.

###### **Protection**

Drop cloths or other approved protection materials shall be furnished and laid on all areas where white washing is being done so as to adequately protect floor and other places from all damage caused during the execution of the distempering work.

###### **Preparation of white wash**

The lime shall be brought to the Site in an un-slaked condition and thoroughly slaked on the spot, mixed and stirred with sufficient water and requisite amount of blue and gum to make a thin cream

and allowed to stand for 24 hours. If 4 grams of gum (or shellac) and 50 grams of common salt dissolved in hot water are added to 1 kilogram of limestone for the last coat, the white wash will not easily rub off. Indigo (blue) upto 3 grams per kilogram of lime dissolved in water is added and the wash stirred well.

The lime is placed 30cm deep in a drum or a tub with about 90cm of water and allowed to stand for about 24 hours or such longer period as may be necessary to slake the lime completely. It is better to add lime to the water and not water to the lime. The mixture should be well stirred.

Lime is considered to be completely slaked when the temperature of the lime and the water ceases to rise and any further addition of water also produces no further chemical action or heat. As a precaution, water should be allowed to stand on for 12 hours or more. A vigorous slaking with heat and noise indicates a high calcium content. After slaking, the lime should be screened through a 3.35mm sieve or kept in excess of water to meet the requirements. Limes must be thoroughly slaked which is also ground very fine. Any un-slaked particles left will produce "blisters".

#### **Application of white wash**

The workmanship for white washing shall be of high quality. Experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before washing or finishing is started.

The lime wash should be strained through a course cloth or sieved through a fine wire gauge before applying.

All white washing shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. White washing shall be worked in to all corners and crevices.

The coats shall be applied alternatively vertically and horizontally. One stroke is given from the top down- wards and the other from the bottom up-wards over the first stroke and similarly, one stroke from the right and another from the left over the first brush before it dries. Each coat shall be let to dry before applying the next coat.

White wash shall be applied on surfaces in two coats over a priming coat. The final coat shall be applied vertically and finished surface shall be free of dust, dirt and must be free from brush marks. The finished dry surface shall not readily come off on the hand when rubbed.

Brush shall always be cleaned after use.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other works while applying white wash. Any damage, stains or spots caused by white washing shall be rectified and removed at the expenses of the Contractor.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior washing shall be done in rainy and damp weather until the surfaces are thoroughly dry. No interior washing shall be done on damp surfaces.

Each coat shall be thoroughly dry before application of the subsequent coat.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior washing respectively.



The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during white washing.

#### **Completion**

At completion of white washing, the Contractor shall remove any wash spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section and the Contractor shall rewash or retouch any surface, which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.

All rubbish and accumulated painting materials shall be removed from the premises.

#### **17.4.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually white washed with required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.4.5 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and all white washing materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| White washing          | Square meter / Square feet |

#### **17.5 COLOUR WASHING**

##### **17.5.1 DESCRIPTION**

Works covered under this item shall consist of colour washing on the plastered wall or ceiling surfaces or at locations as directed by the Engineer in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer. Colour washing shall be done in a manner to obtain an even, smooth finish without any mark of brush and joint.

##### **17.5.2 MATERIALS**

###### **Lime stone**

Limestone is high calcium lime with about 6% material insoluble in acid, obtained by burning pure limestone or chalk in a kiln. Limestone shall be slaked as early as possible after it is burnt in a kiln. Stone lime should be stored in an enclosed space in large heaps and air excluded as far as possible. Un-slaked lime weighs 640 kilogram per cubic meter when fresh, increasing to about 800 kilogram per cubic meter after 10 days.

###### **Shell lime**

Shell lime is also high calcium lime with about 6% material insoluble in acid, obtained by burning seashells in a kiln.



### **Gum arabic**

This is a kind of glue used as a binding agent between the white wash and the plaster surfaces.

### **Colour**

Mineral colours, not affected by lime, shall be added to white wash instead of indigo (blue).

### **Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

## **17.5.3 CONSTRUCTION METHODS**

### **Samples**

Color washing scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.

For all finished color washing on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be washed. The finished samples shall be approved by the Engineer.

### **Protection**

Drop cloths or other approved protection materials shall be furnished and laid on all areas where color washing is being done so as to adequately protect floor and other places from all damage caused during the execution of the distempering work.

### **Surface preparation**

All surfaces to be colour washed shall essentially be thoroughly cleaned through removing all grit, grease, dirt, loose materials, mortar drippings and the like. It is better that some soap is added in the wash.

The surfaces shall be given a thorough rub down with a brush or by rubbing with an old gunny bag to remove all loose materials. All holes, cracks, surface irregularities and minor repairs shall be made good with patching plaster and lime putty to obtain a smooth and even surface to the satisfaction of the Engineer. Lime putty is obtained by slaking lime with water and sifting it. The filler shall be let dry for 24 hours before colour washing. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Filler shall be applied before priming and the surface shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.

The plastered surfaces shall be made smooth by sand papering and made free from marks before applying the prime coat.

In the case of new cement plaster walls, a solution of 2 kg of zinc sulphate in 4 litres of water should be applied to the plastered surface and when dry given a coat of pure raw linseed oil; or the surface may be treated with dilute sulphuric or hydrochloric acid (1 part acid to 50 parts water) and then washed down with water. Cares shall be taken to ensure that acids are added to the water and not water to the acids.

### **Preparation of colour wash**

The lime shall be brought to the Site in an un-slaked condition and thoroughly slaked on the spot, mixed and stirred with sufficient water and requisite amount of colour and gum to make a thin cream and allowed to stand for 24 hours. If 4 grams of gum (or shellac) and 50 grams of common salt dissolved in hot water are added to 1 kilogram of limestone for the last coat, the colour wash will not easily rub off. Mineral colour in requisite quantity per kilogram of lime dissolved in water is added and the wash stirred well.

The lime is placed 30cm deep in a drum or a tub with about 90cm of water and allowed to stand for about 24 hours or such longer period as may be necessary to slake the lime completely. It is better to add lime to the water and not water to the lime. The mixture should be well stirred.

Lime is considered to be completely slaked when the temperature of the lime and the water ceases to rise and any further addition of water also produces no further chemical action or heat. As a precaution, water should be allowed to stand on for 12 hours or more. A vigorous slaking with heat and noise indicates high calcium content. After slaking, the lime should be screened through a 3.35mm sieve or kept in excess of water to meet the requirements. Limes must be thoroughly slaked which is also ground very fine. Any un-slaked particles left will produce "blisters".

### **Application of colour wash**

The workmanship for colour washing shall be of high quality. Experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before washing or finishing is started.

The colour wash should be strained through a course cloth or sieved through a fine wire gauge before applying.

All colour washing shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Colour washing shall be worked in to all corners and crevices.

The coats shall be applied alternatively vertically and horizontally. One stroke is given from the top down-wards and the other from the bottom up-wards over the first stroke and similarly, one stroke from the right and another from the left over the first brush before it dries. Each coat shall be let to dry before applying the next coat.

Colour wash shall be applied on the surfaces in two coats over a prime coat. The prime coat for the colour wash shall be of white wash with lime or with whiting. The final coat shall be applied vertically and finished surface shall be free of dust, dirt and must be free from brush marks. The finished dry surface shall not readily come off on the hand when rubbed.

In replacing one colour with another, a coat of white wash shall be given or the old paint scraped off, before the new colour is given. Gum or rice water shall be added as for white washing.

Brush shall always be cleaned after use.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other work while applying white wash. Any damage, stains or spots caused by colour washing shall be rectified and removed at the expenses of the Contractor.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior washing shall be done in rainy and damp weather until the surfaces are thoroughly dry.

No interior washing shall be done on damp surfaces.

Each coat shall be thoroughly dry before application of subsequent coat.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior washing respectively.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during application of colour wash.

#### **Completion**

At completion of colour washing, the Contractor shall remove any wash spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section and the Contractor shall rewash or retouch any surface, which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.

All rubbish and accumulated painting materials shall be removed from the premises.

#### **17.5.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually colour washed with required quality in accordance with the provisions of the BOQ and/or shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.5.5 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and all colour washing materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub- section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| Colour washing         | Square meter / Square feet |

## **17.6 COLOURED CEMENT PAINTING**

### **17.6.1 DESCRIPTION**

Works covered under this item shall consist of applying coloured cement paint on the wall or ceiling plaster or at any other locations as directed by the Engineer. Cement paint of any approved brand and colour shall be used in minimum 2 coats over a coat of priming in accordance with these specifications as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers. Painting shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

### **17.6.2 MATERIALS**

#### **Cement powder**

Cement powder shall be manufactured of the best quality and of approved colour supplied in original sealed containers bearing the manufacturers labels and seals and be delivered at the Site.

Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

#### **Water**

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

### **17.6.3 CONSTRUCTION METHODS**

#### **General**

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of cement powder proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

#### **Samples**

Coloured cement painting scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer. For all finished coloured cement painting on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

#### **Protection**

Drop cloths or other approved protection materials shall be furnished and laid on all areas where painting is being done so as to adequately protect floor and other places from all damages caused during the execution of the coloured cement painting.

#### **Surface preparation**

All surfaces to be painted shall essentially be thoroughly cleaned through removing all grit, grease, dirt, loose materials, mortar drippings and the like. It is better that some soap is added in the wash.

The surfaces shall be given a thorough rub down with a brush or by rubbing with an old gunny bag to remove all loose materials. All holes, cracks, surface irregularities and minor repairs shall be made good with patching plaster and lime putty to obtain a smooth and even surface to the satisfaction of the Engineer. Lime putty is obtained by slaking lime with water and sifting it. The filler shall be let dry for 24 hours before colour painting. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Filler shall be applied before priming and the surface

shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.

The plastered surfaces shall be made smooth by sand papering and made free from marks before applying the prime coat.

In case of any inconsistency with the manufacturer's instructions, the manufacturer's instructions shall prevail.

#### **Preparation of paint**

The paint shall be prepared by mixing and stirring coloured cement powder, sand/lime as per manufacturer's specifications and water in such quantities as will produce a mixture of the consistency of thin cream. When sufficiently mixed, the mixture shall be strained through a clean coarse cloth.

#### **Application of paint**

The workmanship for coloured cement painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before washing or finishing is started.

All painting shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Painting shall be worked into all corners and crevices.

Painting shall be applied on the surfaces in two coats over a prime coat. The prime coat shall be of white wash with lime or with whiting. The coats shall be applied alternately vertically and horizontally. The final coat shall be applied vertically and finished surface shall be free from dust, dirt and must be free of brush marks. The finished dry surface shall not readily come off on the hand when rubbed.

In replacing one colour with another, a coat of white wash shall be given or the old paint scraped off, before the new colour is given. Gum or rice water shall be added as for white washing.

Brush shall always be cleaned after use.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other work while applying paint. Any damage, stains or spots caused by coloured cement painting shall be rectified and removed at the expenses of the Contractor.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.

Each coat shall be thoroughly dry before application of subsequent coat.

The washing shall be done with good hairbrush and not with brush made of jute.

Proper curing shall be done at least for 7 days on application of the final coat and/or as per instructions of the manufacturer.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during application of paint.

In case of any inconsistency with the manufacturer's instructions, the manufacturer's instructions shall prevail.

#### **Completion**

At completion of coloured cement painting, the Contractor shall remove any paint spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section and the Contractor shall repaint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.

All rubbish and accumulated painting materials shall be removed from the premises.

#### **17.6.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually painted with required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.6.5 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and all painting materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities and/or as directed by the Engineer.

| <b>Item of Payment</b>   | <b>Unit</b>                |
|--------------------------|----------------------------|
| Coloured cement painting | Square meter / Square feet |

#### **17.7 WATER REPELLENT PAINTING**

##### **17.7.1 DESCRIPTION**

Works covered under this item shall consist of applying two coats of clean silicon water repellent on exposed brick or concrete surfaces and cement rendered on wall, ceiling and at any other locations in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers.

##### **17.7.2 MATERIALS**

Silicon water repellent shall consist of sodium silicate or other alkaline silicates based clear approved product supplied in original sealed containers bearing the manufacturer's trade mark.

All silicon water repellent painting materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals.

Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

---

**17.7.3 CONSTRUCTION METHODS**

**GENERAL**

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of silicon water repellent proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

**Samples**

For all finished silicon water repellent painting on masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

**Protection**

Drop cloths or other approved protection materials shall be furnished and laid on all areas where colour washing is being done so as to adequately protect floor and other places from all damages during the execution of the painting.

**Surface preparation**

All surfaces to be silicon water repellent painted shall essentially be thoroughly cleaned by removing all grit, grease, dirt, loose materials, mortar drippings and the like.

The surfaces shall be given a thorough rub down with a brush or by rubbing with an old gunny bag to remove all loose materials. All holes, cracks, surface irregularities and minor repairs shall be prepared in such a manner so as to provide a smooth and even surface to the satisfaction of the Engineer.

**Application of silicon water repellent paint**

The workmanship for silicon water repellent paint shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be neatly cleaned before painting or finishing starts.

All silicon water repellent paints shall be applied with brushes under adequate illumination, evenly spread and smoothly flowed on. Silicon water repellent paint shall be worked into all corners and crevices.

The application of water repellent coat shall strictly comply with the manufacturer's instruction. The application shall preferably be carried out after a period of dry weather and before application, the surface shall be thoroughly cleaned and dried. A heavy coat shall be applied evenly direct from the container by flooding the surface with a wide brush so that at least 6mm penetration is achieved. A second coat shall be applied in the similar manner, which shall follow after 24 hours.

Brush shall always be cleaned after use. Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other work while applying the paint. Any damage, stains or spots caused by painting shall be rectified and removed at the expenses of the Contractor.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.



The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during painting.

#### **Completion**

At completion of silicon water repellent paint the Contractor shall remove any wash spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section, and/or as per provision of the BOQ and the Contractor shall re-paint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications and/or the provisions of the BOQ or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from all defects and blemishes.

All rubbish and accumulated painting materials shall be removed from the premises.

#### **17.7.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually painted with silicon water repellent of required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.7.5 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport all silicon water repellent materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| Water repellent paint  | Square meter / Square feet |

#### **17.8 VARNISHING**

##### **17.8.1 DESCRIPTION**

Works covered under this item shall consist of varnishing to the surfaces of wood works in three coats in accordance with these specifications, as per the provisions of the BOQ and/or as directed by the Engineer.

##### **17.8.2 MATERIALS**

###### **Oil varnish**

This is a kind of varnish belonging to the class 'Oil Varnish'. The essential constituent is 'resin' or rosin which is dissolved in oils, turpentine, or alcohol. Shellac, Gum Arabic, Rosin and Amber. Resins are most commonly used for preparation of varnishes. Various types of varnishes are obtainable in the market, each suited to a specific work. Preparation of varnishes is a difficult matter and it is best to purchase ready-made.

###### **Storage of materials**

Materials and tools shall be stored in a single place at the Site as designated by the Engineer.



Storage area shall be maintained in a neat and clean condition with surroundings protected from damage.

Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day's work. Every precaution shall be taken to prevent fire.

Storage area shall be all time accessible to the Engineer.

### **17.8.3 CONSTRUCTION METHODS**

#### **Samples**

Before starting full scale finishing work, sample finishing shall be done on similar wooden surfaces on an area of 300mm x 300mm and shall receive the approval of the Engineer.

Modifications, if required, in the above specimen shall be done depending on the outcome of sample work.

No payment will be made unless samples are made beforehand and approval of the Engineer is received for the same.

#### **Surface preparation**

Wood, surfaces that would be varnished, shall be well seasoned. The surfaces to be varnished shall be perfectly dry.

The process of preparing the surfaces shall include removal of all machine and plain marks and defects that will make an imperfect surface. Unless the surface is perfectly smooth and free from defects, varnish shall not be applied. The following rules shall be maintained in preparing the wood surfaces.

Before assembling the work, all marks shall be removed from the visible parts with a plane or cabinet scraper.

All traces of glue from around the joints shall be removed.

Defects, such as cracks and holes that can not be removed, shall be filled with stick shellac or its equivalent.

After the shellac or its equivalent hardens, it shall be placed down until it is nearly leveled with the adjoining surfaces.

The surfaces then shall be scraped and sanded thoroughly. Emery paper shall be used as abrasive. Four grades of abrasive paper shall be used successively in the order of No. 2, No. 1, No. 0 and No. 0. Sand papering shall be done with the grain. When thoroughly sand papered, the dust shall be brushed off with a stiff brush and inspected to see if the surfaces are free from all blemishes. It shall then be rubbed with a clean woolen rag.

Before application of varnish or painting, all articles shall receive inspection and approval of the Engineer.

#### **Application**

##### **Type of finish**

Unless otherwise specified wooden surfaces shall receive clear shellac varnish.

### **Finishing materials**

Fillers shall be White Zinc or natural paste fillers.

Sealers shall be of shellac wash coat. This is a mixture of seven parts alcohol to one part shellac, using Two-Pound-Cut shellac. Two-Pound-Cut shellac means that there are 1.8 kg of shellac mixed to 4.5 liters of alcohol.

Finish shall be done with a mixture of equal amount of alcohol and Four-Pound-Cut shellac.

Benzene shall be used as a cleaning fluid.

### **Application method**

Fillers made in the form of heavy paste by adding desired amount of turpentine shall be applied with a stiff brush, brushing first with the grain and then across it, covering only a small area at a time. It shall be allowed to dry for a few minutes until it loses its glossy appearance.

Excess fillers shall be wiped off across the grain with rough cloth. The surface shall then be rubbed down with the grain lightly with soft cloth to remove the excess. It should be pressed in such hardness so that the filler is not wiped off the pores.

Finishing shall be applied only after the filler has dried up.

Clean shellac varnish shall be applied with a good quality brush, 40mm to 75mm wide. Varnishing shall start near the center and top of a vertical surface or the middle of a horizontal surface, quickly brushing out in long sweeping strokes without going over the same area several times as shellac dries out very rapidly.

Brushing should be done towards the edges and care should be taken not to allow the shellac to run over the edges and pile up. It shall then be allowed to dry for 3 to 4 hours. The surface shall be lightly rubbed down with No.00 dry abrasive paper along the grain.

Grit and dust shall be removed with soft cloth before applying the second coat with slightly reduced alcohol mixture. It shall then be allowed to dry and rubbed down lightly with No.00 dry abrasive paper along the grain.

Grit and dust shall be removed again before applying the third coat with 25 percent alcohol mixture.

After the last coat dries up, the surface shall be wiped out lightly with Benzene.

The workmanship for varnishing shall be of high quality for this purpose, experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not congenial for the production of good results. All spaces shall be broom cleaned before varnishing or finishing starts.

All varnish shall be applied under adequate illumination. Varnish shall be worked into all corners and crevices.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during varnishing.

### **Completion**

At completion of varnishing work, the Contractor shall remove any varnished spot and stain caused during the whole process of works as stated under this Sub-section leaving the surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Sub-section and as per provisions of the BOQ. The Contractor shall re-varnish or retouch, as directed by the Engineer, any surface which does not comply with the requirements of these specifications, as per

provisions of the BOQ or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.

All rubbish and accumulated varnishing materials shall be removed from the premises.

#### **17.8.4 MEASUREMENT**

Measurement shall be taken for payment in square meter of the surface area actually varnished with required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

#### **17.8.5 PAYMENT**

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and varnish and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| Varnishing             | Square meter / Square feet |

|  |            |
|--|------------|
| <b>18.0 DOORS, WINDOWS AND CEILINGS</b>                    | <b>171</b> |
| <b>18.1 WOOD WORK FOR DOOR/ WINDOW FRAMES AND SHUTTERS</b> | <b>171</b> |
| <b>18.1.1 DESCRIPTION</b>                                  | <b>171</b> |
| <b>18.1.2 GENERAL REQUIREMENTS</b>                         | <b>171</b> |
| <b>18.1.3 OTHER REQUIREMENTS</b>                           | <b>171</b> |
| <b>18.1.4 MATERIALS</b>                                    | <b>172</b> |
| <b>18.1.5 FINISH HARDWARE</b>                              | <b>172</b> |
| <b>18.1.6 MATERIALS AND FINISH</b>                         | <b>173</b> |
| <b>DOOR HINGES</b>   | <b>173</b> |
| <b>DOOR STOPPER</b>  | <b>173</b> |
| <b>PVC BUFFER BLOCK</b>                                    | <b>173</b> |
| <b>DOOR HANDLE</b>   | <b>173</b> |
| <b>DOOR TOWER BOLTS</b>                                    | <b>173</b> |
| <b>HATCH BOLT</b>  | <b>173</b> |
| <b>WINDOW HINGE</b>  | <b>173</b> |
| <b>WINDOW HANDLES</b>                                      | <b>173</b> |
| <b>WINDOWS CATCH HOOK</b>                                  | <b>173</b> |
| <b>WINDOW TOWER BOLT</b>                                   | <b>174</b> |
| <b>GLASS</b>   | <b>174</b> |
| <b>LOCK SETS</b>   | <b>174</b> |
| <b>18.1.7 JOINERY</b>                                      | <b>174</b> |
| <b>18.1.8 GLUING UP</b>                                    | <b>174</b> |
| <b>18.1.9 FABRICATION AND INSTALLATION</b>                 | <b>175</b> |
| <b>18.1.10 GLAZING</b>                                     | <b>176</b> |
| <b>18.1.11 MEASUREMENT</b>                                 | <b>176</b> |
| <b>18.1.12 PAYMENT</b>                                     | <b>176</b> |
| <b>18.2 VENEERED PARTEX FIXED PANEL DOOR/WINDOW</b>        | <b>177</b> |
| <b>18.2.1 DESCRIPTION</b>                                  | <b>177</b> |
| <b>18.2.2 GENERAL REQUIREMENTS</b>                         | <b>177</b> |
| <b>18.2.3 OTHER REQUIREMENTS</b>                           | <b>177</b> |
| <b>18.2.4 MATERIALS</b>                                    | <b>177</b> |
| <b>18.2.5 JOINERY</b>                                      | <b>177</b> |
| <b>18.2.6 GLUING UP</b>                                    | <b>177</b> |
| <b>18.2.7 FINISH HARDWARE</b>                              | <b>177</b> |
| <b>18.2.8 FABRICATION AND INSTALLATION</b>                 | <b>177</b> |

|  |            |
|--|------------|
| <b>18.2.9 MEASUREMENT .....</b>                              | <b>177</b> |
| <b>18.2.10 PAYMENT .....</b>                                 | <b>178</b> |
| <b>18.3 ALUMINIUM DOORS, WINDOWS AND CURTAIN WALLS .....</b> | <b>178</b> |
| <b>18.3.1 DESCRIPTION .....</b>                              | <b>178</b> |
| <b>18.3.2 MATERIALS AND PRODUCTS .....</b>                   | <b>178</b> |
| <b>18.3.3 SHOP DRAWINGS .....</b>                            | <b>179</b> |
| <b>18.3.4 INSTALLATION .....</b>                             | <b>179</b> |
| <b>18.3.5 MEASUREMENT .....</b>                              | <b>180</b> |
| <b>18.3.6 PAYMENT .....</b>                                  | <b>180</b> |
| <b>18.4 GYPSUM BOARD FALSE CEILING .....</b>                 | <b>180</b> |
| <b>18.4.1 DESCRIPTION .....</b>                              | <b>180</b> |
| <b>18.4.2 MATERIALS AND PRODUCTS .....</b>                   | <b>180</b> |
| <b>18.4.3 SHOP DRAWINGS .....</b>                            | <b>180</b> |
| <b>18.4.4 INSTALLATION .....</b>                             | <b>180</b> |
| <b>18.4.5 MEASUREMENT .....</b>                              | <b>181</b> |
| <b>18.5.6 PAYMENT .....</b>                                  | <b>181</b> |
| <b>18.5 ALUMINIUM FALSE CEILING .....</b>                    | <b>181</b> |
| <b>18.5.1 DESCRIPTION .....</b>                              | <b>181</b> |
| <b>18.5.2 MATERIALS AND PRODUCTS .....</b>                   | <b>181</b> |
| <b>18.5.3 SHOP DRAWING .....</b>                             | <b>181</b> |
| <b>18.5.4 INSTALLATION .....</b>                             | <b>181</b> |
| <b>18.5.5 MEASUREMENT .....</b>                              | <b>181</b> |
| <b>18.5.6 PAYMENT .....</b>                                  | <b>182</b> |
| <b>18.6 POLYCARBONATE SHEET .....</b>                        | <b>182</b> |
| <b>18.6.1 DESCRIPTION .....</b>                              | <b>182</b> |
| <b>18.7.2 MATERIALS .....</b>                                | <b>182</b> |
| <b>18.6.3 INSTALLATION .....</b>                             | <b>183</b> |
| <b>18.6.4 MEASUREMENT .....</b>                              | <b>183</b> |
| <b>18.6.5 PAYMENT .....</b>                                  | <b>184</b> |

## **18.0 DOORS, WINDOWS AND CEILINGS**

### **18.1 WOOD WORK FOR DOOR/ WINDOW FRAMES AND SHUTTERS**

#### **18.1.1 DESCRIPTION**

Works covered under this item shall consist of furnishing, finishing and installing of wooden door/window frames and shutters of the size and shape shown on the Drawings and/or as specified in the Bill of Quantities and/or as directed by the Engineer including supplying and fixing of all finished hardware and glazing.

#### **18.1.2 GENERAL REQUIREMENTS**

##### **Design drawings**

Design Drawings shall be thoroughly studied by the Contractor before the Work is commenced. Detail of joints as shown on the Drawings must be specifically checked. If any detail description or specification is found missing or in the opinion of the Contractor inadequate, inconsistent or otherwise, the Contractor shall draw the same to the attention of the Engineer who may make necessary arrangements as deemed fit. On no account, the Contractor shall use his own judgement when any discrepancy is noticed in the Drawings, details and descriptions.

##### **Shop drawings**

Detailed Shop Drawings of doors and windows and other wooden works including glazing and installation details, when required, shall be submitted to the Engineer for approval.

Shop Drawings shall include the submission of manufacturer's literature, brochures and delivery date for all finish hardware and manufacturer's literature or specification for glass.

Fabrication of wooden doors/windows shall not start until the Engineer approves the Shop Drawings.

##### **Samples**

Within 35 days (or as may be specified otherwise) following the Contract is awarded, the Contractor shall furnish the Engineer, for his approval, a complete list in 4 copies of all hardware proposed for use under the Contract, scheduling all hardware for every door/window.

The Contractor shall submit to the Engineer two pieces of wood specimens, each of size 150mm x 250mm x 25mm, for his approval. The Contractor shall submit to the Engineer one sample of each type of finished hardware for doors and windows for his approval. However, the hardware shall be of the quality equal to or better than the samples, if available in the Engineer's office.

The Contractor shall submit to the Engineer two pieces of glass sample, each of size 150mm x 200mm and of required thickness proposed for glazing for his approval. The samples shall bear the name of the manufacturer, thickness and the type of glass.

All approved samples may be kept at Site for comparing the materials supplied by the Contractor.

The works of this Sub-section shall not commence until the samples get approval of the Engineer.

#### **18.1.3 OTHER REQUIREMENTS**

Dimensions shown on the Drawings are finished dimensions. In sizing rough components, necessary allowance, therefore, must be kept for the working loss arising from planing, smoothing and finishing.

Requisite precautionary measures against fire, denting, breakage or loss must be ensured while the articles are in transit and till the supply is completed.

Polishing or painting, as the case may be, shall be done at Site on receiving approval of the woodwork, carpentry etc. by the Engineer. The working area shall be cleaned properly before the finishing works start and subsequently before each day's work to ensure reasonably dust-free surroundings.

Particulars of the workshop, working area and storage space must be furnished to the Engineer, which shall be checked by him. If required, modifications shall be made as instructed by the Engineer to ensure proper atmosphere and amenities.

The Contractor shall provide adequate locked-up storage space. The Contractor shall replenish all lost or damaged hardware at his own expenses.

In case of inflicting injury to any part of the building/other works while installing, the Contractor shall rectify the same employing proper workers of the trade and furnishing all requisite materials at his own expenses.

The Contractor shall keep the Employer indemnified against all charges, which may arise out of this Contract in case of procurement of timbers from local sources.

#### **18.1.4 MATERIALS**

##### **Timber**

###### **General**

Timber, only as specified on the Drawings and Bill of Quantities, shall be used. Timber used for woodwork shall be well seasoned, kiln dry containing not more than 8% to 12% moisture so as to ensure minimum tendency towards warping, shrinking and swellings. It shall be free from all defects, such as large or loose knots, saps, shakes, upsets, wane edge and twisted fibre. It shall also be free from all diseases such as decay, wet rot, dry rot, woodworms and white ant. Timber shall be finished to the exact dimensions shown on the Drawings or as directed by the Engineer. The pieces of wood shall be properly finished by planer and other tools before joining and the completed wood works shall be accepted by the Engineer before fixing those in position.

###### **Wood for frame**

High quality, well-seasoned Garjan, Jarul, Local Sal, Shilkarai/Chikrashi, Telsu and Teak Chambol or any other equivalent type of wood as approved by the Engineer, shall be used for frame work or any other related works required.

###### **Wood veneered flash door shutter**

Jack wood, Gamari and Chapalish wood, Teak Chambol wood and Chittagong Teak wood veneered flash door shall be used for door shutter or sash or any other related works required. Any other equivalent type of wood may be used when it is required by the Engineer.

###### **Wood for solid door shutter**

High quality Jack wood, Chittagong Teak wood, Gammari and Chapalish wood and Teak Chambol wood or any other equivalent type of wood, as approved by the Engineer, shall be used for solid door shutter or any other related works required.

###### **Wood for panel door shutter**

High quality Jack wood, Chittagong Teak wood Gammari and Chapalish wood and Teak Chambol wood or any other equivalent type of wood, as approved by the Engineer, shall be used for solid door shutter or any other related works required.

**18.1.5 FINISH HARDWARE**

**18.1.6 MATERIALS AND FINISH**

Two sets of complete list indicating the manufacturer's name, brand name, type, size and location of all hardware to be installed shall be submitted to the Engineer for his approval. No hardware shall be ordered until the Engineer has approved this list.

Unless otherwise specified on the Drawings and in the Bill of Quantities or directed by the Engineer, specifications of the finish hardware shall be as follows:

**Door hinges**

Hinges shall be locally available, best quality iron or brass hinge of 100mm size and attached with No. 8 steel screw 32mm long, as approved by the Engineer or as directed by him.

**Door stopper**

Door stopper shall be made of timber as specified previously in the relevant portion of this Sub-section and shall be 100mm long to act as a stopper to keep the door in open position. Cleat with 65mm steel hinge, "Lion" brand or approved equal shall be fixed with No. 6 steel screws 20mm long, "Diamond" or "Star" brand or equal standard approved by the Engineer or as directed by him. One cleat to be furnished for each leaf as approved by the Engineer.

**PVC buffer block**

PVC buffer block shall be locally available best quality PVC block 38mm diameter and attached to wall with No.8 steel screw 50mm long, "Diamond" or "Star" brand or approved equal or as directed by the Engineer. One block to be furnished for each leaf as approved by the Engineer.

**Door handle**

Door handle shall be locally available best quality chromium or nickel plated 150mm long, attached with No.7 steel screw 25mm long or as directed by the Engineer. Two handles to be furnished for each door, one inside and one outside as approved by the Engineer.

**Door tower bolts**

Door tower bolts shall be locally available best quality 250mm and 200mm brass or iron bolts fitted on the interior side of the door leaf. 250mm long bolts shall be fitted at the top of the leaf vertically and the 200mm long bolts shall be fitted at the bottom of the door leaf horizontally. The 250mm and 200mm tower bolts shall be fitted with No. 6 brass screw 20mm long and as approved by the Engineer.

**Hatch bolt**

Hatch bolt shall be locally available best quality brass or iron bolt 300mm long fixed with approved bolts and nuts fitted on the outside of the door for locking arrangement as per direction of the Engineer.

**Window hinge**

Window hinge shall be locally available best quality 100mm iron hinge, "Lion" brand or approved equal, 75mm x 50mm in size and fixed with No. 7 steel screw 25mm long "Diamond" or "Star" brand or approved equal or as directed by the Engineer. Three hinges shall be furnished per window.

**Window handles**

Window handles shall be locally available best quality Chromium plated 100mm long, "Lion" brand or approved equal or as directed by the Engineer. One handle shall be furnished for each leaf at the centre on the inside.



#### **Windows catch hook**

Window catch hook shall be locally available best quality, "Diamond" brand or approved equal, galvanized iron 225mm long or as directed by the Engineer. One catch hook shall be furnished for each leaf.

#### **Window tower bolt**

Window tower bolt shall be locally available best quality iron, "Diamond" brand or approved equal. Tower bolts 150mm long be fitted on the interior side of the window leaf. Tower bolts shall be fixed with No. 5 steel screw 20mm long, "Diamond" or "Star" brand or approved equal or as directed by the Engineer and fixed vertically one each at the top and bottom on the interior side of the leaf to close the window from inside.

#### **Glass**

All glass shall be the approved best quality locally available sheet glass unless otherwise specified and shall be of the various sizes and thickness as shown on the Drawings and Bill of Quantities. All glass shall be free from bubbles, distortion and flaws of every kind with even surface and free from all other imperfections. Each piece of glass shall bear a label indicating the name of the manufacturer, the thickness and the type of glass. Label shall remain on the glass till they are cleaned finally on completion of work.

#### **Lock sets**

All Lock sets shall be of the best quality 'Yale' brand door lock or approved equal in perfect operating conditions or as directed by the Engineer, if not shown on the Drawings or mentioned elsewhere. Strikes shall be used where required to protect trim from being marred by hatch bolt. Three keys shall be furnished with proper identification for each lock set.

#### **18.1.7 JOINERY**

Joints shall be made according to the sizes and profiles as shown on the Drawings.

No extra nails or screws, other than those used in the approved samples, shall be used. Nails and screws to be used on finished surfaces shall be fitted slightly below the surface. Polyvinyl acetate adhesive of 'Aica Aibon' brand or other equivalent brand shall be used where use of adhesive is required or instructed. Wooden pins, where required or instructed, shall be of the same specimen, perfectly round and pressure fitted in the holes which shall be circular.

All joints shall be of such true-fit that they will not be discernible from a distance of one meter.

Layout of the joints shall be made by using accurate instruments. A knife can be used whenever a line is to be cut. A sharp pencil can be used for all layouts and specially when part of the area is to be cut away. All measurements shall be made from a common starting point, edge or surface. All identical joints shall be laid out at the same time. Two members of each joint shall always be identified with a pencil mark for quick identification during assembling.

Right instrument or machine shall be used for each cut. The cut shall always be made just inside or outside the layout line. The joints shall be trimmed out with a router plane or chisel when necessary.

Proper type of clamping devices shall be used for assembling the joint. A trial assembly shall be made to make sure that each joint shall fit properly. A correct method of fastening shall have to be determined. The same shall be completely square and aligned when properly assembled.

#### **18.1.8 GLUING UP**

The stock shall be glued together where necessary. The glue shall be of 'Aica Aibon' brand Polyvinyl-acetate emulsion adhesive or its equivalent quality. The grain of all the pieces shall run in the same direction. The edge of gluing stock shall be of the same maturity and strength.

Good glue must develop the full strength of the wood under all condition stress. To obtain this result, it is necessary to control the gluing operation as well as the condition of the material. The moisture content before gluing shall not be too low or too high.

The average moisture content of wood is about twelve percent. High quality glue joints can not be made on wet wood. The moisture content of timber shall be checked through each step of manufacturing preferably with an electrical Moisture Meter. The following points must be checked in order to ensure proper gluing:

Parts of the assembly are at proper moisture content and temperature.

Gluing surfaces have been made smooth, free from irregularities and even as much as possible.

All joints have been placed under equal pressure.

Excess glue has been removed before machining.

### **18.1.9 FABRICATION AND INSTALLATION**

All materials and finish shall get the approval of the Engineer before they are installed. All hardware and accessories shall be purchased in the manufacturer's original packages complete with all required trimmings. They shall conform to the requirements of the specifications and no substitution shall be made for the samples submitted without prior approval of the Engineer. Required templates shall be submitted for proper installation.

All wood works shall be fabricated and installed in a way to conform to the details and dimensions indicated on the Drawings in the Bill of Quantities and as directed by the Engineer.

All hardware and accessories shall be of best stainless and non-corroding variety of screws, bolts, nuts and other fastenings and approved by the Engineer before attaching them. These shall be of the same finish as the material, which they attach and shall be of the type and standard of the manufacturer.

All items of finish hardware and accessories shall be carefully fitted and adjusted to ensure smooth operation. All items of finish hardware and accessories shall be in perfect operating condition and undamaged while installing.

Door/window frames shall be properly cut, housed together and jointed with 'mortice' and 'tenon' joints. The frames shall be rabbeted on one side by a cut measuring 13mm in one direction and the full thickness of the shutter in the other. Frames shall be plumbed and leveled with corners at right angles. All exposed surfaces shall be smoothened with sandpaper. Back faces of wood, remaining in contact with or against concrete or masonry, shall be treated with a minimum of two coats of wood preservation paint, such as creosote or solignum. Wood preservatives, to be used, shall be approved by the Engineer.

The frame shall be fitted vertically in position true and plumb and fixed with clamps made with M.S. angle iron of size 375mm x 40mm x 6mm set in cement concrete within the masonry wall. There shall be six clamps for door frames and four clamps for window frames in general. However, the number and the size of the clamps shall conform to the requirements of the Drawings and as specified in the Bill of Quantities. The clamps shall be fitted by filling the recess properly so as to fit the frame nicely with the wall.

Door sash shall be of panel design and made as shown on the Drawings. Panel-sash frame shall be housed and jointed with mortise and 'tenon' joints. Panels for doors shall be solid wood, placed properly in retaining grooves with 4mm gap between adjacent panels on all sides or as indicated/shown on the Drawings.

Door/window frames and door sash shall be approved by the Engineer on assembling and before installing in position.

All hardware shall be installed and all door/window assemblies shall be fitted properly with minimum clearances. Hinges shall be recessed flush with surrounding wood surfaces. All sash shall be tested for proper and smooth operation without hinge bind.

On completion of door/window installation, all wood surfaces shall be French polished or painted.

#### **18.1.10 GLAZING**

##### **General requirements**

All glazing work shall be performed in accordance with the typical glazing details shown on the Drawings. Joints and spaces, to be sealed, shall be thoroughly dried and made free from dust and other foreign materials before glazing. All glass shall be set with proper clearance as recommended by the manufacturer at all edges. Glass with nipped or damaged edges shall not be installed. Adjacent materials, which are solid, shall be cleaned immediately before the sealant and compound harden or stain the adjoining surfaces.

##### **Glazing process**

Glass to be cut to provide a clearance of 1.7mm to 3mm on all sides. A thin layer of sealant made of chalk, double boiled linseed oil and resin is to be applied to the frame surfaces coming in contact with the glass. The glass panes shall be fitted in to the rabbet not less than 20mm wide taking care to centre with equal clearance of jambs between glass and frame. The glass is next to be pressed firmly in to the place against the sealant. A bead of sealant is then to be laid in to the spaces between the glass and the frame. Sufficient sealant shall be applied so that when the stop is put in place, the sealant will be forced in to the gap between the glass and the stop and completely fill the space between the frame, glass and stop. The removal stop is then to be installed. The remaining space between the face of glass and stop shall be completely filled with sealant.

##### **Cleaning**

No glazing shall be considered complete until and unless paints and other stains have been removed from the surface of the glass. Glass must be cleaned and polished with pads of damp cloth and then with clean dry soft cloths. It will have to be finally finished with appropriate glass cleaning fluid and made absolutely free of foreign particles.

##### **Defects and breakage**

The Contractor shall replace any glass not conforming these specifications or having defects not admissible under the manufacturer's grading rules. The Contractor shall replace all glass, broken, cracked or chipped by his workers or by faulty installation or from any other cause. All glasses shall remain in perfect condition at the time of handing over of the building to the Employer.

#### **18.1.11 MEASUREMENT**

All wood door/window frames and assemblies completed, including all hardware installed in place, shall be measured in cubic meter for the specified section of the installed frame and accepted by the Engineer.

All wood door/window leaf and assemblies completed, including glass panes and all hardware installed in place shall be measured in square meter of the installed area and accepted by the Engineer.

#### **18.1.12 PAYMENT**

For all wood door/window frames, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per linear meter, which payment shall constitute the full compensation for furnishing all materials and assemblies, fitting and fixing the frames, filling the recess, painting, all tools and appliances and labour including storage, transport, providing scaffolding and other works as well as all incidentals necessary for completion of all works

as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

For all wood door/window shutters including window glass panes, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials, hardware and assemblies, fitting and fixing the shutters/panes, all tools and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>          | <b>Unit</b>                |
|---------------------------------|----------------------------|
| Wood door/window frame          | Cubic meter / Cubic feet   |
| Wood door/window shutters/panes | Square meter / Square feet |

## **18.2 VENEERED PARTEX FIXED PANEL DOOR/WINDOW**

### **18.2.1 DESCRIPTION**

Works covered by this item shall consist of supplying and fitting fixing Gammari Veneered Partex Panel of the size and shape as shown on the Drawing or as directed by the Engineer including supplying and fixing of all necessary hardware and meeting all requirements as described under the Sub-section on the 'Wood Work for Door/Window Frames and Shutters'.

### **18.2.2 GENERAL REQUIREMENTS**

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

### **18.2.3 OTHER REQUIREMENTS**

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

### **18.2.4 MATERIALS**

Gammari Veneered Partex door/window panel.

### **18.2.5 JOINERY**

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

### **18.2.6 GLUING UP**

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

### **18.2.7 FINISH HARDWARE**

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

### **18.2.8 FABRICATION AND INSTALLATION**

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

### **18.2.9 MEASUREMENT**

All Veneered Partex panel door/window and assemblies completed and all hardware installed in place shall be measured in square meter of the installed area. Only the works completed in accordance with

the provisions of the BOQ, and/or as shown on the Drawings and/or as directed by the Engineer and accepted by the Engineer will be eligible for payment.

#### **18.2.10 PAYMENT**

For all Veneered Partex panel door/window and assemblies, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials, hardware and assemblies, fitting and fixing the panel, all tools and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>                  | <b>Unit</b>                |
|---|----------------------------|
| Veneered Partex fixed panel door/window | Square meter / Square feet |

### **18.3 ALUMINIUM DOORS, WINDOWS AND CURTAIN WALLS**

#### **18.3.1 DESCRIPTION**

Works covered under this item shall consist of supplying and fixing aluminum products of various types and uses such as doors, windows, curtain wall, curtain rail, cladding/flushing of sills, window grills, etc. fitted with necessary hardware, glass (where required) and finished in accordance with applicable Drawings and specifications.

#### **18.3.2 MATERIALS AND PRODUCTS**

##### **Doors, windows and curtain walls**

Doors, windows, curtain walls etc. shall be of approved standard conforming to the U.S. Architectural Aluminum Manufacturing Association (AAMA) or approved equivalent specifications. The frames and such members shall be of extruded shape made of 6063-T5 high quality aluminum alloy having a minimum section thickness of 1.8mm unless otherwise shown on the Drawings or indicated in the Bill of Quantities and shall conform to the U.S. Architectural Aluminum Manufacturing Association or approved equivalent standard.

##### **Fasteners, hardware and anchors**

Fasteners, hardware and anchors shall be of aluminum or non-magnetic, non-corrosive material compatible with aluminum. All windows shall be provided with non-jamming latches of rocker type designed to be locked from inside. Window locks shall be 'flush type' as manufactured by the Adams Rite Manufacturing Company of Glendale, California or any approved equivalent. The doors shall be provided with cylinder lock and suitable built-in-non-jamming latches and bolts.

Security locks shall be pin type 'Mortice' lock, 6 or 7 pins and adaptable to Master, Grand Master and Great Grand Master keys. Sliding windows and doors shall be fitted with adjustable sealed bearing sheaves of durable hydrated nylons or approved equivalent. Closer, push/pull and kick plates shall have to match with the frames. Any other necessary hardware to be incorporated in the works shall also match with the frame. Assembly and installation screws shall be of stainless steel. Doors, windows, curtain walls etc., to be installed with 'Teflon' injected expanding bolts and sills, shall contain adequate provisions for drainage. Head, sills and jamb members shall be comprised as single unit. Aluminum to aluminum contact between hardware parts or moving members shall not be permitted. Such contacts shall be properly insulated.

Glazing beads

Glazing beads shall be aluminum shape-in-interchangeable type.

Weather stripping

Weather stripping shall be of neoprene or silicon treated woven wood or any approved equivalent.

#### **Joints**

All joints shall be mechanically done square (telescopic) joints. No 'Mitral' joints and forced fitting shall be accepted. All units shall be fabricated at the factory with high dimensional accuracy. It shall be rigid and designed to permit complete weather stripping. In principle, the parts should be put together by self-tapping screws.

#### **Surface finish**

All exposed surfaces of aluminum members shall be factory finish and of substantially uniform appearance maintaining the "Architectural" standard.

All exposed surfaces shall be given a natural Anodic Oxide Hardcoat coating of 15 micron in thickness and a density of 4 mg per square centimeter and a uniform colour tone conforming to the U.S. Architectural Aluminum Manufacturing Association or any other approved equivalent standard. The colour spectrum shall be an-look. Finish of hardware shall match closely with the door/window/curtain wall finish.

#### **Accessories**

All accessories necessary for proper fixing and operation such as anchors, clips, fins, sub-frames, metal sills, mullion, covers, other trim, cleaning anchors, glazing beads, weathering and glazing strips, hardware and mechanical operators, etc. shall be supplied ready to set in place with the door, window, curtain wall units.

Steel or wood sub-frames shall be painted with Zinc Chromatic primer in case of steel and with wood preservative in case of wood. Steel anchor shall be properly insulated from aluminum frame.

#### **Sealant**

Sealant shall be one part elastic compound of "Architectural" grade caulk and shall be in matching colour.

#### **18.3.3 SHOP DRAWINGS**

The Contractor shall prepare detailed design of all works involved in line with the Employer's design and prepare Shop Drawings for the total works and submit to the Engineer for approval before factory fabrication starts. All exterior doors, windows and curtain walls shall be designed to withstand a wind pressure of 180 kg/cm<sup>2</sup>.

#### **18.3.4 INSTALLATION**

All units shall be assembled at Site under proper conditions, erected, fixed and glazed in place in strict conformity with the manufacturer's instruction. All cut-out operations for hardware preparation shall be made accurately and reinforced as required.

All doors, windows, curtain walls, etc. shall be set plumb, square, level and in exact alignment with surrounding works and shall be securely anchored ready for operation. All joints between the masonry opening and frames shall be caulked and sealed after installation of the frames. All installation works shall be done and finished in such a way as to ensure a free and smooth operation.

Abrasion or other injuries to the finished surfaces shall be carefully avoided. Cleaning should be accomplished with plain water or a petroleum type cleaning agent or with the manufacturer's recommended cleaning reagent. No corrosive reagent shall be used.



#### **18.3.5 MEASUREMENT**

All aluminium door and window frame shutter with glass assemblies complex including all hardware, installed in place shall be measured in square meter of the installed frame. Only the works completed in accordance with the provisions of the BOQ, and/or as shown on the Drawings and/or as directed by the Engineer and accepted by the Engineer will be eligible for payment.

#### **18.3.6 PAYMENT**

For all aluminium door and window frame shutter with glass, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials and assemblies and hardware, fitting and fixing, all tools, accessories and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>                    | <b>Unit</b>                |
|---|----------------------------|
| Aluminium door, windows and curtain walls | Square meter / Square feet |

### **18.4 GYPSUM BOARD FALSE CEILING**

#### **18.4.1 DESCRIPTION**

Works covered under this item shall consist of supplying, fitting and fixing thermal acoustical insulation of ceiling finished in accordance with the specifications of Drawings and Bill of Quantities.

#### **18.4.2 MATERIALS AND PRODUCTS**

Materials for false ceiling shall be made of noncombustible extruded mineral fibre or gypsum board tiles of thickness 12mm and size 600mm x 1200mm or as otherwise required and suspended from the roof by means of adjustable height suspension system and on an appropriate frame work of galvanized steel or aluminium cross rails, furring channels, furring channel joineries, locking keys fasteners, renal plugs etc. and aluminium ceiling tees or any other appropriate and approved material, section and quality.

The ceiling tiles shall be supplied with adjustable height, corrosion resistant metal suspension systems with necessary accessories, all in adequate quantities as recommended by the manufactures.

The Contractor shall submit three sets of samples of all types of materials and products to the Engineer for his approval before procuring the materials. One set will be kept at the office of the Engineer, one set at the Site office and the remaining set will be returned to the Contractor.

#### **18.4.3 SHOP DRAWINGS**

The Contractor shall prepare detailed design of all works involved in line with the Employers design and prepare Shop Drawings for the total works and submit to the Engineer for approval before any work starts.

#### **18.4.4 INSTALLATION**

All units shall be assembled under proper conditions, erected and fixed in place in strict conformity with the manufacturer's instruction. All cut-out operations shall be made accurately and reinforced as required.

Abrasion or other injuries to the finished surfaces shall be carefully avoided. Cleaning should be accomplished with appropriate type cleaning agent as recommended by the manufacturer or as directed by the Engineer. No corrosive reagent shall be used.

#### **18.4.5 MEASUREMENT**

All false ceiling including all aluminium channel, mineral fibre or gypsum board and including all other hardware, installed in place will be measured in square meter of the installed frame and accepted by the Engineer.

#### **18.5.6 PAYMENT**

For all false ceiling, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials and assemblies, fitting and fixing, all tools, accessories and appliances and all labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>     | <b>Unit</b>                |
|----------------------------|----------------------------|
| Gypsum board false ceiling | Square meter / Square feet |

### **18.5 ALUMINIUM FALSE CEILING**

#### **18.5.1 DESCRIPTION**

Works covered under this item shall consist of supplying, fitting and fixing non-combustible aluminium channel false ceiling finished in accordance with the specifications of Drawings and Bill of Quantities.

#### **18.5.2 MATERIALS AND PRODUCTS**

Materials for false ceiling shall be made of non-combustible extruded aluminium channel, aluminium board tiles of 2mm thickness and suitable size and suspended from ceiling by means of adjustable height suspension system and on a frame work of galvanized steel or aluminium cross rails, furring channels, furring channel joineries, locking keys fasteners, royal plugs etc. and aluminium ceiling tees or any other approved section of approved quality.

The ceiling tiles shall be supplied with adjustable height, corrosion resistant metal, suspension systems with necessary accessories, all in adequate quantities as recommended by the manufacturer.

The Contractor shall submit three sets of samples of all types of materials and products to the Engineer for his approval before procuring the materials. One set will be kept at the office of the Engineer, one set at the Site office and the remaining set will be returned to the Contractor.

#### **18.5.3 SHOP DRAWING**

The Contractor shall prepare detail design of the works involved in line with the Employer's design and prepare Shop Drawing for the Work and submit to the Engineer for approval before starting the work. No work shall start before obtaining such approval.

#### **18.5.4 INSTALLATION**

All units shall be assembled under proper conditions, erected and fixed in place in strict conformity with the manufacturer's instruction. All cut-out operations shall be made accurately and reinforced as required.

Abrasion or other injuries to the finished surfaces shall be carefully avoided. Cleaning should be accomplished with appropriate type cleaning agent as recommended by the manufacturer or as directed by the Engineer. No corrosive reagent shall be used.



### **18.5.5 MEASUREMENT**

All false ceiling completed with noncombustible aluminium channel and including all other hardware, installed in place will be measured in square meter of the installed ceiling area and accepted by the Engineer.

### **18.5.6 PAYMENT**

For all false ceiling, completed with noncombustible aluminium channel, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials and assemblies, fitting and fixing, all tools, accessories and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b>  | <b>Unit</b>                |
|-------------------------|----------------------------|
| Aluminium false ceiling | Square meter / Square feet |

## **18.6 POLYCARBONATE SHEET**

### **18.6.1 DESCRIPTION**

The work covered under this item shall consist of supplying and spreading polycarbonate sheet on roof, covering the opening or over "skywalk"/"sky-bridge" connecting the proposed building with the old one in accordance with the applicable plans, Bill of Quantities and these specifications.

### **18.7.2 MATERIALS**

#### **Polycarbonate sheet**

Polycarbonate sheet has excellent resistance when compared to other transparent glazing material. The sheet is available with thickness of 4mm, 6mm, 8mm, 10mm and 16mm. The colours are also various like clear, opal, gray, brown, green and blue. Other properties are as follows:

Polycarbonate sheet can be cold with a minimum radius of 150 times the thickness.

| <b>Thickness</b> | 4mm  | 6mm  | 8mm   | 10mm  | 16mm |
|------------------|------|------|-------|-------|------|
| <b>Radius</b>    | 10cm | 90cm | 120cm | 150cm | cm   |

#### **Other Properties**

| <b>Properties</b>         | <b>Standard</b> | <b>Unit</b>       | <b>Values</b> |
|---------------------------|-----------------|-------------------|---------------|
| Density                   | DIN 53479       | g/cm <sup>3</sup> | 1.2           |
| Modulus of Elasticity     | DIN 53457       | N/mm <sup>2</sup> | 2000-2200     |
| Tensile Strength at Break | DIN 53455       | N/mm <sup>2</sup> | >60           |
| Tensile Strength at Yield | DIN 53455       | N/mm <sup>2</sup> | >70           |

|                                  |            |                                  |            |
|----------------------------------|------------|----------------------------------|------------|
| Coefficient of Thermal Expansion | VDE 0304/1 | K <sub>-1</sub> 10 <sup>-6</sup> | 60-70      |
| Thermal Conductivity             | DIN 52612  | W/k.m                            | 0.2        |
| Heat Resistant Temperature       | DIN 53460  | °C                               | 145-150    |
| Moisture Absorption              | DIN 53495  | %                                | 0.36       |
| Vapour Permiability              | DIN 53122  | g/m <sup>2</sup> d               | 2.28 (1mm) |

Thermal Transmission Coefficient (K).

| Material             | K<br>[kcal/(h.m <sup>2</sup> /°C)] | K [W/(m <sup>2</sup> .°C)] |
|----------------------|------------------------------------|----------------------------|
| Glass 4mm            | 5                                  | 5.8                        |
| Double glass 4/12/16 | 2.6                                | 3                          |
| Acrylic Sheet 4mm    | 4.6                                | 5.3                        |
| Fiber Glass 1.2mm    | 5.5                                | 6.4                        |
| PC 4mm               | 3.4                                | 3.9                        |
| PC 6mm               | 3.2                                | 3.7                        |
| PC 8mm               | 3.1                                | 3.6                        |
| PC 10mm              | 2.9                                | 3.4                        |
| PC 12mm              | 2                                  | 2.3                        |

### **18.6.3 INSTALLATION**

The material for the polycarbonate sheet shall be selected by the Engineer as regards to its thickness, colour and other properties unless otherwise those have been specified on the Drawings or in the Bill of Quantities.

The Contractor shall submit three sets of samples of all types of materials and products to the Engineer for his approval before procuring the materials. One set will be kept at the office of the Engineer, one set at the Site office and the remaining set will be returned to the Contractor.

Manufacturer's literature or specifications shall be strictly followed for installation and laying of all polycarbonate sheet.

### **18.6.4 MEASUREMENT**

All polycarbonate sheet as laid and installed in place will be measured in square meter of the installed roof area and accepted by the Engineer.

**18.6.5 PAYMENT**

For all polycarbonate sheet roofing, completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing and installation of all materials and assemblies, all tools, accessories and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

| <b>Item of Payment</b> | <b>Unit</b>                |
|------------------------|----------------------------|
| Polycarbonate sheet    | Square meter / Square feet |

|   |            |
|---|------------|
| <b>19.0 STAIR RAILINGS .....</b>                  | <b>185</b> |
| <b>19.1 STAINLESS STEEL PIPE FOR STAIRS .....</b> | <b>185</b> |
| <b>19.1.1 DESCRIPTION .....</b>                   | <b>185</b> |
| <b>19.1.2 DESIGN DRAWINGS .....</b>               | <b>185</b> |
| <b>19.1.3 SHOP DRAWINGS .....</b>                 | <b>185</b> |
| <b>19.1.4 MATERIALS .....</b>                     | <b>185</b> |
| <b>19.1.5 SAMPLES .....</b>                       | <b>185</b> |
| <b>19.1.6 FABRICATION AND INSTALLATION .....</b>  | <b>185</b> |
| <b>19.1.7 OTHER REQUIREMENTS .....</b>            | <b>185</b> |
| <b>19.1.8 MEASUREMENT .....</b>                   | <b>185</b> |
| <b>19.1.9 PAYMENT .....</b>                       | <b>185</b> |

## **19.0 STAIR RAILINGS**

### **19.1 STAINLESS STEEL PIPE FOR STAIRS**

#### **19.1.1 DESCRIPTION**

Works covered under this item shall consist of furnishing, fitting, fixing stainless steel pipe of required diameter for stair and any other location in accordance with the provisions of the BOQ, the applicable design Drawings and these specifications and/or as directed by the Engineer.

#### **19.1.2 DESIGN DRAWINGS**

Design Drawings shall be thoroughly studied by the Contractor before the Work is commenced. If any detail description or specification is found missing or in the opinion of the Contractor the descriptions are inadequate, inconsistent or otherwise, the Contractor shall draw the same to the attention of the Engineer who may make necessary arrangements as deemed fit. On no account, the Contractor shall apply his own judgement when any discrepancy is noticed in the design Drawing, details and description.

#### **19.1.3 SHOP DRAWINGS**

The Contractor shall prepare detail design of the works involved in line with the Employer's design and prepare Shop Drawing for the Work and submit to the Engineer for approval before starting the work. No work shall start before obtaining such approval.

#### **19.1.4 MATERIALS**

The materials shall consist of brass pipe of required diameter and thickness as shown on the Drawings or specified in the BOQ or as directed by the Engineer.

#### **19.1.5 SAMPLES**

The Contractor shall submit three sets of samples of all types of materials and products to the Engineer for his approval before procuring the materials. One set will be kept at the Office of the Engineer, one set at the Site office and the remaining set will be returned to the Contractor.

The works of this Sub-section shall not commence until the samples get approval of the Engineer.

#### **19.1.6 FABRICATION AND INSTALLATION**

The stainless steel pipe shall be accurately bent, cut and welded as required and fixed with the vertical post or wall by means of stainless steel tray, anchor bolt or welding. The weld must be smoothen by using grinder. The Contractor shall carryout this work in true perfection in accordance with the Shop Drawings approved by the Engineer earlier, the Design Drawings and the Bill of Quantities.

#### **19.1.7 OTHER REQUIREMENTS**

In case of inflicting damages to any part of the building/other works while fitting and fixing, the Contractor shall rectify the same employing workers of appropriate skill of the trade and materials required at his own expenses.

#### **19.1.8 MEASUREMENT**

All stainless steel pipe completed and installed in place, shall be measured in linear meter for the specified section and actually installed in accordance with the provisions of the BOQ and/or the design Drawings and/or as directed by the Engineer. Only the works completed and accepted by the Engineer 19.9.9 Payment

For all stainless steel pipe, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per linear meter, which payment shall constitute the full compensation for furnishing all materials, fitting and fixing the pipe, all tools and appliances and labour including storage, transport, providing scaffolding and other works as well as all incidentals

necessary for completion of all works as per specifications and requirements described under this Sub-section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

**Item of Payment**

**Unit**

Stainless steel pipe

Linear meter / Linear feet

|  |            |
|--|------------|
| <b>20.0 TERMITE CONTROL .....</b>          | <b>187</b> |
| <b>20.1 SCOPE .....</b>                    | <b>187</b> |
| <b>20.2 MATERIALS .....</b>                | <b>187</b> |
| <b>20.3 METHOD OF APPLICATION .....</b>    | <b>187</b> |
| <b>20.4 WORKMANSHIP .....</b>              | <b>187</b> |
| <b>20.5 LOCATION AND SCHEDULING .....</b>  | <b>187</b> |
| <b>20.6 STANDARDS.....</b>                 | <b>188</b> |
| <b>20.7 GUARANTEE .....</b>                | <b>188</b> |
| <b>20.8 TESTING .....</b>                  | <b>188</b> |
| <b>20.9 MEASUREMENT &amp; PAYMENT.....</b> | <b>188</b> |

## **20.0 TERMITE CONTROL**

### **20.1 SCOPE**

The work covered by this section of Specification consists of furnishing all labour, materials, equipment, services, miscellaneous and necessary items required to complete Termite Control and, related works as indicated on drawings, and specified herein, in strict accordance with this section of specifications, as subject to the terms and conditions of the Contract.

### **20.2 MATERIALS**

Pesticides shall be 0.4% Termidor and/or as directed by the manufacturer, or solution of 0.5% Dieldrin or a 0.5% Aldrin, mixed in clean water for application in earth, and mixed in pure turpentine for application to wood.

Pesticides (Dieldrin & Aldrin) shall be obtainable from the Government of Pakistan, Department of Agriculture, or other sources approved by Engineer in sealed drums at rates in force at the time of their acquisition and only in the quantity necessary for work of this Project. All mixing shall be done at site and the amount of pesticides used shall be verified by the Engineer.

### **20.3 METHOD OF APPLICATION**

Pesticides solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150, p.s.i. (10.5kg/cm<sup>2</sup>) to all application to, on or in earth. Spraying to wood shall be done by hand compression with an approximate pressure of 20 p.s.i.

### **20.4 WORKMANSHIP**

The treatment operation shall be carried out as follows:-

After the excavation for foundation trenches and pits is completed in each and every respect, and passed for concreting work, but before laying of concrete, Pesticide shall be penetrated to a depth of 1" (25 mm) ;minimum in porous earth at bottom and 2" (50mm) to 3" (75 mm) at sides of excavation.

Stock piled excavated material to be used as back fill is to be treated as above. After backfilling to required grade the area is again to be sprayed.

After grading, compaction and levelling of fill and before installation of any soling, all areas are to be sprayed with pesticide, penetrating a minimum of 1" (25mm) into soil.

Pesticide solution shall be applied inside the building lines and for a distance of 10 feet (3 M) out side all building with specified pressure.

All rough wood work for the entire project is to be pesticide treated (before application of Solignum in the case of material to receive both treatments). Pesticide shall be sprayed on all surfaces of all the wooden work viz, door frames blocking, furring, planks,, boards etc, before installation. No spraying shall be necessary after field sawing, planning, joining or installation of such material. All spraying will be done within one week of working of the materials.

### **20.5 LOCATION AND SCHEDULING**

Saturation of earth is to be done by adequate personnel and in such a manner as to in no way disrupt the progress of the work.

Such work is to be scheduled and done by sufficient skilled personnel manner as to in no way impede the progress of the work.

Care shall be exercised to ensure that no mark or damage occurs to the finished building as a result of the work under this section, and Contractor shall verify and ensure that no material used herein will impede the growth of grass or plants at areas where spraying is done.



## **20.6 STANDARDS**

All methods of termite protections used herein be in accordance with best standard practices of National Pest Control Association, U.S.A. and the British Wood Preserving Association.

## **20.7 GUARANTEE**

The Contractor is to guarantee that the building shall be free from termites (white ants), wood bores and other pests or rodents which cause damage to wood or other organic material for 10 years from the date of acceptance of the building.

In the event of any damage caused within the guaranteed period, the Contractor shall replace at his own cost such damage material, finishes affected and suitably preserve and treat the entire premises with the best method known to the trade to prevent the spreading of termites.

## **20.8 TESTING**

All materials and samples shall be subject to testing in accordance with the relevant standards specified herein, and shall be rejected if found below these standards. Rejected materials shall be removed from the site immediately; Contractor shall quote a lump sum rate for the termite control testing and treatment of the ground and excavation covered by this specifications including all ditches, pits, excavations, wood etc., complete.

## **20.9 MEASUREMENT & PAYMENT**

Unless otherwise specifically stated in the Bill of Quantities or herein, all the work involved within the scope of this section of specification shall be deemed to be inclusive of but not limited to the following:-

CONTRACTOR's establishment charges, overhead charges, profit, interest.

All other expenses, charges, taxes specified in the Conditions of CONTRACT.

Labour and all costs in connection therewith.

Use of plant, equipment and machinery and all costs in connection therewith, e.g. mobilizations, demobilization, transporting, fuel, energy charges, grease, oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand parking, removing, damaged, destroyed, salvaged.

Material and goods, e.g. marketing, selecting, conveyance, loading, unloading, storing, watching, returning, handling, hoisting, lowering cutting, joining fixing, wastage, destroyed, damaged, salvaged.

The cost of all the works involved within the scope of this specification as per all the Drawings and Conditions of CONTRACT are covered only within the quoted lump sum rate of the item of the Bill of Quantities.

No separate payment will be made for wood work etc. Covered under this section of the specifications, and all cost in connection therewith shall be included in the unit rates of the various items of the wood work affected by treatment.

**LIST OF APPROVED  
MANUFACTURERS FOR  
ARCITECTURAL / CIVIL WORKS**

| S.NO     | MANUFACTURER                     | CONTACT NO.                  | CONTACT PERSON                    |
|----------|----------------------------------|------------------------------|-----------------------------------|
| <b>1</b> | <b>Cement</b>                    |                              |                                   |
|          | Falcon                           | 021-35309961-62              | -                                 |
|          | Lucky                            | 021-37130123                 | -                                 |
|          | Thatta Cement                    | 021-111 842 882              | -                                 |
| <b>2</b> | <b>Steel</b>                     |                              |                                   |
|          | Amreli                           | 021-32587232                 | -                                 |
|          | Agha                             | 0320-1213176<br>0343-8289828 | Abdul Mateen,<br>Munir ali        |
|          | H.S.J. Steel                     | 021-35878273-6               | -                                 |
|          | Faizan Steel                     |                              |                                   |
| <b>3</b> | <b>Paints</b>                    |                              |                                   |
|          | ICI                              | 042-111 551 111<br>EXT : 292 | Salman                            |
|          | Berger                           | 021-111 237 437              | -                                 |
|          | Nippon                           | -                            | -                                 |
| <b>4</b> | <b>Tiles</b>                     |                              |                                   |
|          | Master Tiles                     | -                            | -                                 |
|          | Shabbir Tiles & Ceramics Limited | -                            | -                                 |
| <b>5</b> | <b>Marble</b>                    |                              |                                   |
|          | Progressive Marble Industry      | 021-35069043-4               | Mehboob Ali                       |
|          | Salim Industry                   | 021-35006127<br>021-35061402 | Mustafa                           |
|          | Sindh Marble                     | 021-36323228                 | -                                 |
| <b>6</b> | <b>Doors</b>                     |                              |                                   |
|          | Sterling Doors                   | 021-36962337<br>0345-2068508 | Umer Sb.                          |
|          | Interwood                        | -                            | -                                 |
| <b>7</b> | <b>Aluminum Work</b>             |                              |                                   |
|          | Lucky                            | -                            | -                                 |
|          | Pakistan Cables                  | -                            | -                                 |
|          | Chawla                           | -                            | -                                 |
| <b>8</b> | <b>Tempered Glass</b>            |                              |                                   |
|          | Pakistan Safety Glass            | 0300-8255921<br>0300-8223752 | Adnan Pishori,<br>Murtaza Pishori |
|          | Ghani                            | 0302-8499749                 | Adnan Butt<br>(GMS & M)           |
|          | Gunj Glass                       | 0300-2001385                 | Muhammad Aslam                    |

**ELECTRICAL  
&  
ALLIED WORKS**

| <b>SECTION #</b> | <b>DESCRIPTION</b>                | <b>PAGE #</b>               |
|------------------|-----------------------------------|-----------------------------|
| 1                | LOW VOLTAGE SWITCHGEAR            | Section - 1<br>Page 1 to 4  |
| 2                | LV POWER CABLES                   | Section - 2<br>Page 1 to 6  |
| 3                | CONDUIT & PIPES                   | Section - 3<br>Page 1 to 3  |
| 4                | WIRING / WIRING ACCESSORIES       | Section - 4<br>Page 1 to 3  |
| 5                | CABLE TRAY & LADDERS              | Section - 5<br>Page 1 to 4  |
| 6                | SWITCHES & SOCKETS                | Section - 6<br>Page 1 to 3  |
| 7                | LIGHTING FIXTURES                 | Section - 7<br>Page 1 to 4  |
| 8                | VOICE & DATA COMMUNICATION SYSTEM | Section - 8<br>Page 1 to 10 |
| 9                | PUBLIC ADDRESS SYSTEM             | Section - 9<br>Page 1 to 4  |
| 10               | EARTHING & GROUNDING SYSTEM       | Section -10<br>Page 1 to 2  |

# **SECTION 1**

## **LOW VOLTAGE SWITCHGEAR**

## **1.0 LOW VOLTAGE SWITCHGEAR**

### **1.1 Scope of Works**

The work under this section consists of manufacturing, fabricating, supplying, testing and installation of all material and services of the complete Low Voltage Distribution Panels as specified herein, shown on the Single Line Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact location and position of the each LV Distribution Panel.

The Low Voltage Distribution Panel with accessories shall also comply with the General specifications for Electrical Works, section - 01 and with other relevant provisions of the Document.

The Low Voltage Distribution Panels shall be sheet steel fabricated suitable for floor standing /surface mounted / recessed totally enclosed, dust and damp proof. It shall be completed in all respects with material and accessories, factory assembled, tested and finished according to the Specifications and to the standard requirements.

The Low Voltage Distribution Panel shall be front operation type and shall:

- have a rated service short circuit breaking capacity, as per IEC 60947-2 unless stated otherwise on the drawings / in the BOQ.

- be suitable for 400 Volts, 3 phase 4 wire, 50 Hz system.

- be designed for flush mounting of all instruments on the front side.

- have incoming and outgoing cable termination arrangement, terminal block/line up terminals.

- be provided with stainless steel name plate on the front side of door and wiring diagram on inside of door.

- have all incoming and outgoing connections from top or bottom according to site requirements or as approved on shop drawings.

- have door grounded by flexible braided copper strip.

- have wiring diagram in the pocket inside the door of Distribution Panel.

- All the components used in the Distribution panel shall be type tested.

### **1.2 Applicable Standards / Codes**

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope for this section:

|           |   |   |
|-----------|---|---|
| IEC 51    | - | Direct setting electrical measuring instruments     |
| IEC 73    | - | Colours for indicator lights and push buttons       |
| IEC 947-2 | - | Low voltage switchgear and control gear             |
| IEC 439-1 | - | Low Voltage Switchgear and Control gear Assemblies. |
| BS 387 1  | - | Miniature & Moulded Case Circuit Breakers           |
| BS 88     | - | HRC fuses   |
| BS 89/90  | - | Ammeters and Voltmeters                             |
| BS 3938   | - | Low voltage current transformers                    |
| BS 1432   | - | Bus Bars  |

### **1.3 Fabrication**

The Low Voltage Distribution Panel (DB) shall be fabricated with 14 / 16 SWG sheet steel recess / surface mounting as approved by the Engineer. All the components shall be installed on a common component mounting plate inside the enclosure and protected from the front with screwed sheet steel front plate. The enclosure shall be provided with rubber gaskets and a lockable hinged door with cam fastener.

The distribution panel shall be supplied complete with all installation materials as recommended by the manufacturer. The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box for accommodating the cables and conduits may be provided. The box shall be of the same material and finish as the DB. All holes, cut-out etc. shall be tool or job manufactured and free from burrs and rough edges.

The cabling inside the DB shall be properly harnessed by means of straps, cords or ties. An earth bar shall be provided for connection of incoming and outgoing earth conductors with separate connection point for each incoming and outgoing circuit. The earth bar shall be permanently connected to the body of DB at two points. Flexible copper strip shall be provided for earthing of the door of DB.

Circuit numbers/ designation on all circuits shall be conspicuously marked to facilitate connection and maintenance.

All metal work of the DB shall be cleaned down to bare shining metal phosphated and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of colour RAL 7035 (or as approved by the architect) and then baked in oven. The thickness of powder coating shall be in the range of 80 to 100 microns.

The MDB-BANK to be located in electrical room at 8th floor shall be additionally coated with anti-corrosive paint to sustain the near to sea atmospheric conditions.

### **1.4 Components**

The Low Voltage Distribution Panels (DB) shall be provided with components as specified and shown on the Tender Drawings and required for the satisfactory operation of the distribution panel and of the electrical system.

Typical component specifications are given below:

#### **Bus Bars**

The Bus bars shall be imported, tinned, made of 99.9% pure high conductivity electrolytic tin plated copper and shall be completely isolated and mechanically braced for the specified fault level. The identification of bus bars shall be by providing heat shrink colour coded sleeves on complete bus bar lengths and these shall be red, yellow and blue for phases and black for neutral. The earth bus bar shall be green.

The bus bars shall be for three phase, neutral and earth and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 45°C at rated current.

Contractor is required to provide bus bar selection chart at 45°C ambient temperature along with shop drawings before commencement of panel manufacturing.



#### **Moulded Case Circuit Breaker (MCCB)**

The MCCBs shall be moulded case triple pole 400 Volts of current ratings as shown on the drawings. These shall have fixed magnetic short circuit and adjustable/fixed thermal overload protection.

The MCCBs shall be installed such that their switching levers are accessible through the front plate for operation.

The triple pole MCCBs shall have short circuit rupturing capacity suitable for the distribution system as approved by the Engineer or as shown on the drawings. The MCCBs shall be suitable for working on lighting and power circuits.

#### **Ammeters and Voltmeters**

All meters shall be flush mounting, Digital type with built-in selector switches. The front dimensions shall be 96 x 96 mm for meters.

The meters shall be of accuracy class 1.5 according to BS-89 and 90. The ammeter shall be suitable for connection to 5 Amps secondary of current transformers or directly through shunt as shown on drawings. The ammeters and voltmeters shall have measuring range as indicated on the drawings or as per the DB in which meters are installed.

#### **Current Transformers**

Air cooled, ring type current transformers shall be provided having transformation ratio as indicated on the drawings. The current transformers shall be of suitable burden having accuracy class 1.0 according to BS 3938. The current transformers shall have 5 amps secondary.

#### **Push Buttons**

Push Button shall be momentary contact type and suitable for flush mounting on the door of panel and on remote area. The push button for ON and OFF switching shall be spring loaded.

#### **Indicating Lamps**

Indicating lamps shall be suitable for flush mounting, complete with base and 230 Volts LED lamp. It shall have rosettes of suitable colours as approved by the Engineer.

### **1.5 Installation**

Low Voltage distribution board for recessed mounting in wall shall be installed such that the door shall finish flush with the surface of wall. The recess mounted distribution board shall be installed before the plastering of walls. The DB shall be protected to avoid any damage due to the civil work.

All loose parts dispatched separately with the DB shall be installed as per manufacturer's instructions and all adjustments or setting shall be made as required. All screws, nuts and bolts used for fixing the distribution board shall be galvanized.

The distribution board installation shall include connecting all incoming and outgoing cables. The cable entry in the boards shall be provided from top or bottom as required.

The distribution boards shall be tested as per instructions contained in article "Testing" of General Specifications for Electrical Works, Section-01 of these Specifications.

All labor, equipment and tools required for complete installation and shall be provided by the Contractor as well as all shimming of the supporting floor steel that may be required to set the switch gear in level position. The MDB-Bank shall be fixed firmly on the floor according to the manufacturer's recommendations. All outgoing and incoming cable connections shall be made and special care shall be taken in fixing cable boxes and in cable connections so as to have no danger of leakage during operation. Earthing connections shall be made according to the instructions given by the Engineer.

**END OF SECTION**

## **SECTION 2**

### **LV POWER CABLES**

**PART 1- GENERAL**

**1.1 RELATED DOCUMENTS**

Drawings and general provisions of the Contract, including General and Supplementary conditions, apply to this section.

**1.2 DESCRIPTION OF WORK**

Work included: Provide low voltage electrical conductor, cable, wire and connector work as shown, schedules, indicated, and as specified.

Types: The types of low voltage electrical conductor, cable, wire and connector required for the project include, but are not limited to, the following:

600/1000 volt building wire and cable.

600/1000 volt building wire and cable connectors.

300/500 volt control/signal wire and cables.

300/500 volt control/signal wire and cable connectors.

Application: The applications for cable, wire, and connectors required on the project are as follows:  
Power distribution circuitry.

Lighting branch circuitry.

Appliance, receptacle and equipment branch circuitry.

Motor branch circuitry.

Control wiring.

Outdoor lighting and power.

**1.3 STANDARDS**

Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

|        |   |
|--------|---|
| BS6346 | PVC insulated, armoured cables for voltages of 600/1000V and 1900 / 3300 V.   |
| BS6004 | PVC Insulated and PVC over sheathed cables – up 300 / 500V – for electric power and lighting.   |
| BS6724 | Thermosetting insulated armoured cables - 600/1000V to 1900/3300V - with low emission of smoke and corrosive gases when affected by fire. |

Where application of applicable codes, Trade Association standards, or publications appears to be in conflict with the requirements of this Section, an interpretation shall be obtained from the Architect/ Engineer.

**1.4 QUALITY ASSURANCE**

Manufacturers: Provide products complying with these specifications and produced by the manufactures provide in the list with BOQ.

**1.5 SUBMITTALS**

Shop Drawing submittals shall include, but not be limited to, the following:

The Contractor shall submit to the Engineer for review, a list of the proposed manufacturers of wire and cable, cable lugs, cable connectors and termination fittings listed herein. The Contractor may install wire and cable, cable lugs, cable connectors and termination fittings furnished by any manufacturer listed on the approved submittal.

Cut sheets on all 300/500 and 600/1000 volt conductors with manufacturers name ratings and capacities, insulation characteristics, and available colors, clearly listed

Cut sheets indicating all cable lugs, termination fittings and cable connectors.

Cut sheets indicating types of conductor identification bands.

**1.6 DELIVERY, STORAGE AND HANDLING**

Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory- packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire, or connectors shall be removed from project site.

Store cable, wire and connectors in their factory-furnished coverings., and in a clean, dry indoor space which provides protection against the weather.

**PART 2- EXECUTION**

**2.1 INSTALLATION**

A. General: Install electrical cable, wire and connectors as shown, in accordance with the manufacturer's written instructions, the applicable requirements of "Standard of Installation", and recognized industry practices to ensure that products serve the intended functions.

B. Coordination: Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.

Installer shall examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

**600 Volt Building Wires and Cables:**

Mains and feeders are to be run their entire length in continuous pieces Without joints or splices, [unless otherwise indicated or noted].

Conductors may be run in multiple on sizes inclusive, provided all multiple conductors are the same size, length, and type of insulation, and are so arranged and terminated as to ensure equal division of the total current between all conductors involved. Before any wire is pulled into any conduit, the conduit shall be thoroughly swabbed in such a manner as to remove all foreign material and to permit the wire itself to be pulled into a clean, dry conduit. All conductors shall be pulled into the conduit at the same time.

### **300 Volt Control/Signal Cable and Wire:**

Install all low voltage wiring in a suitable raceway except in areas with accessible (lay-in) ceilings unless otherwise noted on Drawings. Where cable is routed without a raceway, bundle all cables and suspend to one foot above ceiling using loop rings on 5' centers. Do not run cable loose on top of suspended ceilings. Do not attach cables to suspended ceiling supports or any mechanical, plumbing, or sprinkler piping. Conceal conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.

Number code or color code conductors appropriately for future identification and servicing of the system. Refer to consultants advice for additional requirements.

## **2.1 TESTING**

A. Feeder Insulation Resistance Test: Each new [and reused existing] 600 volt feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination.

1. Tests shall be made using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 volt dc. Resistance shall be measured between phase, neutral, and ground conductors and from conductors to raceway (ground). Readings shall be taken after 30 seconds and 60 seconds of Megger operation at slip speed and insulation resistance shall not be less than the 1 MΩ.
2. New conductors which do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.
3. Where reused existing feeders fail to meet the above insulation requirements, notify the Engineer in writing for direction prior to placing the existing feeders back in service.

B. Neutral Testing: After all feeder and branch circuit conductors are terminated, neutral to ground testing shall comply with the following:

1. The resistance of the system's neutral to ground shall be greater than 10 kΩ with the system bonding jumper disconnected.
2. Repeat neutral to ground test for neutrals of separately derived systems.

C. Pre-energization Check: Prior to energization, check all new [and reused existing] branch circuit cable and wire for continuity of circuitry and for short circuits. Correct malfunction when detected. No submittal is required for this test.

D. Voltage and Current Values: The voltage and current in each main feeder conductor shall be measured and recorded after all connections have been made and the feeder is under load.

E. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit four copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, test results, relative humidity, temperature, and weather conditions.

## **2.3 AS BUILT DRAWINGS**

As-Built Drawings: Refer to Section, "Electrical General Provisions", for applicable requirements.

**2.4 IDENTIFICATION**

A. Identification: Refer to Section, "Identification for Electrical Systems", for color coding and markings for all conductors and cables.

| S.No     | Description   | Data To Be Submitted<br>(By Bidder) | Remarks |
|----------|---|-------------------------------------|---------|
| <b>A</b> | <b>400 V, LOW VOLTAGE CABLES<br/>(To be filled in for each size of cable)</b> |                                     |         |
| 1        | Type Designation  |                                     |         |
| 2        | Manufacturer  |                                     |         |
| 3        | Standard to which manufactured  |                                     |         |
| 4        | Test certificates   |                                     |         |
| 5        | Issuing institute   |                                     |         |
| 6        | Number and date   |                                     |         |
| 7        | Maximum allowable temperature   |                                     |         |
| 8        | At continuous operation   |                                     |         |
| 9        | Under short-circuit conditions  |                                     |         |
| 10       | Conductor material  |                                     |         |
| 11       | Insulation material   |                                     |         |
| 12       | Sheath material   |                                     |         |
| 13       | Screening material  |                                     |         |
| 14       | Armoring material   |                                     |         |
| 15       | A.C. test withstand voltage level<br>For 5 minutes, kV                        |                                     |         |
| 16       | D.C. test withstand voltage level<br>For 5 minutes, kV                        |                                     |         |
| 17       | Short circuit current capacity<br>(1 sec.)                                    |                                     |         |

# **SECTION 3**

## **CONDUITS & PIPES**



**1.1 GENERAL**

The work under this section consists of supplying, installing, and commissioning of all material and services of the complete conduit & pipe system as specified herein and/or shown on Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the electrical lines.

**1.2 PVC CONDUITS**

All wiring for light, power, control and other circuits shall be carried out in PVC pipe otherwise as stated in BOQ, minimum 25mm dia. The conduits and pipes shall be supplied complete with all accessories including bends, sockets, junction boxes of identical material as that of conduit and all cutting, repair, excavation backfilling, etc., required for complete installation. The conduits for internal wiring to lights, sockets and power circuit shall be of approved brand.

Manufactured smooth bends shall be used wherever conduit changes direction. The sharp 90 degree bends or tees shall not be allowed. All conduit accessories shall conform to same material specifications as given above for conduit.

The bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joints.

The round junction box for ceiling light points shall be of PVC having minimum dimensions of 63 diameter and 63mm deep. The outlet box at wall light points shall be general purpose type having minimum dimensions of 75mm x 75mm and 38 mm deep. Pull boxes and inspection boxes shall be installed in conduit runs where required to limit the pulling of the cables or for inspection purposes. The pull boxes shall be square having minimum dimension of 100mm and 50 mm deep. In all cases, the minimum length of inspection boxes shall be not less than four times the cable manufacturers recommended bending radius of the cable. These dimensions are minimum only and the Contractor shall determine the exact size keeping in view ease of maintenance and installation. In general the use of pull boxes and inspection boxes shall be avoided. The pull boxes and inspection boxes shall be of 16SWG. sheet steel provided with anti-rust paint and finished in gray enamel paint or orange powder coated paint. The face plate shall be secured to the box by means of flat head galvanized screw.

**1.3 INSTALLATION**

**Conduits**

The conduit shall be installed concealed in wall, column ceiling or under floor, on surface, above the false ceiling or as stated on the drawings. The drawings are diagrammatic and do not indicate the location of junction boxes, pull boxes or inspection boxes which shall be provided to suit site conditions.

The concealed conduits shall have a minimum of 25 mm concrete cover, when concealed in R.C.C works. The conduits in R.C.C works shall be laid before pouring of concrete. Chisels shall not be made in R.C.C structure for conduits and accessories after pouring of concrete. In slab, conduits shall be laid over the bottom reinforcement steel and tied firmly to it. The conduit outlet boxes shall be held firmly to finish with the surface of the slab or beam. At expansions joints, flexible conduits or alternate arrangement shall be provided.

Where conduits have to be concealed in cement concrete work after concreting or in block masonry, chisels shall be made with appropriate tools and of required depth. The conduit shall then be firmly recessed and covered after plastering. All chisels for concealing conduits shall be carried out by the Contractor. The Contractor will be responsible for bringing back the general finish to the condition that it was before the cutting and chiselling by the Contractor.

The work of conduit installation and cutting in cement concrete work or brick work shall be coordinated with civil construction so as not to cause any undue hindrances and delays in progress. The Contractor shall obtain approval of the Consultant for route, etc. to suit the site conditions before starting chiselling and cutting. All junction boxes, outlet boxes, pull boxes etc., shall be installed concealed so as to finish with the surface.

Conduits installed on surface shall be fixed by means of black enamelled steel saddles and clamps having thickness of 3 mm or as mentioned in BOQ. The clamps shall be installed at a distance of not more than 600 mm.

All conduit bends shall be made with an approved conduit bending machine or hickory.

The radius of curvature of the inner edge of any bend shall not be less than the following table :

| Conduit size     | Radius                |
|------------------|-----------------------|
| 25 mm ( 1" )     | Not less than 150 mm. |
| 32 mm ( 1-1/4" ) | Not less than 200 mm. |
| 38 mm ( 1-1/2" ) | Not less than 255 mm. |
| 50 mm ( 2" )     | Not less than 305 mm  |
| 70 mm ( 2-1/2" ) | Not less than 380 mm  |
| 82 mm ( 3" )     | Not less than 460 mm. |
| 100 mm ( 4" )    | Not less than 610 mm  |

After completion of conduit installation, the system shall be checked for any charred or twisted portion prior to the pulling of wire. At all joints, PVC jointing solution or cement must be used.

The termination of conduits is shown diagrammatically on the drawings. The exact final location of the termination shall be coordinated with the equipment to be installed. Conduit ends pointing upwards or downwards shall be properly plugged, in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all termination of conduit, soft bushes shall be fixed to prevent sharp edges of conduit ends from cutting or damaging the wires or cables to be pulled through them. Brass glands of appropriate sizes (as per size of conduit) with proper chuck nuts shall be used for fixing of conduits in junction boxes.

The entire conduit system shall be installed and tested before wiring is carried out. Any obstruction found shall be cleared by use of a cutting or other approved device and the conduit be cleaned out before the installation of cable.

**1.4 OTHER ACCESSORIES**

Outlet boxes, pull boxes, inspection boxes, switch and socket outlet boxes, fan regulator boxes, shall be of 16 SWG sheet steel, de-rusted, degreased, rust-proof with two coats of zinc chromate primer and painted with enamel, complete with earthing terminal. All boxes shall have ample wiring space, and boxes used outdoors shall be weather-proof.

All the pull boxes are to be properly labeled according to the type of services for which it is installed.

**END OF SECTION**

# **SECTION 4**

## **WIRING AND WIRING ACCESSORIES**

---

**1.1 GENERAL**

The Contractor shall furnish and install all wires and cables along with the accessories as specified herein, in Bill of Quantities and Drawings. Apart from the material specified, the Contractor shall provide, the necessary material for termination or fixing of wires and cables such as lugs, solder, supports, bushes, glands for a complete wiring installation. Miscellaneous materials, like filing compound, identification tags, markers and earthing strips shall be furnished for completion of works in accordance with the best engineering standards and practice. The wiring installation shall be carried out in strict accordance with the scheme, cable sizes and circuit details shown on the drawings or as specified. The contractor is to produce purchase certificate from recommended manufacturers like Pakistan Cables or equivalent for each & every lot and each and every coil of wires to be stamped by consultants before it is being sent to site for use.

**1.2 L.V. CABLES AND WIRING**

Cable and conductors shall be PVC insulated, PVC sheathed with copper conductors, single / multi-core, unarmored 450/750 volts grade for light and socket circuits and 600/1000 grade for motor power circuits, to BS 6004 and BS 6346.

The neutral and phase conductors shall be colored black and red/yellow/blue respectively. The circuit protective conductors shall be of green having same cross-sectional area as that of phase and neutral upto 6 sqmm and above as specified in BOQ and drawings. Each circuit shall have its own separates neutral, and the "looping in" system for wiring shall be used. Joints shall be made at main switches, distribution boards and panels, sockets outlets, light fan points and switch boxes only; no joints shall be made in joint boxes, nor will any "through joints" be allowed.

PVC/PVC 3-core flexible cords, shall be used for connection to the luminaries and fixtures from the ceiling rose/outlet box, through **3-terminal imported crystalline PVC connectors, make : Cembre or equivalent**. Soldered or crimped tinned copper lugs, shall be used on the termination of cables and conductors 10sq.mm and larger. All multi-core cables shall be provided with compression glands, of the correct size and type, at panel entry positions.

**1.3 INSTALLATION**

The wiring through exposed or concealed conduit shall be started only after the conduit system is completely installed and all junction boxes, outlet boxes, switch boards, etc. have been fixed in proper position. For outdoor installation, where specified the cables shall be run direct in ground or in pipes as specified. The cables shall be pulled through conduit or pipes with care to prevent any damage to cables. To facilitate pulling, lubrication only as recommended by cable manufacturer may be used for decreasing friction. Under no circumstances shall oil or soap be used for cable pulling. Where several wires are to occupy the conduit or pipes they shall be pulled along together with earth continuity conductor. In general, the wires shall not be bend to radius less than ten times the overall diameter of the wire, or as otherwise recommended by cable manufacturer. The contractor shall furnish all installation material and labor for installation, testing and commissioning of cable system.

The wiring to power circuit and 15 amperes single phase socket outlet shall be run in conduit separate from light wiring conduits. Care shall be taken to ensure that all phase conductors are connected to the proper terminals and correct phase sequence is maintained. Wherever the size of conduit is not stated on drawings, it shall be in accordance with the Table based on I.E.E. Regulations. The wires or cables shall be terminated at light points, switchboard, etc. such that the insulation is always led into the equipment to which connection is made. The cable entry hole in equipment shall be such as not to damage the cable. Inside the switchboards or control boards, the wires or cables shall be securely fanned out in a neat arrangement and laced with

wax cord. The wires of different phases shall preferably be bunched separately. Identification tags or ferrules shall be provided at termination of wires in switchboards with respect to connected equipment for ease of installation and maintenance.

#### **1.4 POWER, LIGHTING AND CONTROL CABLES**

PVC Cable for underground installation shall be PVC insulated and PVC sheathed.

##### **1.4.1 Surface Cables**

Cables for distribution system on surface shall be either single-core or multi-core, as required and PVC insulated and PVC sheathed.

##### **1.4.2 Cables in Conduits**

All cables/wires, in conduits shall be of copper, PVC sheathed or PVC insulated as specified in design drawings or BOQ.

#### **1.5 PHASE IDENTIFICATION**

All cables shall have phase identification colors on insulation of each phase. The color code for three phase circuits shall be red, yellow and blue for phase conductor and black for neutral conductor. Single phase circuits shall have red for phase and black for neutral conductor.

#### **1.6 CABLE ACCESSORIES**

Best quality cable accessories should be used with the approval of consultant. The cable accessories, include, cable tray, cable trunking, floor trunking, clips, saddles (all galvanized). Cable glands made of brass should be used when cable enters/leaves a panel/Distribution Board. Identification tags made of engraved brass plates to be used for all cables. All the cables should be security fixed to cable tray or trunking with help of plastic ties. Cable lugs should be compression type of BICC U.K, Elpress Sweden or equivalent. Lugs should be pressed with help of compression machine approved by consultants.

#### **1.7 CONDUIT WIRING-INSTALLATION**

The wiring through conduit shall be started only after the conduit system is completely installed and all outlet boxes, junction boxes, etc. are fixed in position. The wires shall be pulled in conduit with care and, to facilitate pulling, the cable manufacturer's recommended lubricant shall be used. Use of any kind of oil or soap will not be permitted.

Where several wires are to be drawn in the same conduit, they shall be pulled together. The wires shall not be bent to a radius less than ten times the overall diameter of the wire, unless otherwise recommended by the manufacturer.

The wiring shall be continuous between termination. The looping in system shall be followed throughout. Any joint in wires will not be allowed. The use of connectors will only be allowed at location where looping-in is rendered difficult. The consent of the Consultant in writing, will be required for using connectors.

The connector shall be of suitable rating having porcelain body, sunk-in screw terminals and terminal strips. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm extra length of cable/wire shall be provided at each termination to facilitate repairs in future.

#### **1.8 INSULATION RESISTANCE TESTS**

Insulation resistance tests shall be made on all electrical equipment by using a megger tester of 500V for circuits upto 250 Volts and 1000V for circuits upto 500 volts.

The insulation resistance values of cables, transformers and switchgear etc., shall be as per B.S.S. and Pakistan Electricity Rules.

Before making connections at the ends of each cable run, the insulation resistance measurement test of each cable shall be made. If insulation resistance test readings are found to be less than the specified minimum, the cable shall be replaced and the new cable installed and tested.

All switchgears shall be given an insulation resistance measurement test after installation, before any wiring is connected. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit under test is less than the specified value, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters if equipment is found to contain moisture. After all tests have been made, the equipment shall be reconnected as required.

#### **1.9 CONTINUITY TEST**

Continuity test on all the sub and main circuits should be performed for phase, neutral & earth wires.

**END OF SECTION**

**SECTION 5**  
**CABLE TRAY & LADDER**



**1.0 CABLE TRAY & LADDERS**

**1.1 SCOPE OF WORKS**

Under this section of the specification cable tray shall be installed to support distribution cables, communication cables and all wiring cables not generally installed in conduit and or trunking.

The cable tray shall be installed in such a manner to enable easy access for cable installation.

The cable tray shall vary in type, i.e: where large cables are installed, ladder rack type cable tray shall be permitted. Where smaller type communication cables are installed, ventilated type cable tray shall be permitted.

Cable trays shall be Mild Steel Powder Coated finish or as specified in BOQ.

Cable ladders shall be installed in risers for the full length of the risers unless otherwise instructed by the Consultant.

**1.2 QUALITY ASSURANCE**

Acceptable Manufacturers

Subject to compliance with the requirements of the Contract Documents, acceptable manufacturers are to be firms regularly engaged in manufacturer of all materials specified in this section of types and sizes required, whose products have been in satisfactory use under similar service conditions for not less than ten years.

**1.3 SUBMITTALS**

Submit the standards to which the cable tray is manufactured to.

Submit shop drawings and data in accordance with the general requirements of the contract.

Show actual cable tray installation details, size and suspension system.

**1.4 PRODUCTS**

**GENERAL**

The cable tray system shall be of one manufacturer and shall include factory made trays, tray fittings, connections ,complete with accessories and supports to from a complete tray support system.

The cable tray system shall include the following factory made tray elements. Straight trays and ladders, fittings and horizontal and vertical bends of various angles crosses, tees, wyes, reducers, vertical riser elements, connectors, joint plates and all necessary fixing accessories including supports. No local or site fabrication of any cable tray system including ceiling and wall supports are acceptable. Threaded rods for ceiling supports are not acceptable.

### **1.5 CABLE TRAY**

The whole of the tray work, fittings and supports shall be of mild steel after manufacture. The thickness of the powder coating on any element shall not be less than 80 microns with anti-corrosive treatment.

Cable trays shall be constructed from mild steel of minimum thickness 16 gauge (1.5mm). Height shall be 60mm. Trays in excess of 300mm width shall be of minimum thickness 14 gauge (2.0mm). Flange height shall be 100mm or as indicated in drawings.

Insert elements, bolts, screws, pins etc., shall be cadmium plated/stainless steel.

Tray work shall have oval perforations. Ladder type trays shall be used as required and/or approved by the Engineer.

All trays (straight and fittings) to be heavy duty returned flanged type unless specified otherwise.

Tray components are to be accurately rolled or formed to close tolerance and all edges rounded. Flanges are to have full round smooth edges.

Ladder racks for widths up to and including 300mm shall be constructed from rolled steel sections of minimum thickness 16 gauge (1.5mm). Height shall be 60mm. Ladders in excess of 300mm width shall be C Section construction with a minimum thickness of 14 gauge (2.0mm). Height shall be 100mm or as indicated in drawings. The rungs shall be spaced at a maximum 300mm.

Unless indicated otherwise on drawings, cable trays shall be used in the range and 150mm to 750mm wide, in five preferred standard sizes: 150, 300, 450, 600 and 750mm.

Other sizes shall be used where specified or previously agreed with the Engineer.

Return flanges shall be a minimum of 10mm deep, unless otherwise specified.

Minimum radii at side rails, horizontal, and vertical tees and crosses shall be in accordance with the Manufacturer's standard.

### **1.6 EXECUTION / INSTALLATION**

Install all cable trays and ladder racks strictly in accordance with IEE and local authorities requirements.

Drilling, machining or cutting shall not be carried out after application of protective coat, unless previously agreed by the Engineer. If cutting or drilling is necessary, edges shall be cleaned up and painted with zinc based paint before erection.

Provision shall be made when installing all cables and cable trays for the expansion and settlement of the building.

Cables shall be fixed to the trays/ladders by means of PVC cleats and flame retardant cleats for flame/fireproof cables with galvanized bolts, nuts and washers. Use galvanized metal trefoil cleats with rubber pad for single core cables

Control cables run and clipped in groups shall not exceed twelve in number and shall be not more than double banked. Power cables shall be laid in a single layer except with the prior approval of the Engineer. Power cables should be spaced 2D between centres of

cables throughout the run of cables. Submit calculations for voltage drop for cables and increase the size if necessary.

Vertical distances between trays mounted horizontally shall be minimum of 250mm. Local reduction of distances between trays will be allowed to a minimum of 150mm with approval from the Engineer.

Trays shall be adequately supported to prevent sagging by more than 3 Deg. between fixed points. All supporting steel work shall be fixed at not more than 1 meter centers unless otherwise specified.

Where cable tray pass through floor arrange for 100mm concrete curb around opening and fire sealants shall be provided.

The Contractor shall submit calculations relating to tray / ladder work and tray / ladder supports demonstrating acceptable mechanical stresses and sag.

Where cable tray must pass below a beam a short length of tray shall be installed on the underside of the beam with 25mm spacers between the tray and the beam underside surface. Cables shall be strapped rigidly to the tray to prevent any possible sag in the cables.

Where cable tray is intended to cross a series of beams the tray shall be supported from each beam it crosses by metal supports suspended from below the underside of the beam  
- the space between the tray and the beam underside surface shall not exceed three times the diameter of the largest cable to be carried on the tray.

Cable tray covers are only required on roofs or outdoor where cables are installed exposed to weather conditions.

## **1.7 EARTHING**

The entire cable tray and ladder system shall be bonded using 12mm x 1.5mm braided tin copper, which shall be bolted across each joint in the system by means of galvanized nuts and bolts, complete with flat and spring washers.

Tray systems shall be bonded to the main building earthing system as required or directed by the Engineer.

**1.8 FIRE BARRIERS**

Arrange for opening in fire rated walls, and floor for width and depth of cable tray to run through in addition to the specified clearance of the above cable trays.

Arrange and make good fire rating of floors or walls after cables have been installed. For all floor openings of all risers (telephone, power) except vertical telecom cable risers where grating shall be provided.

All openings / sleeves within floor slabs and fire rated walls shall be sealed with proper fire rated material.

**END OF SECTION**

# **SECTION 6**

## **SWITCHES & SOCKETS**

## **1.0 LOCAL SWITCHES**

- 1.1 The local switches shall be 10/20 amp. Gang type , one-way, two-way, intermediate or double pole as indicated on the drawings. Where more than one switch is indicated at any position multiple gang units shall be used.
- 1.2 Switches shall be of the quick start make, slow break type specially designed for AC circuits to BS Standards. The operation of the switch shall not depend wholly on the action of the spring. The switches shall generally be of the rocker operated type.
- 1.3 All switch boxes shall be supplied with adjustable steel grids and earthing terminals.
- 1.4 Generally, switch units shall be of the adjustable grid pattern and to be secured to the adjustable grid by means of screws. For flush mounting switches the switch-plate shall overlap all edges of the box by not less than 7mm. For surface mounting switches the switch plate shall finish flush with the edges of the switch boxes. Switches for water heaters and fan coil units shall be complete with neon indicator lights.
- 1.5 In Plant rooms the switch units shall be surface or flush as required.
- 1.6 Local switches shall be arranged in convenient positions for switching the various circuits and generally as indicated on the drawings.
- 1.7 The switches shall be of the same manufacture for a particular type of switch throughout the installation. All accessories in wet and damp areas shall be of the splash-proof type to IP54 protection standard.
- 1.8 All switch boxes should be galvanized steel.
- 1.9 To ensure easy and correct connection of the conductors during installation, the necessary terminal shall be easily identified, grouped in line, upward facing, captive and backed out prior to the installation.
- 1.10 All dimmer switches shall be suitably rated to the lighting load being Controlled with 25% spare capacity and shall be adequate for tungsten and / or fluorescent lighting as specified.

## **2.0 POWER OUTLETS**

- 2.1 The switch socket outlets, shall be in accordance with BS1363 Standard as appropriate and shall be of the three pin grounding type.
- 2.2 Switch socket outlet in the different areas shall comply with section 607 BS7671 :2001
- 2.3 Live contact of the socket shall be completely shuttered such that it is not possible to engage any pin of the plug into a live contact whilst any other pin of the plug is exposed.
- 2.4 All floor mounted socket outlets shall be fixed as part of the under floor trunking service boxes.
- 2.5 These outlets shall be of the same manufacturer throughout the installation.
- 2.6 The sockets should provide a double earth terminal as per latest BS7671, 2001, Section 607.

### **3.0 FUSE CONNECTION UNITS / DP SWITCHES**

- 3.1 These shall be of flush or surface mounting type as manufactured in compliance with BS Standard as appropriate. The fuse connection units shall incorporate integral switch, neon indicator and 20 amp fuse links. The DP switches supplied for water heaters shall be incorporated with neon indicator lights, and these also shall be engraved 'Water Heater'.
- 3.2 These shall be of the same manufacturer for a particular type of switch throughout the installation and shall be complete with the other accessories installed.
- 3.3 Fuse selection shall be based on actual requirement of equipments.

### **4.0 G.I BOXES**

GI boxes to be provided with brass earth terminal to facilitate earth wire connection. The boxes to have sufficient number of 20mm and 25mm knockout. The boxes thickness shall be 1.1mm minimum and shall comply with BS 4662. Boxes to have adjustable lug for proper installations of wiring accessories. Extension ring to be used alongwith GI boxes, in places where the box is deep inside the wall, marble or concrete.

### **5.0 ISOLATORS**

All external isolators must have IP-65 protection with aluminum alloy or die-cast aluminium housing with bolt on drip proof canopy. Isolators must be de-rated for 50 deg. Ambient temperature. Internal isolators shall be IP 54 / IP 65 depending on the location with polycarbonate housing for non-armoured cables.

### **6.0 FLOOR SERVICE BOXES**

Floor Service Boxes shall be two-compartment type of the size 300 x 300 x 75-90mm (or as specified in BOQ) and shall be constructed from high-pressure Zinc Alloy die casting base frame pillars. This shall be fixed on to heavy gauge galvanized steel base plate for support by support frame. Other materials adequate in strength and performance shall be used and these shall be protected against corrosion. The boxes shall be constructed with provisions for ducting or conduit access on all four sides. Unwanted entries shall be blanked off with detachable side blanks.

Cover for floor service boxes shall be made of high pressure zinc alloy die casting provided with suitable hinges designed to enable the trap cover to open through 180 degrees and giving access at all times to the power and telephone outlets.

Covers for junction boxes shall be made of high pressure Zinc Alloy die casting with 12mm recess to receive ceramic tiles or carpet tiles. Counter sunk screws shall secure the covers of boxes. All exposed portions of the boxes shall be epoxy coated in grey color.

All boxes shall have extra wide gaskets in order to minimize water seepage. Gaskets shall be made of material that is durable in order to withstand loads.

All boxes shall be adjustable in height independently of the ducting system to take account of difference in floor thickness.

Adequate segregation shall be provided between service runs within boxes by using cross-over bridges and rigid compartments.

Circuit protective conductors shall be provided between the covers and the boxes.

Cable emerging for service boxes shall be protected against damage by means of nylon cables exit grommets or equivalent and shall be reversible to close position when not in use.

## **7.0 ACCESSORIES PLATE FINISH**

- 7.1 All the wiring accessories shall be vandal proof. The accessories plate shall have the following finishes depending on the location where it is installed and on the feeding arrangement.

Switches to comply with BS 3676:2000, and sockets to BS 1363, ceiling rose to BS67 : 1999.

All external outlets and outlets in pump room and parking shall be weatherproof to IP-66.

Weatherproof range should be suitable for semi recessed mounting and supplied with back boxes.

All outlets above false ceiling, store, etc. shall be white plastic.

Switches and outlets in apartments shall be white plastic slim type.

Main entrance, common area and lift lobbies shall be matt chrome steel face plate slim type.

Outlets in Electrical rooms, Mechanical floors, Tel. Rooms, etc shall be metal clad.

All switch plates including SSOs are to be coordinated with tiling layouts by prior agreement with the Architect on site.

## **8.0 MOUNTING HEIGHTS**

The mounting heights for the electrical equipment and accessories shall be coordinated with the furniture layout and shall be as per site requirements to Engineer's / ID's instruction and approval. In general the mounting heights from FFL to center of fixtures shall be as shown in legend.

**END OF SECTION**



**SECTION 7**  
**LIGHTING FIXTURES**

### **1.1 Scope of Works**

The work under this section consists of supplying, installing, testing and commissioning of all material and accessories of the complete Light fixtures as specified herein and/or shown on the drawings and given in the Bill of Quantities. The Vendor shall discuss the electrical layout with the Engineer and co-ordinate at Site with other services for exact locations and positions of the light fixtures.

The description of light fixtures is given in the bill of quantities, and stated on the drawings, and all relevant material is described in this Section. The determination of quality is based on certified photometric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.

The Contractor shall submit at least two samples of each and every light fixture specified and obtain approval of the Engineer before purchasing. The quality and finishes of the local make light fixtures (if mentioned in BOQ) shall be same as that of standard manufacturer. The accessories such as ballast, lamp/starter holders, starters, lamps, ignitors, etc., for all type of light fixtures shall be of Philips make or approved equivalent. Approved equivalent against those specified will be accepted if the specified one is/will not be available. For any substitution the Engineer's approval is necessary. Engineer's decision will be binding and final.

All fixtures shall be finished in standard colour schemes as mentioned in the manufacturer's catalogue for respective fixtures, unless specifically stated in the Specifications, Drawings or Bill of Quantities or directed by the Engineer.

### **1.2 Applicable Standard / Codes**

The latest editions of the following standards/codes shall be applicable to the material specified within the scope of this section:

|                   |   |  |
|-------------------|---|--|
| IEC 60598-2-3     | - | Luminaries   |
| IEC 60400         | - | Lamp holders and starter holders for fluorescent lamps     |
| IEC 62471         | - | LED Luminaries   |
| IEC 1048/1049     | - | Capacitors for use in TL, HP mercury & HP/LP sodium vapour |
| BS 3677/3767/4017 | - | Discharge lamp circuits                                    |
| IEC 922/923       | - | Ballast for discharge lamps                                |
| IEC 60662         | - | High pressure sodium lamp                                  |
| IEC 81 & BS 1853  | - | Tubular fluorescent lamps                                  |
| IEC 82 & BS 2818  | - | Ballast for tubular fluorescent lamps                      |
| IEC 155 & BS 3772 | - | Starters for fluorescent lamps                             |
| BS 5266           | - | Emergency Lighting   |
| BS 2560           | - | Exit Signs   |

### **1.3 Material LED Lights**

The LED light fixtures shall have lamps of proper rating as shown on the drawings. Each lamp shall be provided with electronic gear. The LED lamps shall be tubular, 1214/604mm long, 28-mm/16-mm. dia. for 42/25 watts respectively as specified. The LED shall be cool white/warm white, with colour rendering and light colour of 840 characteristics with an average output of more than 100 lumens/watt and life of 50,000 hours with

70% lumens maintained. The ballast shall be 'Low Loss' electronic type, totally enclosed and suitable to operate up to 250 VAC.

The lamp holders shall be rotary lock-in type. The internal wiring of the LED light fixtures shall be done with heat resistant wires at the manufacturer's factory. The internal wiring shall be clipped properly and heat resistant sleeves be provided on cables passing near ballasts. All light fixtures shall be provided with power factor improvement capacitor to give a minimum power factor of 0.90. Connectors suitable for connecting 2.5 sq.mm cable conductors shall be provided for supply connections. An earth terminal for connection to 2.5-sq.mm cable conductor shall be provided.

The body of the LED light fixtures shall be minimum 24 SWG sheet steel, derusted, degreased, finished in heat resistant paint, stove enameled. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided.

Light fixtures shall be furnished with Prismatic diffusing panels, polystyrene louvers or metal grid louvers or mirror optic reflectors, etc., as specified on the drawings or in BOQ. The louvers shall be secured firmly and in level. The louvers shall be in one section and not in pieces.

The design of light fixture for recess mounting shall be coordinated with the design of false ceiling prior to commencement of manufacture. Shop drawings shall be submitted for approval of Engineer.

#### **Fluorescent Light Fixtures**

The fluorescent light fixtures shall have lamps and ballasts of proper rating as shown on the drawings. Each lamp shall be provided with independent ballast.

The fluorescent lamps shall be tubular, 1214/604mm long, 16-mm. dia. for 28/14 watts respectively as specified. The fluorescent shall be cool white, with colour rendering and light colour of 840 characteristics with an average output of 3200 lumens ( $\pm 5\%$ ) for 28 watts and 1200 lumens ( $\pm 5\%$ ) for 14 watts after 100 burning hours. The ballast shall be 'Low Loss' electronic type, totally enclosed and suitable to operate up to 250 VAC.

The lamp holders shall be rotary lock-in type. The starters shall be glow type with radio interference suppressor/by-pass capacitor. The internal wiring of the fluorescent light fixtures shall be done with heat resistant wires at the manufacturer's factory. The internal wiring shall be clipped properly and heat resistant sleeves be provided on cables passing near ballasts. All light fixtures shall be provided with power factor improvement capacitor to give a minimum power factor of 0.90. Connectors suitable for connecting 2.5 sq.mm cable conductors shall be provided for supply connections. An earth terminal for connection to 2.5-sq.mm cable conductor shall be provided.

The body of the fluorescent light fixtures shall be minimum 24 SWG sheet steel, derusted, degreased, finished in heat resistant paint, stove enameled. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided.

Light fixtures shall be furnished with Prismatic diffusing panels, polystyrene louvers or metal grid louvers or mirror optic reflectors, etc., as specified on the drawings or in BOQ. The louvers shall be secured firmly and in level. The louvers shall be in one section and not in pieces.

The design of light fixture for recess mounting shall be coordinated with the design of false ceiling prior to commencement of manufacture. Shop drawings shall be submitted for approval of Engineer.

**Incandescent / Incandescent reflector/  
Compact fluorescent Light Fixtures/ Decorative Lights**

The incandescent/incandescent reflector/compact fluorescent light fixtures shall be as stated on drawings and bill of quantities. The light fixture shall be finished in standard colours unless otherwise stated on drawings or directed by Engineer. All incandescent/incandescent reflector/compact fluorescent light fixtures shall be of international standard and quality. The types of fixtures with manufacturer's catalogue reference are given on the fixture schedule and in bill of quantities. Equivalent fixture may be acceptable provided that the contractor submits for review all necessary data indicating photometric curves to show that the fixture proposed are of the same type, construction and quality.

The body of the light fixtures shall be minimum 18 SWG sheet steel, de-rusted, degreased, finished in heat resistant paint, stove enameled. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided.

The lamps for incandescent/incandescent reflector/compact fluorescent light fixtures shall be compact fluorescent lamp with normal or electronic control gear and shall be supplied and installed according to the wattage/type as indicated on drawings.

Weatherproof light incandescent/compact fluorescent light fixtures shall comprise of UV treated plastic body or aluminium body and gasketed clear glass cover secured to the body by means of wing nuts/screws to give a weatherproof and watertight fit. The gasket shall be weather resistance type.

The glass shade of the light fixtures shall be opal white or clear as furnished by the manufacturer with the light fixture unless specified and free from any air bubbles or voids. The shade may be spherical, cylindrical, flattened bottom or any other shape as specified in the drawings or BOQ.

**2.0 LIGHTING EQUIPMENT, GENERAL REQUIREMENTS**

- 2.1 Complete manufacturers data shall be supplied along with the proposal of luminaries.
- 2.2 Lighting equipment and lighting fixtures shall be as called for on plans by designated symbols and type. Said equipment shall embody the highest standards of electrical and mechanical design with maximum efficiency obtainable and all shall be subject to the approval of the Engineer.
- 2.3 All hangers, cables, supports, channels, frames and brackets of all kinds for safely erecting this equipment in place, shall be furnished from the standard manufacturer's product range and shall be erected in place under this Section.
- 2.4 Each lighting fixture shall have a manufacturer's label affixed to it and shall comply with the requirements of all authorities having jurisdiction.
- 2.5 The right to select other fixtures of the same quality, without additional cost to the Employer is reserved by the Engineer regarding the shape of the lighting luminaire.
- 2.6 The supply to lighting fittings mounted on or recessed into a false ceiling shall be effected by means of a ceiling rose on a conduit box within the false ceiling space with a three core heat resisting flexible cable connection. When fixtures are surface mounted to the ceiling. Ceiling rose to be provided adjacent to the fitting. In plasterboard ceiling areas, ceiling rose to be installed and supported next to the luminaire with a back box to terminate the flexible conduit from the conduit box within slab at high level.

- 2.7 All prismatic controllers for fluorescent fittings shall be of the injection moulded acrylic type to obviate discoloration. Plastic diffusers will not be accepted.

### **3.0 INSTALLATION**

The light fixtures shall be installed on trunkings / ceiling or recessed in false ceiling. All surface mounted fixtures shall be installed by means of galvanized steel screws or bolts depending on the type of fixture and as advised by the Consultant. Light fixtures installed in the false ceiling shall be supported to the roof in order to avoid loading on false ceiling.

**END OF SECTION**

# **SECTION 8**

## **EARTHING & GROUNDING SYSTEM**

**1.0 EARTHING & GROUNDING SYSTEM**

**1.1 GENERAL**

An Integrated Grounding System is one that establishes a single point ground (or earthing) system that achieves an acceptably low resistance ground and provides for a low surge impedance path from any point in the system. This concept is often referred to as a Common Point Grounding (CPG) System.

**1.2 EARTHING SYSTEM COMPONENTS**

Grounding system shall be composed of the following components:

Chemically activated grounding electrodes, commercially known as Chemically Enhanced Earth (CEE). Thin wall, soft copper tubing of at least one half-inch diameter, of at least ninety-nine (99%) percent pure copper.

**1.3 EARTH INSTALLATION**

CEE is an electro-chemical grounding electrode that automatically conditions the soil/rod interface. This is accomplished by absorbing local moisture to facilitate the electrolytic process. The installation must be accomplished in such a manner as to encourage this process.

To install the CCE, first bore a hole in the selected location to a diameter of not less than six (6) inches to accommodate the Earth Conductivity Enhancement Compound (ECEC) and a depth equal to the length of the selected rod plus one foot.

Remove all of the tapes covering the absorption and electrolyte holes.

Insert the electrode in the bored hole to its full length. It is preferable to leave the top exposed and protected by the special wall assembly, as illustrated. Pour 2 to 4 liters of water in the hole as it is being back filled.

Tamp the earth in place, leaving space to reach the connections and to install the well access assembly.

Make the connection to the CCE copper electrode.

Do not install in a place where watershed or downspout carry-off will flood the unit. Provide for carry-off when you install. The unit may be cemented or paved around, providing above instructions are followed and may be installed indoors.

Upon completion of installation of the earthing system, resistance-to-ground (earthing connection) shall be tested with a resistance tester. Where tests indicate resistance-to-ground is over 5 ohms, appropriate action shall be taken to reduce resistance to 5 ohms or less, by installing additional, properly spaced, ground electrode and treating soils in proximity to ground electrode. A retest shall be performed to demonstrate compliance.

**1.4 TEST POINTS**

These points are for testing of earthing systems. At these points hot work can be separated and can be tested for continuity and resistance. Test points should be made of brass and solidly fixed to wall at a height of 1.5 meter.

**1.5 EARTH PITS**

These should be made of pre cast concrete with a cover lid and should be placed over the electrode in level with the finished ground level. The cover lid should have marking showing its number and written "Earth Electrode".

**1.6 EARTH RESISTANCE TEST**

Earth resistance tests shall be made by the Contractor on the earthing system, separating and reconnecting each earth connection as required.

The electrical resistance of the E.C.C together with the resistance of the earthing leads measured from the connection with earth electrode to any other position in the complete installation shall not exceed 3 OHM.

Earth resistance test shall be performed as per Electrical inspector's requirements. Where more than one earth electrode is installed, the earth resistance test of each electrodes shall be measured by means of resistance bridge instrument.

**END OF SECTION**



**LIST OF APPROVED  
MANUFACTURERS  
ELECTRICAL AND ALLIED  
WORKS**

| S.#      | MANUFACTURER                               | CONTACT NO.                              | CONTACT PERSON      |
|----------|--|--|---------------------|
| <b>1</b> | <b>LV Panels &amp; Distribution Boards</b> |  |                     |
|          | Karimi Electromech                         | 0333 303 6059                            | Mr. Arsalan         |
|          | RA Engineering                             | 92 334 3316920                           | Mr. Faraz           |
|          | Hussain&Co                                 | 0333-2315658                             | Mr. Raza hussain    |
|          | Sunbeam                                    | 0333-2780926                             | Mr. Aneel Kumar     |
| <b>2</b> | <b>Lighting Fixtures</b>                   |  |                     |
|          | Future Technologies                        | 0322-2612582                             | Ms. Mona            |
|          | Pierlite Pakistan                          | 021-3536-0972,73<br>0322-2880031         | Mr. Shafi           |
|          | Britlite                                   | 0321-2035931                             | Mr. Darrel          |
|          | Osram, Unilux                              | 0321-2434034                             | Mr. Kamran Shamsi   |
| <b>3</b> | <b>Low Voltage Wires and Cables (LSZH)</b> |  |                     |
|          | Newage Cables                              | 3583 7577 – 3587 9121<br>0322-2620076    | Mr. Farhan          |
|          | Pakistan Cables                            | 021-3256-1170 ,75<br>0301-2844690        | Mr. Wasim           |
|          | Pioneer Cables.                            | 021-3241-7786<br>0300-8209926            | Mr. Ali Raza        |
|          | Fast Cables                                | 021-34395013<br>0321-4434059             | Mr. Farhan          |
| <b>4</b> | <b>Switches , Sockets &amp; Dimmers</b>    |  |                     |
|          | Schneider, (Clipsal Pakistan)              | 021 111 081 081 Ext: 112<br>0308 2228967 | Mr. Aamir           |
|          | Legrand, MegaPlus                          | 111-00-DELL (3355)<br>346 2759190        | Mr. Mahmood         |
|          | MK, (Leimra Engineering)                   | 021-4558611-12<br>'0300-2318227          | Mr. Shoaib          |
| <b>5</b> | <b>PVC/UPVC Conduits &amp; Accessories</b> |  |                     |
|          | Dadex                                      | 111-000-789<br>021-3431-3881             | Mr. A Qayyum        |
|          | Galco                                      | 021-32732475                             | Mr Zaheer           |
|          | Jeddah Polymer                             | 021-3634-3666<br>0321-2137162            | Mr. Ejaz            |
| <b>6</b> | <b>Cable Lugs</b>                          |  |                     |
|          | 3M   | 021-3263-6011<br>0321-2555010            | Mr. Habib ur Rehman |
|          | Cembre                                     | 021-3536-0916<br>0300-2008982            | Mr. Moazzam         |
| <b>7</b> | <b>GI/Steel Conduits &amp; Accessories</b> |  |                     |
|          | International Industries Limited (IIL)     | 021-32313508                             | Mr. Azam            |

| S.#       | MANUFACTURER  | CONTACT NO.                     | CONTACT PERSON      |
|-----------|---|---------------------------------|---------------------|
| <b>8</b>  | <b>Cable Trays / Ladder &amp; Accessories</b>           |                                 |                     |
|           | Hussain & Co.   | 021-3636-7002<br>0333-2315658   | Mr. Raza            |
|           | Zain Lighting   | 021-3666-9967<br>0321-9200546   | Mr. Ejaz            |
|           | Electroline   | 021-35869201<br>0334-2146245    | Mr. Arif            |
| <b>9</b>  | <b>Linear Aluminum Channels / Wall Trunking</b>         |                                 |                     |
|           | Japan Metal Industries                                  | 0312-1006233                    | Mr. Babar           |
|           | Zain Lighting   | 021-36657195<br>0321-9200546    | Mr. Ejaz            |
| <b>10</b> | <b>MS Back Boxes / Ceiling Pull Boxes (Local)</b>       |                                 |                     |
|           | Hussain & Co.   | 021-3636-7002<br>0333-2315658   | Mr. Raza            |
|           | Falcon Engineering                                      | 021-3507-4719<br>0321-2449043   | Mr. Saleem          |
| <b>11</b> | <b>Floor Service Outlet Boxes (Imported)</b>            |                                 |                     |
|           | Davis (Clipsal Pakistan)                                | 021-111-081-081<br>0308-2228967 | Mr. Mukhtar         |
|           | MK, (Leimra Engineering)                                | 021-4558611-12<br>'0300-2318227 | Mr. Shoaib          |
| <b>12</b> | <b>Junction /Pull Boxes Imported</b>                    |                                 |                     |
|           | S.A Hamid & Co. (Hensel , Germany)                      | 0301-8472264<br>42-3594-9261    | Mr. Shahzad Latif   |
|           | Zain Lighting   | 021-3666-9967<br>0321-9200546   | Mr. Ejaz            |
| <b>13</b> | <b>Industrial Sockets and Isolators</b>                 |                                 |                     |
|           | Gewiss (Overseas Enterprise)                            | 0300-8278799<br>0423-7186381-85 | Amail Alvi          |
|           | Schneider, (Clipsal Pakistan)                           | 111-081-081<br>0301-8201906     | Mr. Faraz           |
|           | S.A Hamid & Co. (Walther, Germany)                      | 0301-8472264<br>42-3594-9261    | Mr. Shahzad Latif   |
| <b>14</b> | <b>Network Cables / Voice and Data &amp; Equipments</b> |                                 |                     |
|           | Actasi by Schneider (Clipsal Pakistan)                  | 021-111-081-081<br>0308-2229597 | Mr. Jahanzeb        |
|           | Panduit (Awan Distributors)                             | 0334-8244883                    | Mr. Shafqat Ali     |
|           | 3M,USA (3M-Pakistan)                                    | 111 22 55 36<br>0333-30306716   | Mr. Habib ur Rehman |
| <b>15</b> | <b>Communication Racks (Improted Brand)</b>             |                                 |                     |
|           | Schneider Clipsal                                       | 021-111-081-081<br>0308-2229597 | Mr. Jahanzeb        |
|           | 3M Habib  | 111 22 55 36<br>0333-30306716   | Mr. Habib ur Rehman |

| S.#       | MANUFACTURER  | CONTACT NO.                       | CONTACT PERSON      |
|-----------|---|-----------------------------------|---------------------|
| <b>16</b> | <b>Fire Alarm System (Wiring Only)</b>  |                                   |                     |
|           | Prismian, FP Plus (Solution Cloud)  | 0321-2554234                      | Mr. Shahzeb         |
|           | Cavice SR 114E (Cxor)   | 0300 8477751                      | Mr. Amir Kadar      |
| <b>17</b> | <b>Public Address System (Wiring Only)</b>  |                                   |                     |
|           | Pakistan Cables   | 021-3256-1170 ,75<br>0301-2844690 | Mr. Wasim           |
| <b>18</b> | <b>Co-axial Cables</b>  |                                   |                     |
|           | Actasi by Schneider (Clipsal Pakistan)  | 021-111-081-081<br>0308-2229597   | Mr. Jahanzeb        |
|           | 3M Habib  | 111 22 55 36<br>0333-30306716     | Mr. Habib ur Rehman |
|           | Panduit (Awan Distributors)   | 0334-8244883                      | Mr. Shafqat Ali     |
| <b>19</b> | <b>Earthing</b>   |                                   |                     |
|           | Consumer Electric   | 021-3536-0916<br>300 200-8982     | Mr. Moazzam         |
|           | Cross Linkers   | 0300-2685891                      | Mr. Shoaib          |
|           | <b>NOTE:</b><br>The provided contact names and numbers are only for reference and ease of approach to the suppliers of recommended brands. They are not to be considered short listed by any means. But still the Consultant holds the right to discard any supplier, keeping in view the past record and quality of their product. |                                   |                     |

# **PLUMBING WORKS**

## GENERAL CONDITIONS OF PLUMBING AND SANITARY WORKS

### GENERAL

Supply, installation, testing and commissioning of Plumbing and Sanitary works as per the conditions and specifications are laid in this section and in other sections and as per instruction of Consultant.

### SCOPE OF WORKS

The contractor shall provide all materials and equipment, perform all the works necessary for the execution and completion including testing and commissioning of all Plumbing and Mechanical works as shown on drawings, specified herein and to the satisfaction the Consultant. The Plumbing and Sanitary works include but not limited to the followings:

#### a. Plumbing Systems

- Plumbing Fixtures
- Water Supply System
- Soil, West and Vent System
- External Drainage System

### RELATED WORKS

The contractor shall include the cost of all related works which are necessary for good engineering practice in his bid whether mentioned in BOQ or not, which are necessary to complete the entire Plumbing and Sanitary systems in all respects. The related works include but not limited to the followings:

- (i) Chiseling, cutting, patching, placing pipe and duct sleeves and making good whereas required including masking plates. (ii) Painting whereas required.
- (iii) Supports, hangers, anchor and foundations of pipes, ducts and equipment.
- (iv) Making co-ordination with all other trades. (v) Making Shop and As-built Drawings. (vi) Testing, Balancing and Commissioning.

### INTENT

It is the intent of the Working Drawings, Specification and BOQ that all work shall be provided complete, commissioned, tested, adjusted and ready for operation. The Drawings, Specifications and BOQ shall be taken as whole and not separately since they are intended to explain and illustrate each other.

Any apparatus, appliance, material or work not shown on drawings but mentioned in the Specification and BOQ, or Vice Versa, then any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided without additional expense to the Employer.

Minor details not usually shown or specified, but necessary for the proper installation and operation shall be included in the work and in the Contractor's bid.

### **COORDINATION**

The contract documents have been carefully coordinated to avoid overlapping or conflicting. However, should any discrepancies be noted between contract documents within a trade or between trades, they shall be immediately reported to the Consultant, so that the required revisions or work directives may issued to all parties concerned, at the earliest possible date.

### **EXPENDABLE MATERIALS**

The contractor shall supply all expendable materials or services which are necessary to test or set to work the system at his own expense.

### **MATERIALS AND EQUIPMENT**

Unless otherwise specified, all materials and equipment provided shall be new and shall conform to grade, quality and standards specified.

Materials and equipment provided under these specifications shall be limited to products regularly produced and recommended by the manufacturer for the service intended. The capacities and ratings of equipment shall be exactly in accordance with the specifications

### **MATERIALS AND SUBSTITUTIONS**

Model and serial numbers on the drawings and in the specifications are taken from the catalogs of the manufacturers equal in quality and utility may be accepted. When specific names are used in connection with materials hereinafter mentioned, they are mentioned as standards but this implies no right to use

other materials or methods unless approved as equal in quality and utility by the Consultant. The decision of the Consultant should govern as to what material is equal to that named but the burden of proof as to the quality of any proposed material should be given by the contractor. If any test is necessary to determine the quality of the proposed materials, such test should be made at the expense of the contractor by an unbiased laboratory satisfactory to the Consultant.

Where more than one specific name is used, it is to be understood that the name mentioned first represents the manufacturer whose equipment has been used as the basis of design. All other names mentioned are to be considered substitutions within the meaning of this paragraph, and no additional cost to the Employer shall accrue due

to any revisions, additions or deletions required to make substituted equipment perform in accordance with the drawings and specifications.

The responsibility for all changes involving the work of other trades as a result of substitutions should be included under the Plumbing & Sanitary Work. All such changes should be made at no extra cost.

#### **APPROVAL OF MATERIALS AND EQUIPMENT**

The Material, workmanship, design and arrangement of all work installed under the Contract shall be subjects to approval of the Consultant.

Approval of material and equipment by the Consultant shall not be considered as a guarantee of measurements or building conditions. The approval does not in any way relieve the contractor from his responsibility, or necessity, of furnishing material or reforming work as required by the Contract Documents.

The Contractor shall be responsible for this work until the completion and final acceptance and shall replace any of the same, which may be damaged, lost or stolen without any additional cost.

#### **MANUFACTURER'S RECOMMENDATIONS**

Where dimensions or specified installation and operating instructions of equipment are not provided in the drawings or herein, the contractor shall perform the work according to approved manufacturer's specifications and recommendations with a prior approval of Consultant. Any materials and work required under this heading should be supplied at no additional cost by the contractor.

#### **SUPERVISION AND WORKMANSHIP**

After getting the approval from the consultant, the contractor shall employ the experienced persons for execution of the Work. Through an authorized and competent representative keep constantly supervising the work and as far as possible keeping the same Site Engineer, Foremen and Workmen on the work from commencement to completion. The workmanship of the entire job must be in every way first class and only experienced and competent workmen should be allowed on the job.

#### **INSPECTION**

All work and materials covered by these specifications should be subject to observation and review at any and all times by authorized representatives of the Consultant

#### **ACCURACY OF DATA**

The layout of piping, ductwork and equipment shown on the drawings is generally diagrammatic unless specifically dimensioned. The layout, which shall finally include all approved materials to be used on the job, should be checked for interferences with work of



other trades and with existing conditions before installation. The right is reserved by the Consultant to make any reasonable change during the construction in location of piping, equipment and ductwork and its size as shown on the drawings in order to conform to the building conditions at no additional costs.

The general layout of piping shown on the drawings indicates branch run out terminated at individual or groups of fixtures and equipment. The piping should be considered continuous and finally connected to all fixtures and equipment.

All dimensions of doors, partitions walls etc., for the location of piping, ductwork and equipment should be taken from the Architectural Drawings.

### **STORAGE AND SHOP**

The contractor shall provide all temporary storage shop rooms care and cleaning that may be required at the site for safe and proper storage of tools, materials etc. to be utilized as per this section.

### **SUBMITTALS**

The following materials and data (4 sets) should be supplied by the Contractor.

#### **MATERIALS AND EQUIPMENT LIST**

Within 7 days after award of contract, submit to Consultant, a list of all materials and equipment's proposed to be furnished and installed for Mechanical works.

Shop drawings as per condition no.16 should be prepared and supplied to the Consultant for approval before any mechanical work is started.

List of materials and equipment with names and addresses of manufacturer's catalog numbers, trace names, illustrations, and descriptive data for each article proposed for a specified article. Descriptive literature to be sufficient for complete evaluation of equality of the proposed substitutions for specified articles. All pertinent data of each article should be underlined in each copy of each catalog or brochure in which it is described.

Materials for which the contractor does not propose a substitute can be described in the submitted list with the list "as specified in lieu of complete description". Equipment submitted list must include data.

For materials and equipment where the contractor proposes a substitute for items specified, submit complete data.

## **SHOP DRAWINGS**

Prior to the delivery of any material to the job site, and sufficiently in advance of manufacturer's lead time to permit the Consultant ample time for checking, submit for approval four (4) copies of detailed shop drawings showing:

Pipe work and duct work with locations of equipment & fixtures.

Cutout, sleeves, equipment/fixture arrangement and operating clearance.

Invert Level (IL), Ground Levels (G.L.L.), Finished Floor Level (F.F.L.), Bottom of Duct (BOD) and Bottom of Pipes (BOP).

Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested, shall be specific and identified in the catalogue, pamphlets, etc., and shall be clearly marked in ink. Data of general nature will not be accepted.

Examine all shop drawings before submission for approval, and place thereon initial approval stamp designating compliance of the submission with the contract drawings and specification. Shop drawings submitted without Contractor's approval stamp will not be accepted. Name of equipment being submitted, Pump, Electric Motor, Valve, etc.

Approval of shop drawings shall not be considered as a guarantee of measurements or building conditions. Where as the drawings' approval does not in any way relieve the contractor from his responsibility, or necessity, of furnishing material or reforming work as required by the Contract Documents.

No change to the contract, including extension of contract will be allowed as a result of failure to submit shop drawings giving ample time for checking.

No further changes in shop drawing will be permitted after approval has been given, except upon written request and subsequent approval of Consultant.

The contractor shall submit a certificate along with the shop drawings confirming that these shop drawings have been carefully coordinated with the architectural, electrical and structural works. The contractor will be responsible for this coordination and inform the engineer of any hindrance in pipes or ducts routes. Any losses due to mis-coordination will be borne by the contractor.

## **AS-BUILT DRAWINGS**

Keep an accurate record of all deviations in work as actually installed from work indicated on drawings,

Contractor, shall, before any work is started, procure, at his own expenses, an extra complete set of contract drawings for his trade. Keep this set at the job site and use for "marking up" to suit the works as actually installed.

Record on this "**AS BUILT**" set each change, not later than 24 hours after such respective change in work is complete. Make changes neatly using sharp colored pencils, straight edges and drawing instruments. Keep this '**AS BUILT**' set available for inspection at all time, and at job completion, deliver it to the Consultant for submission to the Employer, complete and unsoiled.

Upon completion of the work all changes should be incorporated on the reproducible drawings and one set of reproducible and Five sets of prints & soft copies on Computer Disks should be submitted to the Consultant.

### **TESTS AND ADJUSTMENTS**

Provide all materials, services, equipment, and personnel needed and perform all tests necessary to demonstrate to Consultant that all mechanical Works meet the specified standards.

If any piece of apparatus or any material or work fail in any of these tests, it should be immediately removed and should be replaced by perfect material, and the portion of the work replaced should again be tested by the contractor at his expense.

### **CLEANING AND PRESERVATION**

All equipment, fans, pumps, motors, piping and all other materials furnished under this section should be thoroughly cleaned free from all rust, scale and all other dirt before any covering or painting is done, or the system put in operation.

All opening of ducts and pipes should be effectively capped with purpose made caps. Paper, wood etc., should not be allowed as cap material.

All finished surfaces of equipment should be protected with heavy paper pasted thereon, or by other means, throughout the period of construction.

### **BASES.**

Unless otherwise indicated, all equipment mounted on concrete floors should be set on non-shrink grout and anchored.

Where equipment is shown mounted on concrete bases the floor shall first be roughened before the base is poured with the equipment set on level grout and anchored to the base. Equipment shall be anchored to the floor or base with approved standard concrete anchors.

## **REFERENCE SPECIFICATIONS AND STANDARDS**

Where called for in the sections which follow, the equipment, material and installation shall comply with the requirements of the latest standards and codes of followings institutions and societies:

- (i) International Plumbing Code (IPC)
- (ii) Uniform Plumbing Code (UPC)
- (iii) British Standards Institute iv. British
- (iv) Standard Codes Of Practice
- (v) Institute of Plumbing& Heating Engineers
- (vi) Pakistan Standards Institute
- (vii) American Society of Plumbing Engineers
- (viii) Pakistan Plumbing Professionals Society

## **ACCESSIBILITY**

Locate all equipment and piping which must be serviced operated or maintained in fully accessible positions. Include, but do not limit access to valves, traps, cleanouts, drain points, motors & controllers. If required for better accessibility, furnish access doors for the purpose. Make minor deviations from drawings where required to allow for better accessibility, but do not make changes of magnitude which involve extra cost without obtaining prior approval from Consultant in writing.

## **GUARANTEE.**

The contractor shall guarantee that all materials, equipment's supplied and workmanship by him to be free from all defects of workmanship and material. The contractor shall to replace at his own expense at any time within one year after installation is accepted by the Consultant any or all parts, materials and equipment that may be found defected or faulty.

## **PLUMBING FIXTURES**

### **GENERAL**

This section of Contract consists specifications for providing and installing complete set of plumbing fixtures, fittings and accessories as per Drawings, Specification and Bill of Quantities, including all labour equipment and materials required for the satisfactory operation and installation of plumbing fixtures complete in all respects.

### **MATERIALS**

#### **A.WASH BASIN type "WB".**

Wash basin will include followings items.

White color vitreous china wash basin 65 cm size Prime quality make.

C.P. pillar cock with connector, quality make.

1-1/4" waste with stainless steel chain and plug.

- 1 no. T. stop cocks - 1-1/4" size bottle trap - Nuts and Bolts.

#### **WATER CLOSET type AWC.**

Indian style Water Closet type AWC should consist of followings:

White color vitreous china water closet, Indian style, Orissa type, Prime quality make.

1 No. C.P. T-stop cock with connector quality make.

3 gallon flushing tank quality make with Stainless Steel pipe.

uPVC S or P-trap 4" size.

Nuts and bolts.

### **INSTALLATION**

Provide all hangers, supports, brackets, etc., for the proper installation of water closet, urinals, wash basins, sinks, flushing tanks etc. Requiring supports shall be in accordance with the manufacturers recommendations, and as approved. Where necessary the supports should be built into partitions or walls, and should be set as the Construction progresses.

All plumbing fixture shall be set in a neat, finished and uniform manner making the connections to all fixtures at right angle to the wall unless otherwise directed by the Consultant. Roughing for this work must be accurately laid out so as to conform with finished wall materials. Fixtures are not to be set until as directed by the Consultant.

All fixtures and trimmings in so far as practicable shall be of one manufacturer.

All exposed chromium plated fittings such as pipes, valve etc., shall be protected immediately after installation. During installation strap or padded wrenches shall be used on chrome plated pipe and fittings etc.

All fixtures shall be set straight and true. The setting shall be level and flush with finished floors and partitions.

Plumbing fixtures shall be supplied complete with all required trimmings, vitreous china fixtures shall be of first class quality with smooth glazed surfaces, free from warp cracks, discolorations or other imperfections.

Fixture mounting heights and spacing shall be as detailed on the Architectural and plumbing drawings.

Protect fixture from damage before and after installation.

Fasten fixture carriers securely to slab construction with power driven expansion shields and bolts.

Clean and adjust all fixtures and trim before and after installation.

## **WATER SUPPLY SYSTEM**

### **GENERAL**

Supply, fixing, testing and commissioning of water supply system, including pipes, other accessories, valves, etc., as specified in sections and herein: as shown on drawings and instruction of Consultant.

### **WATER SUPPLY SYSTEM DESCRIPTION**

Water supply should be in accordance with the bye-laws and regulations of the water supply authorities and executed to their specifications.

### **MATERIAL AND INSTALLATION**

#### **A. Pipe work & Fitting**

uPVC schedule 80 pipes and fittings with solvent joint will be used for cold water pipes sizes dia. 3" and above.

Polypropylene Random (PP-R) pipes and fittings confirming to Din 8077 with fusion jointing will be used for cold water pipe size to (dia. 20 mm to dia. 90 mm).

### **Valves**

Unless otherwise specified, valves should be of the same nominal size as the size of the pipe line to which they are connected. All valves that incorporated packed glands should be capable of having glands packed when connected in line and subject to the working line pressure.

All isolating valves shall provide tight shutoff in the closed position.

All hand wheel valves shall rotate clockwise to close the valve. Check valve should be installed in a plane only which is recommended by the manufacturer and approved by the Consultant/ Engineer.

Valve bonnets and covers should be easily removable and the gasket and glands should be readily renewable.

All gate and sluice valves shall incorporate guides in the body to ensure the correct position of valve discs at all times. The working parts of valves and cock should be bronze and the body casting should be bronze for valves and cocks up to 2" diameter connection and cast iron for valves and cock of 2-1/2" diameter connection and above.

Gland rings and spindles should be of a good running fit and stuffing boxes should be fitted with neoprene 'O' ring seals. The exterior finish of all bronze valves bodies should be polished except otherwise specified.

Check valves up to and including 2-1/2" diameter should be of 'Y' pattern swing type having regrindable bronze discs with the disc seat integral with the valve body. The disc and seat should be accessible via a screwed cap for regrinding with out removal of the disc.

### **Caps**

Should be machined, gasketed, and with straight threads or bolted type.

### **Unions and Flanges**

Unions and Flanges should be furnished and installed at each threaded or flanged connection to all equipment or valves. The faces of flanges being connected should be alike in all cases. Unions and flanges should be located so that pipe can be easily disconnected for removal of equipment, valve or tank.

## **SOIL, WASTE AND VENT SYSTEM**

### **SCOPE**

Supply, installation, testing and commissioning of soil, waste and vent system including, laying of pipe, jointing, cutting, excavation, backfilling as specified herein and as shown on drawings and as per instruction of Consultant.

### **MATERIAL**

All Soil, Waste & Vent pipes & fitting are UPVC, gravity type. All pipes and fitting shall be assembled in strict accordance with manufacturers written instructions.

UPVC (Un-plasticized Polyvinyl Chloride) pipes confirming to Specifications No. SCH-40 with solvent joints will be used for soil, waste and vent system.

Only UPVC molded fitting and specials will be used and no fabricated fitting will allowed.

All pipe work shall be completed as per specification laid in this book

### **INSTALLATION**

All underground pipes should be laid on a firm and compacted natural bed of earth for its entire length. Clean earth, sand or screened gravel should be placed under, around and above the piping to at least 1 ft above it, and compacted carefully. Thereafter excavated earth should not be allowed in trench as backfill material.

All horizontal piping should be provided with clean outs/plug as required for roding. An accessible clean out should be provided at the base of the soil and waste stack

All supports and hangers will be provided and installed as per recommendation of pipe manufacturer and approved by the Engineer.

All pipe work will be tested at least 6'.0 of meter column cleaner and solvent as recommended by the pipe manufacturer will be used.

The pipe and fitting shall be through cleaned with cleaner then solvent shall be applied.

### **INTERNAL DRAINAGE**

#### **3.0 Installation**

3.1 Vent pipes shall extend through roof and terminate 600mm above it with vent cowl. Vent pipes passage through the roof shall be made watertight by proper flashing.

3.2 All changes of direction shall be gradual and not abrupt, 45 degree fittings shall be used wherever possible, and 90 degree fittings shall be of the long sweep type. All unnecessary



turns and off sets shall be carefully avoided, and run as directly as possible from the sanitary fixtures to the vertical stacks.

- 3.3 Concealed pipes shall be installed in such a manner as to permit easy accessibility for maintenance this applies particularly to valve locations.
- 3.4 All pipes shall be fixed in neatly arranged lines, and adequately pitched horizontal lines to allow the system to be properly vented and drained. Air pockets, traps and sags shall be carefully avoided.
- 3.5 Supports, clamps and hangers shall be made of galvanized steel with rubber internal rubber seal, fixed with drilled plugs. Cutting and pinning of fixings will not be permitted.
- 3.6 Run building drains at a minimum grade of 2% (1:100) pitch unless otherwise noted, downward in the direction of flow. Pitch branch connections to stacks from fixtures at 3% (1:30) where possible.
- 3.7 Provide all the required appurtenances to make the drainage system complete in compliance with code requirements including traps, pipe fittings, hangers, and the like.
- 3.8 Wherever possible, vent stack offsets shall be made with 45 degree fittings.
- 3.9 Take special care in setting roof drains to ensure that they are set at an elevation which will prelude formation of puddles.
- 3.10 Install connections to roof drains in conjunction with the roofing specified under civil works, so that the building is adequately protected during construction from damage by storm water.
- 3.11 No short radius bends to be used. Use short "Tee-Wye" fittings in vertical piping only.
- 3.12 Any piping passing through roofs shall be so arranged to be a minimum of 300mm (1 ft.) from walls or other obstructions so as to permit proper flashings which are provided by another trade.
- 3.13 Where drainage pipe work crosses fire rated partitions, walls and floors, provide proprietary fire rated in tumescent sleeves with a fire rating equal to or greater than the fire rating of the respective wall or floor.

3.14 Horizontally long running soil & waste shall be vented from the top end, weather shown or not on layouts.

3.15 Sound lagging shall be provided to the pipes hanging with slab.

#### **4.0 Cleanouts on Soil Waste Vent and Storm Water Installation**

4.1 Cleanouts shall be installed at each change of direction of drainage pipes, greater than 45 degrees, inside the building, and where indicated on the drawings. Cleanouts shall be not more than 10m apart in horizontal lines. A cleanout shall be provided at or near the foot of each vertical waste or soil stack.

4.2 Cleanouts on concealed piping shall be extended through and terminate flush with finished wall or floor. Pits or chases may be left in the wall or floor, provided they are of sufficient size to permit removal of the cleanout plug and proper cleaning of the system.

4.3 Where it is necessary to conceal a cleanout plug, a heavy duty covering plate shall be provided, which will permit ready access to the plug.

4.4 Cleanout plugs shall be of heavy duty with seal and lock. Final finish shall be to the approval of the Architect.

4.5 Cleanouts shall be of the same nominal size as the pipes up to 100mm pipe diameter and not less than 100mm for larger piping.

4.6 Cleanouts shall be so installed that there is a clearance of not less than 45cm for the purpose of rodding and cleaning.

4.7 Provide cleanouts at foot of all stacks, changes of directions, at the ends of branch runs, in straight runs as required and where indicated. Terminate as specified under "Cleanouts".

#### **5.0 Material**

5.1 Unless otherwise indicated drainage, vent and rain water pipes and fittings inside the building (except Commercial Kitchen / Retail areas) shall be of uPVC to BS 4514 for pipe sizes upto 80mm dia and MuPVC / ABS to BS 5255 for pipe sizes 50mm dia and smaller. Fittings shall be push fit type.

- 5.2 Drainage pipes for Commercial kitchens shall be of HDPE withstanding high temperatures.
- 5.3 Acoustic lagging shall be provided for all horizontal drainage pipes above false ceiling, as detailed in drawings.
- 5.4 Drainage pipes buried under ground up to manhole shall be uPVC with rubber ring joints to BS 4660.
- 5.5 Sewage pipe between manholes shall be uPVC Class 'B' with rubber ring joints protected with concrete encasement where as required.
- 5.6 All pipes under building and those subject to traffic specially under roads shall be protected with reinforced concrete.

#### **4.0 Floor / Roof / Balcony Drains**

- 6.1 Floor drains unless otherwise indicated shall have uPVC traps of a minimum water seal of 70 mm, and shall be provided with adjustable and removable strainers. The open area of strainer shall be at least two thirds of the cross-sectional area of the drain line to which it connects. Floor drains shall have heavy duty stainless steel cover with a removable strainer and cover plate. Floor drain shall have built in rodding eye.
- 6.2 All floor drains / cleanouts must be coordinated with floor tiling layout.
- 6.3 Dish washer drains, in kitchen areas, shall include a nickel bronze funnel secured to the grating.

Roof Rainwater outlet shall be promenade roof drain outlets, 300x300 mm (12"x12") size, as by Wade, or approved equal.

Balcony outlet shall be of C.P Nickel Bronze with trapped or non-trapped sump.  
Cover to be chrome plated brass.

### **EXTERNAL DRAINAGE**

#### **7.0 General Requirements**

- 7.1 Pipe connections to manholes, collection tanks and percolating pits shall be made in a completely watertight and approved manner.
- 7.2 Pipes shall be kept clean until final acceptance of the work. Exposed ends of all incomplete lines shall be closed with wooden plugs and adequately secured at all times when pipe laying is not actually in progress.
- 7.3 Pipes shall be installed on a good foundation and adequate means taken to prevent settlement. Pipes laid in trenches shall be provided with a solid uniform bearing throughout their entire length.
- 7.4 Pipes shall not be buried at less than 60 cm below finished grade for protection against mechanical damage. Pipes shall not be run closer than 1m to building bearing walls and footings for protection against building settlement.
- 7.5 All pipes shall be laid to a uniform slope. Slopes of sewer drain shall be limited to 1% maximum. The free vertical drop of a sewer pipe into a manhole shall be limited to 45cm

between the invert level of the pipe opening and the bottom of the manhole. Where conditions necessitate that the drop would exceed 45cm at the maximum slope of 23% a drop manhole shall be used.

7.6 Trenches shall be kept free of water by pumping, use of well points, under drains or other approved means during pipe laying operations so that all pipe joints are made in the dry.

7.7 Precautions shall be taken to protect incomplete work from floating due to storms or from any other cause. All pipe lines or structures not stable against uplift during construction shall be well braced or otherwise protected.

7.8 All completed underground lines shall be subject to the inspection and approval of the Engineer. All pipes shall be true to line and grade. The full circle of the pipe shall be visible at the manholes.

#### **8.0 Installation**

8.1 The drains shall be laid truly straight in line and to an even gradient.

8.2 Excavations shall be made true and even to falls. The bottoms being trimmed to correct level and well rammed. Remove mud, rock projections, boulders and hard spots and replace with approved fill material well consolidated.

8.3 Minimum width of trench shall be 300mm greater than external diameter of pipe.

8.4 Any trenches excavated in error to a greater depth than required shall be in-filled back to the required level with concrete mix, at the Contractor's expense.

8.5 Before laying, all pipes and components shall be checked for defects and joint spaces cleared of dirt.

8.6 Socketted pipes to be laid with sockets uphill.

8.7 Flexible joints shall be made in strict accordance with manufacturer's instructions.

8.8 Where lubrication of the joint is required the pipe manufacturer's recommended lubricant shall only be used.

8.10 Lay and compact bed of granular material to provide at least 100mm thickness over the full width of the trench. Scoop out locally at pipe sockets where socketted pipes are used. Adjust pipes to line and level and ensure that pipe barrels rest uniformly on the bedding.

8.11 Add granular side fill uniformly up each side of pipes compacting by hand.

8.12 Any trench sheeting should be lifted before the fill is compacted.

8.13 The granular material shall be compacted in 100mm layers by hand up to 100mm minimum distance above top of pipes.

8.14 During bad weather, or in wet fine-grained soils such as clays, silts or sands, it is important to prevent the trench bottom being churned up by man working in the trench. In such cases a blanket of granular material 75mm thick laid over the trench bottom immediately after excavation, or alternatively a sealing layer of weak concrete 50mm thick, is required.

8.16 Provide concrete bed Grade A (CP 301 Table 1 Specified Works Cube Strength at 21 N/mm<sup>2</sup> at 28 days) to drain pipes and concrete infill (Concrete Mix 1:15) where drain track is below

level of bottom of foundation base and within 900mm horizontal distance from foundation base. The concrete infill to be carried up to the level of the bottom of the foundation base.

- 8.17 Drain tracks beyond 900mm of adjacent foundations and where the bottom of the trench is lower than a depth beneath the foundation equal to the horizontal distance between the nearside of the trench and the foundation less 150mm, shall be infilled with concrete upto that depth.
- 8.18 Concrete bed and surround shall incorporate movement joints at each drain pipe joint.
- 8.19 Each joint shall form a plane surface in the concrete above and below the drain and vertical to the drain and centre line, and shall separate the lengths of concrete with 13mm thick resilient fiber board or expanded polystyrene pre-cut to pipe diameter and concrete cross-section height and width and left insitu.
- 8.20 Drains below roadways, car parks, and any area subject to vehicular traffic where less than 900mm of cover shall be bedded and surrounded with concrete Grade 'A' (CP 301 Table Specified Works Cube Strength at 21 N/mm at 28days) 150mm minimum thickness all round with provision for movement joints.
- 8.21 Granular fill shall be laid in 100mm layers and had compacted to a level 300mm minimum above top of pipe followed by main backfill material placed and compacted in 300mm layers any trench sheeting being withdrawn as the work proceeds. Heavy mechanical compactors shall not be used until there is at least 300mm cover over the pipes.
- 8.22 Construction vehicles shall not be allowed to cross drain trenches until the final surface is placed except where timber sleepers or steel plates are positioned to bridge the trench.

#### **9.0 Manholes**

- 9.1 All manholes shall be constructed to the requirements of the Drainage Department.
- 9.2 Internal manhole covers shall be bolt down airtight double seal, recessed top.
- 9.3 Covers are to be insitu concrete filled, with surface finish to match surrounding floor. All covers are to be medium duty, locking and sealed, with a clear opening of 600mm x 600mm.
- 9.4 Covers for external manholes subject to vehicular traffic shall be kite marked, heavy ductile iron single seal, non rock heavy duty with square push fit seal plate. Covers to be complete with lifting key-holes, and generally constructed in accordance with BS. 497:76 and shall have a clear openings of 600x600mm unless otherwise indicated. Double seal covers shall be provided where indicated on drawings.
- 9.5 All covers shall be of ductile iron and shall be grey - epoxy coated.

#### **10.0 Gully Trap**

- 10.1 Where indicated on drawings provide gully unit of upvc hinged grate, road retaining bar with clear opening size 532x405mm. Unit shall be designed to deter ingress and help prevent blockage. A GRP grid shall be provided as standard.
- 10.2 Storm water Dome Type gratings shall be heavy duty UV resisted uPVC, clear openings size as per drawings. Flashing shall be provided to hold the water proofing.

**11.0 Testing of Drainage and Vent Pipe Systems.**

- 11.1 Before the sanitary fixtures are installed, drainage and vent pipe systems shall be subjected to a water pressure test to ensure and prove their tightness and to a flow test to ensure their freedom from obstructions.
- 11.2 The water pressure test shall be applied to the system in its entirety or in sections. All openings in the piping shall be tightly closed with special cast iron pipe plugs or other suitable means and the system filled with water to the point of overflow from the highest opening. The plugs shall be temporarily opened to make sure that all air has been vented and that water has reached all parts of the system.
- 11.3 No section shall be tested to less than a 3-metre head of water. In testing successive sections at least the upper 3 meters of the next preceding section shall be tested so that no joint or pipe, except the uppermost 3 metres of the whole system, shall have been subjected to a test of less than a 3-metre head of water.
- 11.4 The water shall be kept in the system or in the portion under test for at least 4 hours before inspection starts. While the system is under pressure, a careful inspection shall be made of all pipes and joints and if any leaks in joints or evidence of defective pipe or fitting is disclosed the defective work shall be corrected immediately by replacing defective parts with new joints and materials. No makeshift repairs or application of any repair compound will be permitted.
- 11.5 After the correction is made the pressure test shall be repeated until the system is proved tight.
- 11.6 Underground drainage pipes shall be tested by plugging the end of the pipe and filling with water to a minimum head of 3 meters. The test pressure shall be maintained for 24 hours. Pipes and joints shall be inspected and approved before backfilling the trench.
- 11.7 All drainage systems shall be tested for proper flow to ensure their freedom from any obstruction. The Contractor shall disassemble, clear, repair and re-assemble obstructed piping at his own expense. After re-assembly the piping shall again be subjected to the pressure test.

## **NATURAL / LPG GAS SUPPLY SYSTEM**

### **SCOPE**

Supply, fixing, installation, testing and commissioning of Natural / LPG Gas System as specified herein and as drawings and instruction of Engineer.

### **DESCRIPTION**

Natural / LPG gas piping system installation should be carried out by a licensed contractor pre-qualified by the SUI NORTHERN GAS COMPANY.

All natural gas piping should be completed with M.S. pipes conforming to the local Gas Company standards.

All under ground G.I pipes should be protected by bitumen/PVC taping.

Pipes laid above ground or exposed in the building should be painted as per engineer incharge instruction.

All pipe work should be tested and approved by Engineer for any leak.

The contractor shall prepare test report and fill up the application forms for individual house on behalf of client and then submit to Gas Supply Company at his own cost.

All G.I. pipe work shall be done as per the specifications laid in Section water supply system.

# **LIST OF APPROVED MANUFACTURERS**



**LIST OF APPROVED MAKE & MANUFACTURERS**

**PLUMBING WORKS**

**IMPORTANT NOTE: ALL MATERIAL SHALL BE OF CLASS 1 QUALITY, PURCHASED FROM APPROVED  
AUTHORIZED DEALER, SOLE IMPORTERS**

|     |                                      |  |
|-----|--------------------------------------|--|
| 1   | Plumbing Fixtures                    | Porta (China), ToTo (Indonesia)  |
| 2   | Toilet Accessories                   | Zilver (Italy)   |
| 3   | Faucets & Trims                      | Zilver (Italy)   |
| 4   | Kitchen Sink                         | Asia (Pakistan), Reginox (Holland)   |
| 5   | uPVC Pipes with Solvent Joints       | A.G.M (Saudia Arabia) Cosmoplast (UAE),<br>Bina Plastic (Malaysia) Terrain (Spain) |
| 6   | uPVC Pipes with Rubber Ring Joints   | Cosmoplast (UAE), Terrain (Spain)<br>Marley (UK)                                   |
| 7   | uPVC Pipes Class 'D' & 'E'           | Dadex, Steelex (Pakistan)<br>A.G.M (Saudi Arabia)                                  |
| 8   | Poly Ethylene Pipes and Fittings     | Hi-Tech, Dadex (Pakistan)  |
| 9   | Rubber Foam Insulation               | Aero flex (Thailand)   |
| 10  | PPR-C Pipes & Fittings               | Rakthrem (UAE), Pak Plast (Turkey),<br>Vesbo (Turkey)                              |
| 11  | G.I (Galvanized Iron) Pipes          | IIL (Pakistan)   |
| 12  | G.I (Galvanized Iron) Fittings       | H.S (China)  |
|     | Bronze Valves from 1/2" to 2" Dia.   | Rub (Italy), SCON (Pakistan)   |
| 13  |                                      |  |
| 14. | C.I Valves from 2-1/2" an above Dia. | Kitz (Japan), Gala (USA)   |
| 15  | Water Supply Pumps                   | KSB, (Pakistan), Pentax (Italy)<br>Wilo (Germany) Grundfos EU.                     |

**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

N.E.D. University of Engineering & Technology

*LIST OF APPROVED  
MANUFACTURERS*

---

|    |  |   |
|----|--|---|
|    | Submersible Pumps                                    | KSB, (Pakistan) Pantax (Italy),<br>Wilo (Germany).  |
|    | Electric Motors                                      | Siemens (Pakistan)  |
|    | Paints   | ICI (Pakistan), Jotun (Malaysia)  |
|    | Steel  | Amreli Steel (Pakistan)   |
|    | Grease Trap  | JAWS, Super Alpine (Pakistan)   |
| 21 | Hot water Electric Heater working<br>pressure 60 psi | Ariston (Italy), Ghanchi, Singer (Pakistan)   |
|    | Motor Control Panels                                 | Comfortech Engineering,<br>Hussain Engineering & Co.<br>Bilal Switch Gear<br>South Asian Electric Concern |
|    | Hangers & Supports                                   | Hilti (UK), Fischer<br>(Germany), Inka (Turkey)   |

**Note: Technical Submittal of all equipment shall be approved by the consultant.**

# **MV WORKS**

**(Mechanical Ventilation)**

# **FANS, BLOWERS AND EXTRACTORS**

## **FANS, BLOWERS AND EXTRACTORS**

### **SCOPE**

Supply & Installation of Exhaust Air & Fresh Air fans complete in all respects of various capacities as shown in schedule of fan, drawings, specified herein, & as per instruction of Consultant.

Motor shall conform to specification under motor and shall be sized to provide the required BHP for meeting the specified conditions without overloading.

### **DESCRIPTION.**

The fans and blowers used for exhaust and ventilation shall be complete with electric motor, starter, frame, weatherproof accessible enclosure and etc. In this section word fan and blower shall be used with the same meanings.

The fan/blower shall be statically and dynamically balanced and factory tested. The vibration of fan shall not be transmitted to buildings structure and damped by suitable vibration isolators.

The belt driven fan shall be supplied with belt guard and variable pitch pulley for adjusting the fan speed  $\pm 10\%$  of the design speed.

Fan housing shall be of heavy gauge mild steel, continuously welded construction with rigid reinforcement on anti vibration support on spring mounting. All fan housing shall be equipped with flanges discharge & removable spun inlet canvas designed for smooth airflow.

For wheel shall be rigidly constructed accurately balanced both statically & dynamically on precision electronic equipment & shall be free from objectionable noise and vibration.

Fan shall have shafts of solid hot rolled stainless steel accurately turned, ground, polished & ring guard for accuracy. Close tolerances must be maintained where the shaft makes contact with the bearing.

Fan shall have heavy duty, permanently lubricated, self-aligning, pillow block type bearing, selected for min avg. bearing life of 125000 hrs.

Fan & motor drive shall be mounted on heavy steel framing. Motor shall be mounted on slide rail. Fan shall be with variable pulley & suitable for adjustment with in  $\pm 10\%$  of specified RPM, provide complete belt guard on fan and motor pulley constructed of heavy steel framing & expanded metal mesh screening.

Cabinet shall be fabricated in 12 gauges M.S. sheet metal with supporting U-channel & angle iron frame complete in all respects as per drawings & instruction of Consultant.

Self-closing gravity louvers, bird mesh and rain protection hood shall be provided for the exhaust and ventilation fans, located outside the building.

IV. Heavy duty, airtight canvas connection shall be provided for fans installed with ducts.

The propeller fans shall be direct-driven type with totally enclosed weatherproof electric motors.

VI. The roof extractor/ventilators shall be of the centrifugal belt driven type with backward inclined fan blades, weather tight housing for motor constructed of aluminum, galvanized steel, or glass fiber reinforced high-impact plastic. Fan discharge opening shall be provided with (1/2" x 1/2") wire mesh bird screens suitable for the weather tight housings. Sealed permanently lubricated sleeve, roller or ball bearing with provision for end thrust, shall be provided. Drip proof electric motor shall be provided with safety disconnect switch mounted under the fan housing adjacent to the motor. Motor and rotating parts shall be mounted on isolators of neoprene or other approved materials. Capacities shall be as shown on the drawings.

VII. The range hood exhaust fan unit shall be of the roof mounted, centrifugal up-blast type, complete with weather tight housing for mounting on a curbed opening, adjustable V-belt drive, motor and vibration isolators. Housing shall be of spun aluminum, designed to discharge air vertically upward and to prevent entry of snow or rain into the building. Fan Wheel shall be of aluminum with backward inclined blades. Motor shall be of the ball bearing, drip- proof type. Motor and drive shall be mounted outside the air stream and cooled by outside air entering through a tube. Unit shall be rewired at factory with a junction box for field connections and a safety disconnect switch mounted inside the cover. Capacities shall be as shown on the drawings. Unit shall be rating in accordance with AMCA Standard 210, or other approved standard.

VIII. The air curtain fans shall be of the cabinet enclosed, direct connected centrifugal fan type, designed for mounted above the ceiling, complete with fans, motor, cabinet, supply air diffuser and ceiling grill. Motors shall be single speed or two speed as shown on the drawings and capacities shall be as indicated.

IX. The cabinet fans shall be of the fully enclosed type with centrifugal fan or fans directly driven by an electric motor mounted in the cabinet. Casing shall be of steel, lined with sound absorbing acoustical insulation and finished outside in a durable paint finish. Motor shall have permanently lubricated ball bearing, thermally protected type, with a solid-state speed controller permitting adjustment down to approximately 50% of full rated speed. Capacities shall be as shown on the drawings with ratings according to the AMCA test Code. The unit shall be arranged for suspended mounting.

Ventilation fans shall be wall mounted propeller fan complete with fan, motor, wall mounting plate mounting bracket, safety guard grill and speed regulator, blades and hub shall be aluminum die coated, contoured to streamline air flow and produce low noise. Blades and hub shall be natural finish anodized after caster. Motor shall be single phase, 720 Rpm, psc type for 50 Hz. Fan motor assembly shall be mounted on a rotating base to divert air flow.

#### **ELECTRICAL WORKS**

Unit shall be pre-wired at factory including weatherproof isolator box with isolator switch. Unit shall be properly grounded with building earthing system.

**PAINT WORK**

Each component shall be thoroughly degreased, phosphatised and provided with two coats of special anti rust primer & two coats of rubber chlorinated paint.

# **EQUIPMENT INSTALLATION**



## **EQUIPMENT INSTALLATION**

### **SCOPE**

Installation of Complete Air conditioning, Ventilation systems and equipment as per drawings, specified herein, as instruction of Consultant and recommended by the manufacturer.

### **DESCRIPTION**

All floor mounted equipment at grade level shall be set on 6" high concrete pads poured integrally with the floors and all floor mounted equipment above grade level shall be set on not less than 4" high structural steel beams anchored to the floor in accordance with drawings.

Air handling units shall be floor mounted or suspended, as shown on the drawings, with vibration isolators furnished with the units. Isolators for floor-mounted units at grade shall be fastened to the concrete pads using foundations bolts or expansion bolts and shields driven into holes drilled in the concrete. Supports for suspended units shall be shown on the shop drawings. Isolators for units mounted on structural steel members shall be bolted to the members.

Air filters for air handling unit, fan coil unit and ventilating units shall be provided. Install one set in each of the units prior to testing and adjusting. At the time of handing over they shall be replaced with new ones. Install a filter gauge at each air handling unit filter bank in accordance with the manufacturer's recommendations.

Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling T-bars or channels. (Do not support from ducts) Install lay-in diffusers for T-bar ceiling, shall be supported by ceiling structure and provide sheet metal adapter box above each diffuser to allow space for volume controller with round collars for connection to round ducts where shown on the drawings, connect duct into side of box, unless shown otherwise, on the drawings. Install volume control blades at 90-degree angle to inlet duct airflow

Wall mounted and duct mounted registers and grilles shall be fastened to flanges of duct collars.

All devices shall be aligned to be parallel to ceiling T-bars or walls and ceiling surfaces, and shall be pulled up tightly to compress gaskets and to fit neatly against the surfaces.

Submit shop drawings for approval showing method of installing each type of equipment and device.

Supply equipment shall be installed after ducts, plenums and casings have been cleaned and blown free of all small particles.

The automatic equipment shall be installed in strict accordance with manufacturer's instructions, and approved by Consultant. All low-voltage (below 900 volts) control wiring or tubing shall be provided under this section of the specifications. Before the air- conditioning installation is accepted, the contractor shall deliver to Consultant a statement certifying that the automatic control equipment has been inspected and found to be properly installed and are functioning satisfactorily.

The control dampers in the air handling units shall be installed by the air handling unit manufacturer and in the ductwork when required, by the contractor as recommended by the automatic temperature control manufacturer or his authorized agent. All necessary blank-off plates and transitions to install the dampers in the duct system shall be the responsibility of the contractor.

Transformers shall be provided for electric or electronic controls when required. For temperature control system each transformer shall be connected to an electric circuit, which serves no other equipment. Spare circuits in electric panels shall not be used for controls. Control wiring shall not be connected to lighting circuits. Power circuits are excluded except when controls serve an individual air- handling unit, in which case transformers may be connected to fan-motor leads of the unit controlled. All low voltage wiring in equipment rooms or areas where other piping is exposed shall be run within adequately supported thin- wall conduit or rigid metallic raceways.

# **ELECTRICAL WORKS FOR MECHANICAL SYSTEMS**

## **ELECTRICAL WORKS FOR MECHANICAL SYSTEMS**

### **SCOPE OF WORK**

The contractor shall provide all materials and equipment: perform all the works necessary for the execution and completion including testing and commissioning of all system of Electrical works as shown on drawings, specified herein and to the satisfaction of the Consultant. The following systems are included in allied Electrical Works for Air Conditioning & Ventilation Works.

### **MARKINGS**

The contractor shall provide "Danger Board" and "Shock Charts" Rubber mats or any other item wherever required to comply with the requirements of local Electricity Rules and according to normal practice at no cost to Owner.

### **ASSOCIATED CIVIL WORKS**

The cost of all civil works associated with any item of electrical works shall be included in the price quoted against respective items of Bill of Quantities for the electrical works. No separate payment for such works will be made.

### **INSTALLATION INSTRUCTIONS GENERAL**

The Contractor shall furnish all labor and materials, tools and equipment required to install, connect, test and commission all electrical equipment specified herein, whether or not he or others furnish such equipment.

For all equipment to be installed by the Contractor, the Contractor shall supply and install all installation materials such as foundation bolts, leveling steel, shims, clamps, cable sockets, lugs, solder, wall plugs, steel raw bolts, washers, nuts, etc. as required and without any additional costs. In general, the manufacturer's instructions for installation shall be followed.

For any major revision from the working drawings that are deemed necessary by the Contractor due to site conditions, he shall submit the details and obtain the Consultants approval at least two weeks time before starting the works

### **FIELD TESTING**

Upon completion of the installation, the Contractor shall perform field tests on all equipment, materials and systems. All tests shall be conducted in the presence of the Consultant for the purpose of demonstrating equipment or system compliance with Specifications.

All tests shall be made with proper regard for the protection of the equipment and the Contractor shall be responsible for adequate protection to all personnel during such tests.

The Contractor shall record values of the tests made on all equipment. Three copies of all test data shall be given to the Consultant for record purpose.

The vetnessing of any tests by the Consultant does not relieve the Contractor of his guarantees for materials/ equipment or any defects.

#### **INSULATION RESISTANCE TESTS.**

Insulation resistance tests shall be made on all electrical equipment by using a megger tester of 500V for circuits upto 250 Volts and 1000V for circuits upto 500 volts.

The insulation resistance values of cables, transformers and switchgear etc., shall be as per B.S.S. and Pakistan Electricity Rules.

Before making connections at the ends of each cable run, the insulation resistance measurement test of each cable shall be made. If insulation resistance test readings are found to be less than the specified minimum, the cable shall be replaced and the new cable installed and tested.

All switchgears shall be given an insulation resistance measurement test after installation, before any wiring is connected. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit under test is less than the specified value, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters if equipment is found to contain moisture. After all tests have been made, the equipment shall be reconnected as required.

#### **EARTH RESISTANCE TEST**

The Contractor shall make Earth resistance tests on the earthing system, separating and reconnecting each earth connection as required.

The electrical resistance of the E.C.C. together with the resistance of the earthing leads measured from the connection with earth electrode to any other position in the complete installation shall not exceed 0.1 OHM.

Earth resistance test shall be performed as per electrical inspector's requirements. Where more than one earth electrode is installed, the earth resistance test of each electrodes shall be measured by means of resistance bridge instrument.

#### **CONTINUITY TEST**

Continuity test on all the sub and main circuits should be performed for phase, neutral & earth wires.

#### **WIRE AND CABLES**

The Contractor shall furnish and install all wires and cables along with the accessories as specified herein, in Bill of Quantities and Drawings. Apart from the material specified, the Contractor shall provide the necessary material for termination or fixing of wires and cables such as lugs, solder supports, bushes, and glands for a complete wiring installation. Miscellaneous materials, like filing compound, identification tags, markers and earthing strips shall be furnished for completion of works in accordance with the best engineering standards and

practice. The wiring installation shall be carried out in strict accordance with the scheme, cable sizes and circuit details shown on the drawings or as specified. The contractor is to produce purchase certificate from recommended manufacturers like Pakistan Cables, Pioner Cables or AGE Cables for each & every lot and each and every coil of wires to be stamped by consultants before it is being sent to site for use.

### **CONSTRUCTION**

The cable for underground exposed on surface and concealed conduit-wiring system to light or power circuit shall be single/multicore, PVC insulated having soft annealed standard copper conductors. The voltage grade shall be 450/1000 volts for lights and sockets circuit and 660/1100 volt for power circuits as specified. All cables shall be tested to BS 2004-1961. Flexible cord for connection of light shall be 3 core PVC insulated PVC sheathed. The make of cables shall be as approved by the Consultant.

In general cables for wiring system shall be as under or otherwise specified or shown as drawings: -

|                |  |
|----------------|--|
| Conduit Wiring | : Single core PVC insulated.                                 |
| Surface Wiring | : Multicore PVC/PVC sheathed OR as specified on the drawings |

For light and power circuits the minimum size of conductor shall be 1.5 and .0sq.mm respectively and minimum size for flexible cords shall be 0.75 and 1 sq. mm for circuits protected with 10 and 15/20 AMPS. mcbs. The color code for power cables shall be red, yellow, blue for phases and black for neutral conductor, whereas for light and socket wiring, red for phase and black for neutral conductors. Specified size of earth wire, green in color, shall be run with each circuit.

### **INSTALLATION**

The wiring through exposed or concealed conduit shall be started only after the conduit system is completely installed and all junction boxes, outlet boxes, switchboards etc. have been fixed in proper position. For outdoor installation, where specified the cables shall be run direct in ground or in pipes as specified. The cables shall be pulled through conduit or pipes with care to prevent any damage to cables. To facilitate pulling, lubrication only as recommended by cable manufacturer may be used for decreasing friction. Under no circumstances shall oil or soap be used for cable pulling. Where several wires are to occupy the conduit or pipes they shall be pulled along together with earth continuity conductor. In general, the wires shall not be bend to radius less than ten times the overall diameter of the wire, or as otherwise recommended by cable manufacturer. The contractor furnishes all installation material and labor for installation, testing and commissioning of cable system.

The wiring to power circuit and 15 amperes single-phase socket outlet shall be run in conduit separate from light wiring conduits. Care shall be taken to ensure that all phase conductors are connected to the proper terminals and correct phase sequence is maintained. Wherever the size of conduit is not stated on drawings, it shall be in accordance with the following Table based on I.E.E. Regulations

**TABLE FOR NO.OF WIRES TO BE LAID IN GIVEN SIZE OF GI CONDUIT**

| WIRE SIZE (Sq.mm) | Size of conduit (mm. Dia) |    |    |    |    |
|-------------------|---------------------------|----|----|----|----|
|                   | 20                        | 25 | 32 | 38 | 50 |
| 1.5               | 6                         | 13 | 20 | -  | -  |
| 2.5               | 4                         | 9  | 13 | -  | -  |
| 4.0               | 3                         | 6  | 11 | -  | -  |
| 6.0               | 2                         | 4  | 8  | -  | -  |
| 10.0              | -                         | 3  | 4  | 8  | -  |
| 16.0              | -                         | -  | 2  | 5  | 8  |

The wires or cables shall be terminated at points, switchboard, etc. such that the insulation is always led into the equipment to which connection is made. The cable entry hole in equipment shall be such as not to damage the cable. Inside the switchboards or control boards, the wires or cables shall be securely fanned out in a neat arrangement and laced with wax cord. The wires of different phases shall preferably be bunched separately. Identification tags or ferrules shall be provided at termination of wires in switchboards with respect to connected equipment for ease of installation and maintenance.

#### **POWER, LIGHTING AND CONTROL CABLES**

##### **Under ground Cables**

PVC Cable for underground installation shall be PVC insulated, sheathed and armored with galvanized steel wire of specified sizes

##### **Surface Cables**

Cables for distribution system on surface shall be either single-core or multicore, as required and PVC insulated and PVC sheathed.

##### **Cables in Conduits**

All cables / wires, in conduits shall be of copper, PVC sheathed or PVC insulated.

#### **PHASE IDENTIFICATION**

All cables shall have phase identification colors on insulation of each phase. The color code for three phase circuits shall be red, yellow and blue for phase conductor and black for neutral conductor. Single-phase circuits shall have red for phase and black for neutral conductor.

#### **CABLE MARKERS/TAGS**

All cables either buried in ground or laid in tray have cable tags giving cables identification and from where it is coming and where it is join. These tags should be engraved on brass or stainless steel sheets. Tags should be attached to cable at every two meters distance and wherever cable enters or leaves a wall/room. Cable markers should be above ground giving full detail of cables buried. Should be made of concrete with a brass sheet having required information.

### **CABLE ACCESSORIES**

Best quality cable accessories should be used with the approval of consultant. The cable accessories, include, cable tray, cable trucking, floor trunking, clips, saddles (all galvanized). Cable glands made of brass should be used when cable enters/leaves a panel/Distribution board. Identification tags made of engraved brass plates to be used for all cables. All the cables should be security fixed to cable tray or trunking with help of plastic tees. Cable lugs should be compression type of BICC U.K, Elpress Sweden or equivalent. Lugs should be pressed with help of compression machine approved by consultants.

### **CONDUIT WIRING-INSTALLATION**

The wiring through conduit shall be started only after the conduit, system is completely installed and all outlet boxes, junction boxes, etc. are fixed in position.

The wires shall be pulled in conduit with care and, to facilitate pulling, the cable manufacturer's recommended lubricant shall be used. Use of any kind of oil or soap will not be permitted.

Where several wires are to be drawn in the same conduit, they shall be pulled together.

The wires shall not be bent to a radius less than ten times the overall diameter of the wire, unless other wise recommended by the manufacturer.

The wiring shall be continuous between terminations. The looping in system shall be followed throughout. Any joint in wires will not be allowed. The use of connectors will only be allowed at location where looping-in is rendered difficult. The consent of the Consultant in writing will be required for using connectors. The connector shall be of suitable rating having procelain body, sunk-in screw terminals and terminal strips. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm-extra length of cable/wire shall be provided at each termination to facilitate repairs in future.

### **SURFACE WIRING**

The cables installed on surface shall be by means of steel or phenolic moulded clamps installed at a maximum distance of 500 mm. Where specified or necessary due to site the cable shall be run in cable ducts or on cable trays.

### **TERMINATIONS.**

Terminations of all cables above 10 sq.mm shall be done employing heat shrink type termination kits as manufactured by 3M, equivalent. RACHEM or All lugs shall be compression type of high conductivity copper.

### **CONDUITS & PIPES**

The contractor shall discuss the electrical layout with the Engineer and co-ordinate at Site with other services for exact route, laceration and position of the electrical lines.

The conduits and pipes with accessories shall comply with the General Specifications, and with other relevant provisions of the Tender.



### **PVC CONDUITS AND ACCESSORIES**

The PVC conduits and accessories for lighting and power socket wiring wherever specified shall conform to BS-4607 (1970).

Using spring type bender or special bending machines or manufactured smooth bends shall be used where conduit changes direction, bending of conduits by heating will not be allowed in any circumstances. Use of sharp 90 bends and tees will not be allowed. The bends shall conform to the same specifications given above for conduits and should have enlarged ends to receive conduit without any reduction in the internal diameter at joint.

The round PVC junction boxes for ceiling light points shall have minimum dimensions of 64-mm diameter and 64 mm depth. The junction boxes for wall light points shall have minimum dimensions of 57-mm diameter and 40 mm depth.

### **STEEL CONDUITS AND ACCESSORIES**

All conduits supplied by the contractor for power and light wiring at specified locations shall be of heavy gauge 14 SWG galvanized sheet steel, manufactured and tested in accordance with latest BS-31.

Each conduit length shall be furnished with threaded ends and a threaded coupling at one end.

The conduit accessories, such as sockets, elbows, bushing, bends inspection boxes, pull boxes, junction boxes, saddles, clamps, etc. as required to complete installation shall be furnished by the contractor. Metal bushes shall be used at conduit termination and entry to prevent damage to cable during pulling operation.

The junction box shall be of cast iron having 50-mm diameter and 63 mm deep. The above dimensions are given as a minimum only.

All junction boxes shall be provided with one-piece cover plate.

The conduits and conduit accessories shall be as manufactured by M/s. International Industries, Karachi, or approved equivalent.

### **GALVANIZED IRON PIPES AND ACCESSORIES**

The GI pipes shall be galvanized inside and outside by hot dip-galvanizing process. The pipes shall be free from stains, burrs. The accessories for GI pipes such as socket, bend, etc, shall be galvanized inside and outside and shall be of same quality and specifications as the pipes. GI pipes for underground installations shall be given bituminous paint coating before installation.

GI pipes as manufactured by M/s. IIL. or approved equivalent shall be provided.

## **CONDUITS INSTALLATION REQUIREMENTS**

### **i. PVC CONDUITS**

The conduit shall be installed concealed in wall, and installed on surface or above the false ceiling or as stated on the drawings.

For conduits concealed in cement concrete (CC) works, or in block masonry, chase shall be made with appropriate tools and shall not be made deeper than required. The conduit shall than be fixed firmly in the recess and covered with cement concrete mixture to have at least 32 mm cc cover after plaster. The electrical contractor shall be responsible for bringing back the original finish of civil works.

Conduits installed on surface shall be fixed by means of black enameled steel saddles and clamps. The clamps shall be installed at a distance of 600 mm in a manner as described for steel conduits.

At all joints PVC jointing solution must be used.

### **SURFACE STEEL.**

Galvanized steel conduits at specified locations shall be installed Concealed or on the surface of wall, column, ceiling, etc, by means of steel saddles and clamps of approved design.

The saddles shall be installed on surfaces by means of nylon wall plugs and galvanized steel screws. Drilling shall make appropriate sized holes in structure. The thickness of saddles shall not be less than 3 mm and clamps shall be of 16 SWG sheet steel, or of design approved by consultant. These shall be fixed at a maximum of 1000-mm spacing along horizontal and vertical runs of conduit. All accessories for complete installation of conduit system shall be provided by the contractor.

Conduits concealed in wall shall be done as described for PVC conduits.

Under floor conduit, installation shall be at a minimum depth of 50 mm from the finished floor level when measured form the top of conduit. The conduits shall be installed empty before finishing of floor.

## **OTHER REQUIREMENTS OF CONDUITS SYSTEMS**

The termination of conduits should be shown diagrammatically on the shop drawings. The exact final location of the termination shall be co-ordinated with the equipment to be installed. Conduit ends pointing upwards or downwards shall be properly plugged, in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all termination of conduit, soft bushes shall be fixed to prevent sharp edges of conduit ends form cutting or damaging the wires or cables to be pulled through them.

The entire conduit system shall be installed and tested before wiring is carried out. Any obstruction found should be cleared by use of a cutting or other approved device and the conduit by cleaned out before the installation of cable.

Pull boxes and adaptable boxes shall be provided in conduit runs wherever required to facilitate pulling operation. The shop drawings prepared by contractor to show pull boxes, no straight run of more than 30 feet is allowed without pull box. Each pull box should be on wall at a length of 6 feet from floor level.

The inspection boxes or pull boxes shall be of 16 (1.63 mm) heavy gauge sheet steel having nipples welded to box at entry holes to receive conduit with force-fit. The box shall be painted inside and outside with black enamel paint over a base 2 coats of red oxide primer paint.

Wherever the conduit length crosses the expansion joint either along the column or slab, suitable arrangement shall be provided by means of flexible conduit.

### **CABLE TRAYS**

For surface installation of cables along the horizontal runs cable trays shall be provided. These should be made of 14 SWG' perfected galvanized M.S sheets, its sides should be strengtheners by strengthener if the width of tray is more then 30 cm.

Minimum width of tray shall be 100 mm. However, the width of tray for different number of cables shall be determined by providing 100-mm clearance between cables and 50 mm at ends. Suitable arrangement to be provided by clamps or other means at intervals to ensure that the above spacing is maintained. The cable tray shall be supported from the roof by steel hangers and to the wall by brackets. The supporting arrangement shall be secured to the civil structure using 10 mm more 12 mm rawl bolts and hanged by galvanized all thread bars of min dia 10 mm. Joints should be made with help of galvanized strips of same material of which cable tray is made of with galvanized nuts & bolts.

Drawings shall be submitted for approval before fabrication.

### **MOTOR CONTROL CENTERS**

The motor control centers (MCC) shall be of sheet steel fabricated totally enclosed, dust & damp proof suitable for floor or surface mounting on wall. It shall be factory assembled, tested complete with all accessories and finished with two base coats of anti-corrosive paint and at one coat of approved color paint, stove enameled.

The cabling inside the MCC shall be properly harnessed. An earth bar or terminal strip of suitable section be provided, which shall be permanently connected to the body of MCC. Flexible copper strip shall earth the door of the MCC.

All components and circuits shall be labeled consistent with the wiring and distribution of circuits by permanent fire resistant plastic engraved plates.

The motor control centers shall be designed for front operation and shall:

▣ be rated for 440/250 volts, 3 phase 4 wire, and 50 Hz system.

- be designed for flush mounting or floor standing of all instruments on the front side.
- have incoming and outgoing cable termination arrangement, terminal block/line up terminals etc.
- have name plate and suitable danger signs on the and wiring diagram on the back side of door.
- have automatic starters with control wiring and indications.
- Under voltage, phase failure & phase reversible device to be provided

The MCC shall be fabricated with minimum 12 SWG thick sheet steel. All the components shall be mounted on a common component mounting plate fixed inside the enclosure with a screwed sheet steel front plate. The enclosure shall be provided with rubber gaskets lockable-hinged door with cam fastener. Locks shall be provided where advised by Consultant.

The motor control centers shall be supplied complete with all installation materials as recommended by the manufacturer and required for completion of work and mentioned on Drgs & BOQ. The short circuit current carrying capacity shall be as shown on drawings. Use of back-up fuses for meeting the short circuit level is not permitted.

### COMPONENTS

#### Circuit Breakers (CB)

The circuit breakers shall be triple pole/single pole as shown on the drawing manual operating device. The circuit breakers shall have temperature compensated thermal over load release and magnetic short-circuit release. Tarasaki Japan, M&G France, or approved make

#### Ammeters and Voltmeters

All meters shall be flush mounting, moving iron, spring controlled. The front dimensions shall be 96 mm x 96 mm. The meters shall have accuracy class 1.5. The ammeter shall be suitable for direct connection or to 5 Amp secondary of current transformers as shown on the drawings. The ammeters and voltmeters shall have measuring range as indicated on the drawings. These shall be of best quality, British, German or French make.

#### Current Transformer

Air-cooled, ring type current transformers (CT) shall be provided having transformation ratio as indicated on the drawings. The CTs shall be of suitable burden having accuracy class 1.0.

#### Selector Switches.

Ammeter and voltmeter selector switches shall be complete with front plate, grip handle and R-Y-B and OFF positions for ammeters and RY-YB-BR-RN and OFF positions for voltmeters.

**Indicating Lamps.**

Indicating lamps shall be suitable for flush mounting complete with bases, 230-volt incandescent bulb and rosettes of approved colors. These shall be British, German or French make.

**BUS BAR.**

The bus bar shall be made of high conductivity electrolytic 99% pure copper insulated and mechanically braced to safety to withstand the stresses due to short circuit currents.

**ENERGY METER**

Kilowatt-hour (kWh) and kilovoltampere hour (KVARH) meter shall be suitable for 3 phase, 3 wire 50 cycles balanced and unbalanced loads. The KWHr meter shall also be provided with maximum demand indicator and built in switch for operation at an interval of 15 minutes.

**INSTALLATION**

The location of MCC as shown on the drawings is indicative and exact location shall be determined at site in co-ordination with other works and other services.

The floor mounted MCC shall be installed by means of bolts on the mounting frame provided on the MCC. The recessed mounted MCC shall be installed before plastering of walls in a manner such that the door finishes flush with the surface.

All materials and accessories used for fixing of MCC shall be of galvanized.

**PAINTING  
AND  
IDENTIFICATION**

## **PAINTING AND IDENTIFICATION**

### **SCOPE**

All exposed Mechanical work, which in general includes piping ductwork, insulation, metal items, equipment etc, should be painted and identified. Polished, aluminum, stainless steel, chrome plated and other finely finished materials including labels, should not be painted unless otherwise indicated.

### **DESCRIPTION**

Before painting metal surfaces should be washed with mineral spirits to remove grease and dirt. Where rust or scale is present, wire brush or sandpaper should be used. For steelwork after first one coat of red lead primer of approved make, two coats of rust resistant paint shall be applied. For Galvanized surfaces zinc chromate of approved make to be used before applying the final coats.

Materials previously shop prime coated by the manufacturer and which have been scuffed, should be touched up with the same materials used for priming, objectionable materials should be removed from prime coats before final painting. Prime coats should be of a lighter tint than final coat.

All surfaces should be dry above 50 F before paint is applied.

Baked enamel finishes should be of a uniform color throughout.

All finish color shall be as selected by the Engineer In charge.

Color identification of pipelines shall be as per BS- 1710.

Identification bands shall be painted on piping at frequent intervals. Lettering shall be as per BS or as agreed with the Engineer.

Identification tags shall be installed on valves, controls and other parts of the system where as required. Tags shall be polished or lacquered brass or aluminum, 50 mm round or hexagonal shaped with 15mm high-engraved letters. The tags shall be fastened securely with brass hook or chain.

### **RELEVANT CODES & STANDARD**

Following are relevant standards and codes are applicable to these sections:

|         |                               |
|---------|-------------------------------|
| BS 1710 | Identification of pipes       |
| BS 5378 | Safety color & safety sign    |
| CP 231  | Code of practice for painting |

Equivalent to mentioned codes and standards may be approved by the Engineer on the provision of evidence of equivalent by the contractor.

# **TESTING, BALANCING & COMMISSIONING**



## **TESTING, BALANCING & COMMISSIONING**

### **SCOPE**

Testing, Balancing & Commissioning of complete Air conditioning and Ventilation system (air side) as per specification and as per instruction of Consultant from independent Testing & Balancing Agency as approved by Consultant.

All equipment shall be started by, and operated under, the supervision of the qualified and approved personal of contractor or the designated authority.

### **TESTING**

All tests shall be conducted in the presence of Consultant who shall be given 7 days notice before any test is to be conducted. Any material, equipment or instruments required for tests shall be provided by the contractor at his own cost.

An approved company experienced and specialized in testing and balancing of air conditioning systems shall be hired. The company shall test and regulate all air/water handling systems and equipment and confirm that the capacities and performances of the system are as indicated on the drawings. The contractor shall furnish to the consultant in writing a statement evidencing that the testing and balancing company is already qualified and has past experience in this type of work.

All testing and/or balancing shall be performed in complete accordance with SMACNA's standards, the AABC National Standards for Field Measurements and Instrumentation, Form No 12173, volume two, as published by the Associated Air Balance Council. All methods and procedures listed in and applicable to sections on Air/Water Balancing shall be included and performed, although repeated herein.

A qualified representative of the approved testing and balancing company shall visit the job site when fabricated ductwork and pipe work are delivered and when installation is in the very early stages and the installation is well along but before any closing, verify to his satisfaction that all fittings, air volume control devices and regulating valves are of the proper type or properly fabricated and are installed in accordance with the specifications and that these will be able to balance the systems as required herein.

All instruments and equipment required for balancing shall be furnished by the contractor at no additional cost.

Furnish any special fittings or devices in the duct/pipe, systems as may be required to obtain the required data. Artificial resistance's, equal to dirty filters shall be added to the clean filter banks in air handling units by partially blanking off the filter face area. Pressure drop for test and balance shall be (0.5").

Prior to any air volume testing, any furred spaces, chases, shafts etc., which are to handle air directly without the use of sheet metal ductwork, shall be checked for leakage. First seal or otherwise prevent the leakage of air through tracks or porous materials in these spaces. All voids around piping, conduit ductwork, or other services, which pierce the constructions, shall be caulked airtight before making final duct connections and grille /register installation.

Contractor should check the design and be responsible for correcting any mistake made inadvertently during the design stage by the designer any change should be notified to the Consultant and prior approval must be taken.

### **EQUIPMENT TESTS**

Before starting or operating any equipment systems, a thorough check shall be made to determine that all systems have been flushed and cleaned as required and that all equipment has been properly installed, lubricated and serviced. Factory instructions shall be checked to see that installations are made accordingly and that recommended lubricants have been used in all bearings, crankcases and similar equipment. Particular care shall be used in lubricating bearings to avoid damage by over lubrication and blowing out seals. Equipment shall also be checked for any damage that may have occurred during shipment, after delivery or during installation. In the event of any damage that may have occurred during the shipment, after delivery or during installation the equipment, shall be replaced, renewed or repaired to the satisfaction of Consultant.

The performance of all components of equipment shall be tested under all possible variations of loads, flow conditions, temperatures, etc. which can be simulated on the job by utilizing any of the heating or cooling equipment which is furnished as part of the work. Any equipment, systems, or work found deficient during tests shall be replaced or revised as required to the satisfaction of the Consultant. The contractor shall be responsible for the complete coordination of the piping, wiring diagrams and control diagrams with the equipment requirements.

### **SYSTEM TESTING AND BALANCING (TAB)**

#### **AIR DISTRIBUTION**

All supply, return, outside air intake, and exhaust systems shall be balanced as follows.

Set all thermostats to the position requiring full airflow.

Set all manual dampers to the full open position including fire dampers and volume controls at diffusers and grilles.

Place the controls of all fans in the running position.

Measure the face velocities and calculate the air volume passing through the systems at the cooling coils, air filters, fan intakes, main ducts, or other approved locations

Adjust and re-adjust the manual balancing dampers, outlet volume controls and fan speeds until all supply, return and exhaust outlets are within 5% of the design air volumes. Record the final air temperature and volume at each outlet and inlet.

Prepare all TAB report forms and submit as required using the SMACNA TAB report forms.

# **LIST OF APPROVED MANUFACTURER**

**LIST OF APPROVED MAKE & MANUFACTURERS**

**FOR ACMV WORKS**

**IMPORTANT NOTE: ALL MATERIAL SHALL BE OF CLASS 1 QUALITY, PURCHASED FROM APPROVED  
AUTHORIZED DEALER**

- |   |   |
|---|---|
| • SINGLE SPLIT UNITS                    | HAIER, CHINA<br>GREE, CHINA<br>MITSUBISHI, THAILAND |
| • FANS                                  | BVN, TURKEY<br>VENTS, UKRAINE<br>SISTEVEN, SPAIN    |
| • WALL MOUNTED / CEILING FANS           | VOLDAM, CHINA                                       |
| • ELECTRIC MOTORS                       | SIEMENS   |
| • REFRIGERENT PIPES                     | MUELLER, USA  |
| • REF PIPE INSULATION                   | AERO FLEX, THAILAND                                 |
| ☐ ALUMINUM TAPE (3" WIDTH)              | ABRO, USA   |
| • FLEXIBLE RUBBERIZED DUCT<br>CONNECTOR | DUCTMATE, USA                                       |
| • WELDING ROD                           | BOC, PAKISTAN<br>KOBE, JAPAN                        |
| • FLEXIBLE DUCT                         | AFICO, KSA  |
| • AIR CURTAINS                          | IMPORTED MAKE                                       |
| • UPVC PIPE & FITTING (SCH. 40)         | AGM, KSA<br>BINA PLASTIC, MALAYSIA                  |
| • G.I PIPE                              | IIL, PAKISTAN                                       |
| • G.I FITTING                           | HE / TG CHINA                                       |
| • CABLES & WIRES                        | PAKISTAN CABLES<br>PIONEER CABLES                   |
| • PVC CONDUIT                           | GALCO<br>BETA                                       |
| • SUPPORTS & HANGERS                    | FISCHER, GERMANY<br>HILTI, UK/ GERMANY              |
| • GASKITS                               | IMPORTED MAKE<br>(as per approved sample)           |
| • CONCRETE FASTENERS                    | FISCHER, GERMANY<br>HILTI, UK/ GERMANY              |

**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

N.E.D. University of Engineering & Technology

*LIST OF APPROVED MANUFACTURER*

---

- |                          |   |
|--------------------------|---|
| • VAPOUR BARRIER COATING | FOSTER, USA<br>ZAHABIYA, PAKISTAN             |
| • WHITE GLUE             | HOECHST, PAKISTAN<br>MOVILITH, GERMANY        |
| • DUCT SEALANT           | LAG IT, USA<br>ZAHABIYA, PAKISTAN             |
| • VIBRATION ISOLATORS    | TARIQ CORPORATION<br>(as per approved sample) |
| • STEEL MEMBERS          | AMRELI STEEL<br>(Or approved equivalent)      |
| • PAINTS                 | ICI<br>JUTON                                  |

TECHNICAL SUBMITAL / SAMPLES OF ALL THE EQUIPMENT SHALL BE APPROVED BY THE CONSULTANT.



**N.E.D. UNIVERSITY OF ENGINEERING & TECHNOLOGY,  
KARACHI**

**CONSTRUCTION OF 03 LABORATORIES  
FOR  
DEPARTMENT OF PHYSICS AND CHEMISTRY**

**BILL OF QUANTITIES**

**VOLUME - 3**

**Consult-Tech** (Since 1970)

11-C, 3<sup>rd</sup> Floor, Shahbaz Commercial Line No. 2,  
Phase-VI, Defence Housing Authority, Karachi  
Tel +92 21 35847692 – 3, Fax +92 21 35847688

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
SUMMARY OF WORKS**

## SUMMARY OF BILL OF QUANTITIES

| S. NO    | DESCRIPTION   | AMOUNT |
|----------|---|--------|
| A        | TOTAL ESTIMATED COST OF CIVIL WORKS<br>(NON – SCHEDULED ITEMS)      |        |
| B        | TOTAL ESTIMATED COST OF CIVIL WORKS<br>(SCHEDULED ITEMS)            |        |
| <b>1</b> | <b>TOTAL COST OF CIVIL WORKS (A+B)</b>                              |        |
| C        | TOTAL ESTIMATED COST OF ELECTRICAL WORKS<br>(NON – SCHEDULED ITEMS) |        |
| D        | TOTAL ESTIMATED COST OF ELECTRICAL WORKS<br>(SCHEDULED ITEMS)       |        |
| <b>2</b> | <b>TOTAL COST OF ELECTRICAL WORKS (C+D)</b>                         |        |
| E        | TOTAL ESTIMATED COST OF PLUMBING WORKS<br>(NON – SCHEDULED ITEMS)   |        |
| F        | TOTAL ESTIMATED COST OF PLUMBING WORKS<br>(SCHEDULED ITEMS)         |        |
| <b>3</b> | <b>TOTAL COST OF PLUMBING WORKS (E+F)</b>                           |        |
| <b>4</b> | <b>GRAND TOTAL (1+2+3) (RS.)</b>                                    |        |

**CIVIL WORKS**  
**(NON – SCHEDULED ITEMS)**



**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR CIVIL WORKS**

| S.NO     | DESCRIPTION  | QUANTITY | UNIT     | RATE | AMOUNT |
|----------|--|----------|----------|------|--------|
| <b>1</b> | <b>Deformed steel reinforcement</b>  |          |          |      |        |
|          | Providing and laying hard grade deformed steel ASTM A-615 reinforcement bars 60 000 psi yield strength with and including the cost of straightening cutting, bending, binding, chairs, wastage and such overlaps as are not shown in the drawings, placing in position on cement concrete , MS chairs, tying with binding wire 18 Swg, cost of chairs and wires etc. in all kind of work in foundation, basement plinth and all floors of building and in projections for future extension as per drawings, specification and as directed by the engineer-in-charge. | 26       | Tons     |      |        |
| <b>2</b> | <b>Over Head Water Tank</b>  |          |          |      |        |
|          | Constructing of RCC overhead water tank including providing material labour, formwork fixing and removal, provision of GI pipes/sleeves etc. complete in all respect as per drawings and as per directed by Engineer-In-charge.  | 2500     | Gallons  |      |        |
|          | 3750 psi cubical strength of concert with water proofing admixture.  |          |          |      |        |
|          | 2.5" thick screed on bottom slab in proper slope.  |          |          |      |        |
|          | 3/4" 1:4 thick plaster with pudloo or equivalent in bottom, internal RCC walls, soffit of slab.  |          |          |      |        |
|          | 3/4" thick Plaster on external walls.  |          |          |      |        |
|          | Making chamfer with 3750psi Cubical strength concrete at all edges wall and bottom slab.   |          |          |      |        |
|          | 24" X 24" manhole cover and Stainless steel ladder as approved.  |          |          |      |        |
| <b>3</b> | <b>Marble Flooring &amp; Stair Marble</b>  |          |          |      |        |
|          | Providing and laying Ziarat white marble tiles size (1'-0" X 1'-0" X 3/4") in floor, laid in white cement mortar with matching colour pigment over 3/4" thick base of cement sand mortar 1:3 at floors, including jointing, curing, rubbing and polishing complete in all respect as per drawings and in accordance with the specification.  |          |          |      |        |
| i        | Second Floor All Labs  | 5600     | Per S.ft |      |        |
| ii       | Second Floor Corridors   | 1100     | Per S.ft |      |        |
| <b>4</b> | <b>4" Marble Skirting</b>  |          |          |      |        |
|          | Providing & fixing 1/2" thick Ziarat white supreme marble tiles of approved quality and color and shade size 12" X4" in dado skirting and facing removal /tucking of existing plaster surface etc. Over 1/2" thick base of cement mortar 1:3 setting of tiles in slurry of white cement over mortar base including fillings the joints and washing the tiles with white cement slurry, curing, finishing, cleaning and polishing etc. complete.  |          |          |      |        |
| i        | Second Floor   | 1800     | P. Sft   |      |        |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR CIVIL WORKS**

| S.NO     | DESCRIPTION  | QUANTITY | UNIT   | RATE | AMOUNT |
|----------|--|----------|--------|------|--------|
| <b>5</b> | <b>Ceramic Tiles For Counters</b>  |          |        |      |        |
|          | Providing and laying 1.5mm joint 1st quality Ceramics tiles of Master tiles or equivalent on Flooring as per approved colours/ shades /design and pattern over 12mm thick bedding plaster in Cement Mortar 1: 4 (1 Cement: 4 Coarse sand with bond) and filling the joints with matching pigment. (Basic tile rate 2425 Rupees / square meter) complete in all respect as per drawings specifications and as directed by the Consultant / Engineer in charge   |          |        |      |        |
| i        | Lab Counters Tiles   | 1000     | P. Sft |      |        |
| <b>6</b> | <b>Solid Core Flush Doors</b>  |          |        |      |        |
|          | Providing and fixing of solid core Flush door in batten board on both sides flush door shutter HDF 1-1/2" thick and lipping 1-1/2" wide and 1/2" on four sides in teak wood, as commercially produced by sterling or similar approved manufacturers under power driven hydraulic press as approved with application of approved wood preservative treatment including brass oxidized fitting 9" long tower bolts on top and bottom and imported Lock. Complete in all respect and as per instructed by engineer-In-Charge. |          |        |      |        |
| i        | D-1 Single Shutter (3'-6" x 7'-0" =24.5 S.ft X 4 Nos.)   | 98       | P. Sft |      |        |
| ii       | D-2 Double Shutter (5'-0" x 7'-0" =35 S.ft X 6 Nos.)   | 210      | P. Sft |      |        |
| <b>7</b> | <b>Aluminum Windows with Frame</b>   |          |        |      |        |
|          | Supplying & fixing in position of 1.6 mm bronze aluminum deluxe channels with collar framing for sliding windows & channel framing for sliding & ventilators of lucky, Chawla, Pakistan cable made with 5 mm thick tinted glass glazing (Belgium) & aluminum fly screen i.e. handles, stoppers & locking arrangement etc. complete   |          |        |      |        |
| I        | Window 4'-0" x 4'-0" = 16 S.ft X 11 Nos.   | 176      | P. Sft |      |        |
| li       | Ventilator 7'-0" x 1'-3" = 8.75 S.ft X 3 Nos.  | 26.25    | P. Sft |      |        |
| <b>8</b> | <b>Water Proofing</b>  |          |        |      |        |
|          | Providing and applying water proofing on roof, internal walls of planters using ADVASEL 2000 elasomeric Acrylic based coating with polymath polyester reinforcement product of UAE or Saniflex - Universal elasomeric approved equivalent complete in all respect as per drawing technical provision and or as directed by the engineer in charge.   | 6800     | P. Sft |      |        |
| <b>9</b> | <b>G.I. Door Frames / Chowkat</b>  |          |        |      |        |
|          | Providing and fixing G.I frames / chowkat of size 7" x 2" or 4-1/2" x 3" for doors using 16 gauge G.I sheet i/c welded hinges and fixing at site with necessary hold fasts, filling with cement and slurry of ratio 1:6 and repairing the jambs. The cost also includes all carriage, tools and plants used in making and fixing.  | 208      | P. Rft |      |        |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR CIVIL WORKS**

| S.NO  | DESCRIPTION   | QUANTITY | UNIT   | RATE | AMOUNT |
|---|---|----------|--------|------|--------|
| <b>10</b>   | <b>Expansion Joint Treatment</b>  |          |        |      |        |
|   | Providing and fixing expansion joint treatment with 2" dia backer rod including applying poly urethane expansion joint material of approved brand with 4" thick Block Masonry on either side of expansion joint and then covering with 16 gauge G.I. Sheet complete in all respect as per directions of the Engineer.                   | 60       | P. Rft |      |        |
| <b>11</b>   | <b>Ready Mix Concrete (4000 PSI Cyl. Strength)</b>  |          |        |      |        |
|   | Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending binding which will be separately. This rate also includes all kind of forms molds lifting shuttering curing rendering and finishing the exposed surface (including sceening & washing of shingle).  |          |        |      |        |
|   | (a) R.C works in roof slab, beams rafts, and other structural members laid in situ or precast laid in position complete in all respect.   |          |        |      |        |
|   | (i) Ratio (1:1-1/2 : 3)   |          |        |      |        |
|   | Add extra labour for R.C.C in 2nd & subsequent storeys.   |          |        |      |        |
| i   | For Roof Slab/Beams   | 87.8     | Cum    |      |        |
| ii  | Columns   | 37.44    | Cum    |      |        |
| <b>12</b>   | <b>Ready Mix Concrete (3000 PSI Cyl. Strength)</b>  |          |        |      |        |
|   | Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending binding which will be separately. This rate also includes all kind of forms molds lifting ;shuttering curing rendering and finishing the exposed surface (including sceening & washing of shingle). |          |        |      |        |
|   | (a) R.C works in roof slab, beams rafts, and other structural members laid in situ or precast laid in position complete in all respect.   |          |        |      |        |
|   | (i) Ratio (1:2:4) 90 lbs cement, 2 cft sand , shingle 1/8" 1/4" guage.  |          |        |      |        |
|   | Add extra labour for R.C.C in 2nd & subsequent storeys.   |          |        |      |        |
| i   | 6" x 12" lintels with 2+2 -1/2" dia. Bottom and Top reinforcement and 1/4" dia ring @ 6" c/c.   | 2.9      | Cum    |      |        |
| li  | Window Sill   | 1.4      | Cum    |      |        |
| lii   | Sill in Labs (2'-6" x 4'-0" x 6") & (4'-0" x 4'-0" x 6")  | 11.3     | Cum    |      |        |
| iv  | Window Ledges / Chajjas / offset  | 28.4     | Cum    |      |        |
| <b>TOTAL ESTIMATED COST OF CIVIL WORKS BASED ON NON-SCHEDULED ITEMS (Rs.)</b> |   |          |        |      |        |

## **CIVIL WORKS (SCHEDULED ITEMS)**

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
SCHEDULE ITEMS FOR CIVIL WORKS**

| S.NO     | DESCRIPTION  | QUANTITY | UNIT  | RATE    | AMOUNT     |
|----------|--|----------|-------|---------|------------|
|          | The Contractor is required to visit the site to fully acquaint himself as to the nature and extent of the works and the value of the work to be demolished, and to provide in his tender for any item not specifically mentioned, but which the tenderer might deem to be necessary for the proper execution and completion of the works. The contractor shall provide all shoring, needling, strutting, and whatever else may be necessary to ensure the stability of all structures associated with alteration work and remove the same at completion of such work. The contractor is hereby deemed to have included in his tender for the costs associated with such stability. The contractor hereby indemnifies employer and his agents against all liabilities associated with damages, loss, etc., arising from failure of such stability, for whatever reason, and from the lack of provision of such stability. |          |       |         |            |
| <b>1</b> | <b>Dismantling (Demolition)</b>  |          |       |         |            |
| a        | Dismantling Cement Block Masonry<br>Chapter 2:, Item # 14, Page #10)   | 2000     | % Cft | 1134.38 | 22,687.60  |
| b        | Dismantling Cement Concrete Plain (1:2:4)<br>Chapter 2:, Item # 19-c, Page #10)  | 1700     | % Cft | 3327.5  | 56,567.50  |
| c        | Dismantling Cement Concrete reinforced separating reinforcement from concrete cleaning and straightening the same<br>Chapter 2:, Item # 20, Page #10)  | 236      | % Cft | 5445    | 12,850.20  |
| <b>2</b> | <b>Roof Screeding (Cubical strength 3000 PSI )</b>   |          |       |         |            |
|          | Providing & Laying 3" thick topping cement concrete (1:2:4) including surface finishing and dividing in to panels.<br>Chapter: Flooring, Item # 16-d, Page # 42)   |          |       |         |            |
| a        | Roof Screeding   | 6800     | % Sft | 12595   | 856,460.00 |
| <b>3</b> | <b>Screeding (Cubical strength 2000 PSI )</b>  |          |       |         |            |
|          | Cement, concrete plain including placing compacting, finishing and curing, concrete complete (including screening and washing of stone aggregates, without shuttering) Ratio 1:3:6<br>Chapter: Concrete, Item # 5-h, Page #16)   |          |       |         |            |
| a        | Roof Screeding (Average 3" Thick)  | 6800     | % Sft | 4411.82 | 300,003.76 |
| <b>4</b> | <b>Solid Block Masonry 6" &amp; 4 "</b>  |          |       |         |            |
|          | 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 racking out joints & curing etc.<br>(Chapter Concrete, Item # 24, page #19)   |          |       |         |            |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
SCHEDULE ITEMS FOR CIVIL WORKS**

| S.NO     | DESCRIPTION  | QUANTITY | UNIT  | RATE     | AMOUNT     |
|----------|--|----------|-------|----------|------------|
|          | <b>Second Floor</b>  |          |       |          |            |
| i        | Solid 4" Th. Block Masonry   | 159.84   | % Cft | 15771.01 | 25,208.38  |
| ii       | Solid 6" Th. Block Masonry   | 3036     | % Cft | 15771.01 | 478,807.86 |
|          | Add Extra labour for block masonry in first floor.<br>(Chapter Concrete, Item # 30, page #19)  |          |       |          |            |
| i        | Solid 4" Th. Block Masonry   | 480      | % Sft | 328.97   | 1,579.06   |
| ii       | Solid 6" Th. Block Masonry   | 7000     | % Sft | 328.97   | 23,027.90  |
|          | <b>Roof</b>  |          |       |          |            |
| i        | Solid 4" Th. Block Masonry   | 33.3     | % Cft | 15771.01 | 5,251.75   |
| ii       | Solid 6" Th. Block Masonry   | 600      | % Cft | 15771.01 | 94,626.06  |
|          | Add Extra labour for block masonry in second floor.<br>(Chapter Concrete, Item # 30, page #19)   |          |       |          |            |
|          | Solid 4" Th. Block Masonry   | 100      | % Sft | 657.94   | 657.94     |
|          | Solid 6" Th. Block Masonry   | 1200     | % Sft | 657.94   | 7,895.28   |
| <b>5</b> | <b>Surface Rendering (Internal Plaster)</b>  |          |       |          |            |
|          | 3/4" thick cement plaster 1:5 up to 12' height. At Joint 22 swg metal mesh 8 inch wide use on joints of masonry & structure member.  |          |       |          |            |
|          | Notes:   |          |       |          |            |
|          | 1) Rates for all finished work include the removal of the surplus debris un-used material and by products.   |          |       |          |            |
|          | 2) The rates include the cost of scaffolding and its removal.  |          |       |          |            |
|          | (Chapter Surface Rendering, Item # 12-C, page #52) As per specification 25.1-25.6  |          |       |          |            |
| i        | Second Floor   | 13365    | % Sft | 3026.7   | 404,518.45 |
| <b>6</b> | <b>Surface Rendering (External Plaster)</b>  |          |       |          |            |
|          | 1/2" thick cement plaster 1:4 up to 12' height. V-groove having size of 1" X 1/2" as shown in drawing As per specification 25.1-25.6   |          |       |          |            |
|          | Notes:   |          |       |          |            |
|          | 1) Rates for all finished work include the removal of the surplus debris un-used material and by products.   |          |       |          |            |
|          | 2) The rates include the cost of scaffolding and its removal.  |          |       |          |            |
|          | (Chapter Surface Rendering, Item # 11-B, page #52)   |          |       |          |            |
| i        | Second Floor   | 4673     | % Sft | 2580.84  | 120,602.65 |
| <b>7</b> | <b>Weather Shield Paint</b>  |          |       |          |            |
|          | Preparing the surface and with weather coat i/e 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. |          |       |          |            |
|          | (Chapter: Surface Rendering, item # 38-A, Page # 56)   |          |       |          |            |
|          | 2nd & Third Coats.   |          |       |          |            |
|          | (Chapter: Surface Rendering, item # 38-B, Page # 56)   |          |       |          |            |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
SCHEDULE ITEMS FOR CIVIL WORKS**

| S.NO      | DESCRIPTION   | QUANTITY | UNIT   | RATE    | AMOUNT     |
|-----------|---|----------|--------|---------|------------|
|           | Extra labour for external surface for distemper/paint/ white wash/ color wash/weather coat above 20'-0" height using long ladder or jhoola for each coat. (for every 10'-0" Additional height)  |          |        |         |            |
|           | (Chapter: Surface Rendering, item # 42, Page # 56)  |          |        |         |            |
| i         | Second Floor  | 4673     | % Sft  | 3024.13 | 141,317.59 |
| <b>8</b>  | <b>Internal Paint</b>   |          |        |         |            |
|           | Preparing the surface & painting with Plastic emulsion of approved make i.e. rubbing the surface with bathy (silicon carbide rubbing brick) filing the voids with zinc/chalk/plaster of Paris mixture, applying first coat primer, making the surface smooth and then painting 3 coats with plastic emulsion of approved make etc.: complete (new surface). | 15000    | % Sft  | 2237.95 | 335,692.50 |
|           | (Chapter: Surface Rendering, item # 40-A, Page # 56)  |          |        |         |            |
|           | 2nd & Third Coats.  |          |        |         |            |
|           | (Chapter: Surface Rendering, item # 40-B, Page # 56)  |          |        |         |            |
| <b>9</b>  | <b>Enamel Paint on Doors &amp; Door Frames.</b>   |          |        |         |            |
|           | Preparing surface and painting of doors and any type (including edges) 3 coats.   |          |        |         |            |
|           | Chapter: Painting & Varnishing, Item # 5C-I, ii, page # 70.   |          |        |         |            |
| i         | D-1 Single Shutter (3'-6" x 7'-0" =24.5 S.Ft X 4 No.s   | 196      | % Sft  | 2116.41 | 4,148.16   |
| ii        | D-2 Double Shutter (5'-0" x 7'-0" =35 S.Ft X 6 No.s   | 420      | % Sft  | 2116.41 | 8,888.92   |
| <b>10</b> | <b>Enamel Paint on Iron Works</b>   |          |        |         |            |
|           | Preparing surface & painting guard bars, gates of iron bars, gratings, railings (including standards braces, etc.). And similar open work.  |          |        |         |            |
|           | Chapter: Painting & Varnishing, Item # 5d-i, ii, page # 70.   |          |        |         |            |
| i         | D-4 Single Shutter (3'-0" x 8'-0" = 24 S.Ft X 3 No.s  | 144      | % Sft  | 896.39  | 1,290.80   |
| ii        | D-7 Double Shutter (6'-0" x 8'-0" =48 S.Ft X 1No.s  | 96       | % Sft  | 896.39  | 860.53     |
| iii       | MS. HAND- Rail for Stairs Corridor and ramp   | 1221.54  | % Sft  | 896.39  | 10,949.76  |
| <b>11</b> | <b>Precast Slab on Windows</b>  |          |        |         |            |
|           | Supply and installation of precast slab (5'-0" x 2'-6") 3" thick, on external windows.Price to include all related works as per drawings, specification and Engineer's Instructions.  | 222.75   | P. Cft | 309     | 68,829.75  |
|           | (i) ratio 1:2:4   |          |        |         |            |
|           | (Chapter: Concrete, item #6-i-B, Page # 17)   |          |        |         |            |

CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
**SCHEDULE ITEMS FOR CIVIL WORKS**

| S.NO   | DESCRIPTION   | QUANTITY | UNIT | RATE   | AMOUNT              |
|--|---|----------|------|--------|---------------------|
| 12   | <b>Water Spout</b>  |          |      |        |                     |
|  | Reinforced cement concrete spout including fixing in position 2 X1/2"X 6" 5".<br>(Chapter: Concrete, item #14, Page # 18) | 12       | Nos. | 261.25 | 3135.00             |
| <b>TOTAL ESTIMATED COST OF CIVIL WORKS BASED ON SCHEDULE ITEMS</b> |   |          |      |        | <b>2,985,857.40</b> |
| <b>% WISE PREMIUM ADD OR SUBTRACT (+ OR -)</b>                     |   |          |      |        |                     |
| <b>COST OF SCHEDULED ITEMS (CIVIL WORKS)</b>                       |   |          |      |        |                     |



**ELECTRICAL WORKS  
(NON – SCHEDULED ITEMS)**

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR ELECTRICAL WORKS**

| S. NO    | DESCRIPTION   | QUANTITY | UNIT  | RATE | AMOUNT |
|----------|---|----------|-------|------|--------|
| <b>1</b> | <b>L.V Distribution Boards</b>  |          |       |      |        |
| a        | Supply, installation, testing & commissioning of Wall/Flush mounted Main Distribution Board (MDB) / Distribution Boards (DB) of Electrech/ Libra Engineering or approved equivalent, made with 16 SWG sheet steel metal, as per single line diagram, dust protected, vermin proof housing coated with approved color having all the necessary switching & protections, ready wired and factory assembled anticorrosive/powder coated, including all mounting accessories as per specifications and drawings, complete in all respect. |          |       |      |        |
| i        | Addition of 250A TP MCCB in Existing LT Panel   | 1        | Nos.  |      |        |
| ii       | MDB   | 1        | Nos.  |      |        |
| iii      | DB-CO-LAB   | 1        | Nos.  |      |        |
| iv       | DB-PH-LAB-1   | 1        | Nos.  |      |        |
| v        | DB-PH-LAB-2   | 1        | Nos.  |      |        |
| <b>2</b> | <b>Conduits &amp; Pipes</b>   |          |       |      |        |
| a        | Providing and laying of following size (inner dia) PVC / UPVC Conduit as race ways with all accessories recessed / surface on wall / column / under floor for Power. As per specifications and drawings, complete respect.  |          |       |      |        |
| i        | 38 mm dia PVC   | 75       | Per M |      |        |
| ii       | 50 mm dia PVC   | 20       | Per M |      |        |
| iii      | 100 mm dia UPVC (Class-D)   | 100      | Per M |      |        |
| <b>3</b> | <b>Low Voltage Cables and Wires</b>   |          |       |      |        |
| a        | Supply, installation, testing & commissioning of following size of single core green PVC insulated with Yellow Strip Cu Conductor Cable 300/500V voltage grade in already laid raceways/Conduits or trench including all accessories lugs, cable gland etc. as per drawings and specification,  |          |       |      |        |
|          | <b>1 Core - CU/PVC Cable (450/750V) as ECC</b>  |          |       |      |        |
| i        | 1 Core - 70 Sq.mm Cu/PVC Cable  | 100      | Per M |      |        |
| ii       | 1 Core - 16 Sq.mm Cu/PVC Cable  | 20       | Per M |      |        |
| ii       | 1 Core - 10 Sq.mm Cu/PVC Cable  | 25       | Per M |      |        |
| <b>4</b> | <b>Wiring Accessories</b>   |          |       |      |        |
| a        | Supply, installation, testing & commissioning of following Clipsal/ MK or approved equivalent 10/13/20A, gang type switches, , Sockets including 16 SWG Sheet Steel powder coated back Boxes with earth terminal, recessed in wall, with all accessories as per specification, complete in all respects.  |          |       |      |        |
| i        | 10A, One Gang Switch  | 3        | Nos.  |      |        |
| ii       | 10A, Two Gang Switch  | 1        | Nos.  |      |        |
| iii      | 10A, Three Gang Switch  | 1        | Nos.  |      |        |
| iv       | 10A, Four Gang Switch   | 10       | Nos.  |      |        |
| v        | 10A, Five Gang Switch   | 1        | Nos.  |      |        |
| vi       | 10A, Six Gang Switch  | 9        | Nos.  |      |        |
| v        | 5A, 3-Pin 1-Gang Universal Switched Socket Outlet   | 24       | Nos.  |      |        |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR ELECTRICAL WORKS**

| S. NO                                    | DESCRIPTION   | QUANTITY | UNIT  | RATE | AMOUNT |
|--|---|----------|-------|------|--------|
| vi                                       | 20A, 3-Pin 1-Gang Switched Socket Outlet  | 14       | Nos.  |      |        |
| b  | Supply, installation, testing and commissioning of Technology Box with Cover and following accessories  |          |       |      |        |
| i  | RJ 11 OUTLET (with face plate+16 SWG Back Box + Jack/connectors+ I/O etc.)  | 106      | Nos.  |      |        |
| ii                                       | 5A Switch Socket Outlet   | 212      | Nos.  |      |        |
| iii                                      | 13A Switch Socket Outlet  | 106      | Nos.  |      |        |
| c  | Supply, installation, testing and commissioning of Technology Box with Cover and following accessories  |          |       |      |        |
| i  | RJ 45 DUAL OUTLET (with face plate+ 16 SWG Back Box/Jack/connectors+ I/O etc.) for data and voice network   | 6        | Nos.  |      |        |
| ii                                       | 5A Switch Socket Outlet   | 12       | Nos.  |      |        |
| iii                                      | 13A Switch Socket Outlet  | 6        | Nos.  |      |        |
| <b>5</b>                                 | <b>Light Fixture &amp; Fans</b>   |          |       |      |        |
| a  | Supply, installation, testing & commissioning of following light fixtures complete with starters, (unless mention otherwise), lamps, lamp holders, drivers, mounting accessories etc., as per specification, complete in all respects. Lighting fixtures sample must be submitted to consultant for approval. |          |       |      |        |
| i  | Surface type 1x 32 watt LED Smart Panel of Britlite (Model # BLP-656-BMP) or approved equivalent.   | 77       | Nos.  |      |        |
| ii                                       | Recessed type 1x 20 watt LED Tube Light of Britlite or approved equivalent.   | 2        | Nos.  |      |        |
| iii                                      | Recessed type 12 watt LED down light of Britlite (Model # BLP) or approved equivalent.  | 16       | Nos.  |      |        |
| b  | Supply, installation, testing & commissioning of following types of fan including all connecting accessories as per drawings and specifications, complete in all respects.  |          |       |      |        |
| i  | 48" Sweep Ceiling Fan of Pak Fan or approved equivalent.  | 46       | Nos.  |      |        |
| ii                                       | 12" Sweep exhaust fan of Pak Fan or approved equivalent.  | 9        | Nos.  |      |        |
| <b>SUMMARY OF LV DISTRIBUTION BOARDS</b> |   |          |       |      |        |
| <b>2</b>                                 | <b>VOICE, DATA COMMUNICATION SYSTEM</b>   |          |       |      |        |
| <b>2.1</b>                               | Providing and laying of (inner dia) 1" PVC Conduit with all accessories recessed / surface on wall / column / under floor for Communication network, as per specifications and drawings, complete in all respect.   | 330      | Per M |      |        |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR ELECTRICAL WORKS**

| S. NO      | DESCRIPTION  | QUANTITY | UNIT  | RATE | AMOUNT |
|------------|--|----------|-------|------|--------|
| <b>2.2</b> | Providing, laying, testing & commissioning of CAT 6 UTP cable in already laid 1"dia PVC conduit with all installation accessories from Patch Panel to Wi-Fi Access Point / RJ-11/ RJ-45 data point with phase plate/outlet , I/O connectors etc. present in already installed TJB as per specification and drawing, up to the entire satisfaction of Consultant complete in all respect. | 1500     | Per M |      |        |
| <b>2.3</b> | Providing, installation, testing and commissioning of following Data / Voice Cabinets, for patch panel / Fiber panels, adapter, PDU's, Fans and space for switches as it may require to accommodate complete the entire passive network as per the single line diagram drawing and specification, complete in all respect.   |          |       |      |        |
| i          | Providing, Installing, testing & commissioning of owner provided Network Matrix COMERACK 18U with complete accessories such as patch cords, PDU cable manager, I/O connectors tagging and piping etc. with all necessary accessories, complete in all respect. as per specification & drawings as required up to the entire satisfaction of Client/Consultant, complete in all respect.  | 2        | Nos.  |      |        |
| ii         | Providing, installing, testing & commissioning of Volition™ Front Cable Manager as per specification & drawings as required up to the entire satisfaction of Client/Consultant, complete in all respect.   | 2        | Nos.  |      |        |
| iii        | Providing, installing, testing & commissioning of following 48 Port Switch to be installed inside Comerack with all installation accessories as per specification & drawings as required up to the entire satisfaction of Client/Consultant, complete in all respect.  | 2        | Nos.  |      |        |
| iv         | Providing, installing, testing & commissioning of following 16 Port Switch to be installed inside Comerack with all installation accessories as per specification & drawings as required up to the entire satisfaction of Client/Consultant, complete in all respect.  | 2        | Nos.  |      |        |
| v          | Providing, installing, testing & commissioning of following 48 Port Patch Panel to be installed inside Comerack with all installation accessories as per specification & drawings as required up to the entire satisfaction of Client/Consultant, complete in all respect.   | 2        | Nos.  |      |        |
| vi         | Providing, installing, testing & commissioning of following 16 Port Patch Panel to be installed inside Comerack with all installation accessories as per specification & drawings as required up to the entire satisfaction of Client/Consultant, complete in all respect.   | 2        | Nos.  |      |        |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR ELECTRICAL WORKS**

| S. NO  | DESCRIPTION  | QUANTITY | UNIT  | RATE | AMOUNT |
|--|--|----------|-------|------|--------|
| vii  | Providing, Installation & commissioning of TJB of 12 pairs for PTCL Connection or as per Client's requirement & specification and as shown in drawing, complete in all respect.  | 1        | Nos.  |      |        |
| viii   | Providing, Laying, testing, terminating & connecting of Pony / 3M Volition™ CAT 5 UTP telecom Cable (From existing nearest PABX/TJB to RJ-45 outlet ) for telecom system along with 25mmΦ PVC conduit with all installation accessories such as junction boxes, jacks, bends, sockets etc. in sheet steel back box as per specification & drawing, complete in all respect.    | 1        | Lot.  |      |        |
| ix   | Providing, installing, testing & commissioning of Wireless Access Point (Wi-Fi) as per specification & drawings as required up to the entire satisfaction of Client/Consultant, complete in all respect.   | 3        | Nos.  |      |        |
| x  | Providing and fixing of TV outlet RJ-55 with appropriate back box of approved make/origin or approved equal as per specification & drawing, up to the entire satisfaction of Client/Consultant complete in all respect.  | 1        | Nos.  |      |        |
| <b>SUMMARY OF FIRE VOICE / DATA /COMMUNICATION</b> |  |          |       |      |        |
| <b>3</b>   | <b>FIRE ALARM SYSTEM</b>   |          |       |      |        |
| <b>3.1</b>   | Providing and laying of (inner dia) 1" PVC Conduit with all accessories recessed / surface on wall / column / under floor /ceiling for Fire Alarm network, as per specifications and drawings, complete respect.   | 180      | Per M |      |        |
| <b>3.2</b>   | Providing, laying, testing & commissioning of 1.5 sqmm twin core Fire resistant cable of BELDEN / Pony or approved equivalent in PVC conduit up to FACP Panel with all installation accessories, as per specification & drawing complete in all respect.   | 180      | Per M |      |        |
| i  | Providing, Installing, testing & commissioning of 2 loop Fire Alarm Control Panel of model VIG-PLUS 12 Gent by Honeywell or equivalent Compact 24N built-in power supply & backup battery or approved equivalent upto the entire satisfaction of Consultant, complete in all respect.  | 1        | Nos.  |      |        |
| ii   | Providing, installing, testing & commissioning of built-in fault isolator Intelligent Addressable Smoke sensor of GENT by honeywell model #S4-715 or approved equivalent, with base mount, Solid-state, unipolar dual chamber area sensor. Led provides 360-Deg visual indication or approved equivalent, upto the entire satisfaction of Consultant, complete in all respect. | 15       | Nos.  |      |        |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR ELECTRICAL WORKS**

| S. NO  | DESCRIPTION   | QUANTITY | UNIT | RATE | AMOUNT |
|--|---|----------|------|------|--------|
| iii  | Providing, Installing, testing & commissioning of Addressable Manual fire alarm station, break-glass type with built in fault isolator of Gent by Honeywell model # S434845 or approved equivalent surface/semi-flush mounted type, with all required accessories, complete in all respect. | 1        | Nos. |      |        |
| iv   | Providing, Installing, testing & commissioning of addressable electronic sounder with flasher ,with built in fault isolater model # MFA-ST105 or GENT model # S3-S-R or approved equivalent, with all required accessories, complete in all respect.  | 1        | Nos. |      |        |
| <b>SUMMARY OF FIRE ALARM SYSTEM</b>  |   |          |      |      |        |
| <b>TOTAL ESTIMATED COST OF LV DISTRIBUTION BOARDS, FIRE ALARM, VOICE / DATA /COMMUNICATION (NON - SCHEDULED ITEMS)</b> |   |          |      |      |        |

## **ELECTRICAL WORKS (SCHEDULED ITEMS)**

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
SCHEDULE ITEMS FOR ELECTRICAL WORKS**

| S.NO   | DESCRIPTION   | Quantity | UNIT      | RATE  | AMOUNT              |
|--|---|----------|-----------|-------|---------------------|
| <b>1</b>   | <b>SUB HEAD I Main &amp; Sub Mains</b>  |          |           |       |                     |
|  | <b>WITH 3 WIRE PVC CONDUIT RECESSED IN THE WALL OR COLUMN</b>   |          |           |       |                     |
| i  | Providing & laying (MAIN or SUB MAIN) PVC insulated with size 3-7/.029 copper conductor in ¾" dia PVC conduit recessed in the wall or column as required.<br>Item # 24(D)/ P-4/ Second Edition-2012 | 250      | Per M     | 294   | 73,500.00           |
| ii   | Providing & laying (MAIN or SUB MAIN) PVC insulated with size 3-7/.036 copper conductor in ¾" dia PVC conduit recessed in the wall or column as required.<br>Item # 25(D)/ P-4/ Second Edition-2012 | 830      | Per M     | 338   | 280,540.00          |
|  | <b>WITH 4 CORE OVERHEAD OR UNDERGROUND 300/500</b>  |          |           |       |                     |
| iii  | Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheeted with 4 core copper conductor 600/1000 volts size 16mm <sup>2</sup><br>Item # 100(N)/ P-12/ Second Edition-2012                    | 200      | Per M     | 500   | 100,000.00          |
|  | <b>WITH 4 CORE OVERHEAD OR UNDERGROUND 600/1000</b>   |          |           |       |                     |
| iv   | Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheeted with 4 core copper conductor 600/1000 volts size 16mm <sup>2</sup><br>Item # 102(O)/ P-12/ Second Edition-2012                    | 75       | Per M     | 1300  | 97,500.00           |
| v  | Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheeted with 4 core copper conductor 600/1000 volts size 25mm <sup>2</sup><br>Item # 103(O)/ P-12/ Second Edition-2012                    | 20       | Per M     | 1909  | 38,180.00           |
| vi   | Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheeted with 4 core copper conductor 600/1000 volts size 150mm <sup>2</sup><br>Item # 109(O)/ P-13/ Second Edition-2012                   | 100      | Per M     | 10028 | 1,002,800.00        |
|  | <b>Total of Main &amp; Sub Main</b>   |          |           |       | <b>1,592,520.00</b> |
| <b>2</b>   | <b>SUB HEAD II Point Wiring</b>   |          |           |       |                     |
| i  | Wiring for light or fan point with 3/.029 PVC insulated wire in 20mm (3/4") PVC conduit recessed in the wall or column as required.<br>Item # 124/ P-15/ Second Edition-2012                        | 150      | Per Point | 1130  | 169,500.00          |
|  | <b>Total of Point Wiring</b>  |          |           |       | <b>169,500.00</b>   |
| <b>3</b>   | <b>SUB HEAD XI Electrical Accessories</b>   |          |           |       |                     |
| i  | Wiring for AC point with 6mm sq PVC insulated wire in 25mm (3/4") PVC conduit recessed in the wall or column as required.<br>Item # 124/ P-15/ Second Edition-2012                                  | 14       | Per No    | 3000  | 42,000.00           |
|  | <b>Total of Electrical Accessories</b>  |          |           |       | <b>42,000.00</b>    |
| <b>ESTIMATED COST OF SCHEDULE ELECTRICAL WORKS</b> |   |          |           |       | <b>1,804,020.00</b> |
| <b>% WISE PREMIUM ADD OR SUBTRACT (+ OR -)</b>     |   |          |           |       |                     |
| <b>COST OF SCHEDULED ITEMS (ELECTRICAL WORKS)</b>  |   |          |           |       |                     |



**PLUMBING WORKS  
(NON - SCHEDULED ITEMS)**

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR PLUMBING WORKS**

| S.NO                 | DESCRIPTION   | QUANTITY | UNIT | RATE | AMOUNT |
|----------------------|---|----------|------|------|--------|
| <b>1</b>             | The Contractor is required to visit the site to fully acquaint himself as to the nature and extent of the works and the value of the work to be demolished, and to provide in his tender for any item not specifically mentioned, but which the tenderer might deem to be necessary for the proper execution and completion of the works. 'The contractor shall provide all shoring, needling, strutting, and whatever else may be necessary to ensure the stability of all structures associated with alteration work and remove the same at completion of such work. The contractor is hereby deemed to have included in his tender for the costs associated with such stability. The contractor hereby indemnifies employer and his agents against all liabilities associated with damages, loss, etc., arising from failure of such stability, for whatever reason, and from the lack of provision of such stability. |          |      |      |        |
| <b>1.1</b>           | <b>S.S Lab Sink</b>   |          |      |      |        |
|                      | S.S Laboratory sink, with S.S waste, plastic P-trap, spout, tee cock.   | 4        | Nos. |      |        |
| <b>1.2</b>           | <b>Sink Mixer</b>   |          |      |      |        |
| i                    | Cold water single for Lab sink.   | 4        | Nos. |      |        |
| <b>1.3</b>           | <b>Bib Cock</b>   |          |      |      |        |
| i                    | Hot and cold water mixer for Ablution.  | 4        | Nos. |      |        |
| <b>1.4</b>           | <b>S.S Sink</b>   |          |      |      |        |
| i                    | Stainless steel kitchen sink including stop cocks, P-trap / Bottle trap, waste pipe etc complete in all respects.   |          |      |      |        |
|                      | SK - 2, 70" x 20" double bowl and single drainer  | 2        | Nos. |      |        |
| <b>1.5</b>           | <b>Sink Mixer</b>   |          |      |      |        |
|                      | Sink hot and cold water mixer, etc.   |          |      |      |        |
| i                    | For SK – 2 (Single cold only)   | 2        | Nos. |      |        |
| <b>1.6</b>           | <b>Toilet accessories complete set.</b>   |          |      |      |        |
| i                    | Coat Hooks  | 6        | Nos. |      |        |
| ii                   | Hand Dryer  | 6        | Nos. |      |        |
| <b>SUB TOTAL RS.</b> |   |          |      |      |        |
|                      | <b>SECTION - 02 WATER SUPPLY SYSTEM</b>   |          |      |      |        |
|                      | Supply, installation, testing and commissioning of complete pipe work for cold and hot water system including all accessories required to complete systems ready to operate as per specification, drawings & instruction of Consultant.   |          |      |      |        |
| <b>2.1</b>           | Polypropylene Random PP-R pipes PN 20 and fittings with fusion jointing along with all types of unions, tees, bends, sockets, clamps, hangers, supports, sleeves, masking plates, chiseling, making holes making good, excavation, bedding backfilling as required complete in all respect.   |          |      |      |        |
| i                    | 25 mm OD  | 600      | Rft. |      |        |
| ii                   | 32 mm OD  | 10       | Rft. |      |        |
| iii                  | 40 mm OD  | 10       | Rft. |      |        |
| iv                   | 63 mm OD  | 10       | Rft. |      |        |
| v                    | 75 mm OD  | 660      | Rft. |      |        |

**CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF  
PHYSICS AND CHEMISTRY  
N.E.D UNIVERSITY OF ENGINEERING & TECHNOLOGY  
NON-SCHEDULE ITEMS FOR PLUMBING WORKS**

| S.NO  | DESCRIPTION   | QUANTITY | UNIT | RATE | AMOUNT |
|---|---|----------|------|------|--------|
| <b>2.2</b>  | Same as above item 2.1 but Polypropylene Random PP-R pipe (PN -25) reinforced with Aluminium foil for hot water.  |          |      |      |        |
| i   | 25 mm OD  | 10       | Rft. |      |        |
| <b>2.3</b>  | Brass body gate valves / ball valves with unions.   |          |      |      |        |
| i   | Size. 3/4"  | 1        | Nos. |      |        |
| ii  | Size. 1"  | 6        | Nos. |      |        |
| iii   | Size. 2"  | 1        | Nos. |      |        |
| iv  | Size. 3" (C.I body)   | 1        | Nos. |      |        |
| <b>2.4</b>  | Goose neck for overhead water tank.   |          |      |      |        |
|   | Size. 2"  | 2        | Nos. |      |        |
| <b>2.5</b>  | Construction of CC Valve chambers with material including, excavation, base top RCC slab CI cover with frame.   |          |      |      |        |
| i   | Size. 24"x 24"  | 1        | Nos. |      |        |
| <b>SUB TOTAL RS.</b>  |   |          |      |      |        |
|   | <b>SECTION - 03 EXTERNAL SEWER &amp; MANHOLES</b>   |          |      |      |        |
|   | Supply, fixing, testing and commissioning of equipment, pipe work required to complete the sewerage disposal services in all respects with accessories ready to operate as per specifications, drawings and instructions. |          |      |      |        |
| <b>3.1</b>  | UPVC pipes class 'B' for Sewer drainage with push fit rubber joints including excavation in any type of soil, dewatering if required bedding, back filling with selected material, removing of extra materials.           |          |      |      |        |
| i   | Dia. 8" size  | 380      | Rft. |      |        |
| <b>3.2</b>  | Construction of Gully Trap with material including, excavation, 4" size UPVC P-trap CC base CI cover with frame, CC benching water proof internal plaster inlet/out connections etc.                                      |          |      |      |        |
| i   | Type GT, Size 10"x10"   | 10       | Nos. |      |        |
| <b>SUB TOTAL RS.</b>  |   |          |      |      |        |
| <b>4</b>  | <b>SECTION - 04 SEWERAGE PIPES</b>  |          |      |      |        |
|   | Supply and installation of sewerage pipes complete in all respect as per drawings and specifications.   |          |      |      |        |
|   | uPVC pipes of approved make along with specials, fittings, bends, wyes, tees, sockets, sleeves, masking plates, traps, chiseling, making hole, excavation, backfilling making good whereas required solvent jointing.     |          |      |      |        |
| i   | 1 inch dia (25mm)   | 165      | Rft. |      |        |
| ii  | 2 inch dia (50mm)   | 145      | Rft. |      |        |
| <b>SUB TOTAL RS.</b>  |   |          |      |      |        |
| <b>TOTAL OF ALL SECTIONS RS.</b>  |   |          |      |      |        |
| <b>TOTAL ESTIMATED COST OF PLUMBING WORKS (NON - SCHEDULED ITEMS) RS.</b> |   |          |      |      |        |



# N.E.D University of Engineering & Technology Karachi

## CONSTRUCTION OF 03 LABORATORIES FOR DEPARTMENT OF PHYSICS & CHEMISTRY

### TENDER DRAWINGS

#### VOLUME 4

ARCHITECTS & CONSULTANTS:



**Consult-Tech**  
ENGINEERING · PLANNING · MANAGEMENT

11-C, Second Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93  
e-mail: [info@consult-tech.org](mailto:info@consult-tech.org) WEB: [www.consult-tech.org](http://www.consult-tech.org)

# LIST OF DRAWINGS

## ARCHITECTURE DRAWINGS

|      |                           |
|------|---------------------------|
| A-01 | ARCHITECTURAL PLAN        |
| A-02 | SECTION 1-1 & SECTION 2-2 |
| A-03 | FRONT & REAR ELEVATION    |
| A-04 | FURNITURE PLAN            |
| A-05 | TYPICAL SECTIONS          |
| A-06 | TOP ROOF PLAN             |
| A-07 | FLOORING PLAN             |

## STRUCTURE DRAWINGS

|      |                                |
|------|--------------------------------|
| S-01 | ROOF FRAMING PLAN              |
| S-02 | ROOF SLAB REINFORCEMENT PLAN   |
| S-03 | ROOF BEAM ELEVATION            |
| S-04 | PLAN & TYPICAL SECTION DETAILS |

## ELECTRIC DRAWINGS

|              |  |
|--------------|--|
| UESI-NED-E00 | LEGEND, LIST OF DRAWINGS & GENERAL NOTES |
| UESI-NED-E01 | LIGHTING LAYOUT                          |
| UESI-NED-E02 | POWER LAYOUT                             |
| UESI-NED-E03 | A/C POWER LAYOUT                         |
| UESI-NED-E04 | DATA & VOICE LAYOUT                      |
| UESI-NED-E05 | FIRE ALARM LAYOUT                        |
| UESI-NED-E06 | SINGLE LINE DIAGRAM                      |
| UESI-NED-E07 | SINGLE LINE DIAGRAM                      |
| UESI-NED-E08 | FIRE ALARM PANEL RISER DIAGRAM           |
| UESI-NED-E09 | DATA & VOICE RISER DIAGRAM               |
| UESI-NED-E10 | MISCELLANEOUS DETAILS                    |

## PLUMBING DRAWINGS

|      |                        |
|------|------------------------|
| P-01 | PLUMBING FLOOR DRAWING |
| P-02 | PLUMBING ROOF DRAWING  |

TENDER DRAWING

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

LIST OF DRAWINGS

DRAWN BY:

M.S.R

CHECKED BY:

R.A

APPROVED BY:

R.A.K

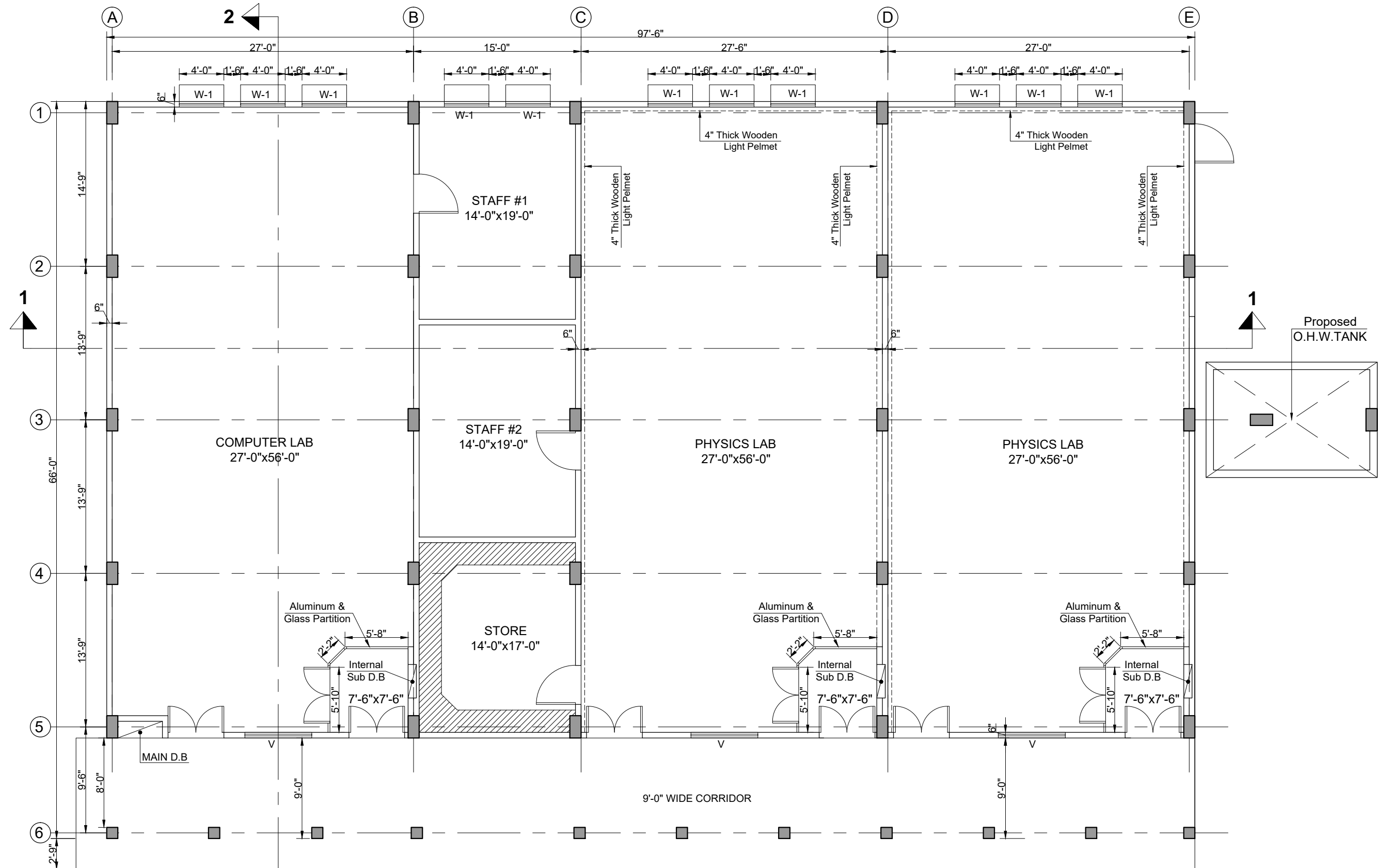
DATE:

SEP, 2020

DRAWING NO.

A-00

ARCHITECTURAL  
DRAWINGS



SECOND FLOOR PLAN

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

ARCHITECTURAL PLAN

DRAWN BY:

ASIF

CHECKED BY:

R.A

APPROVED BY:

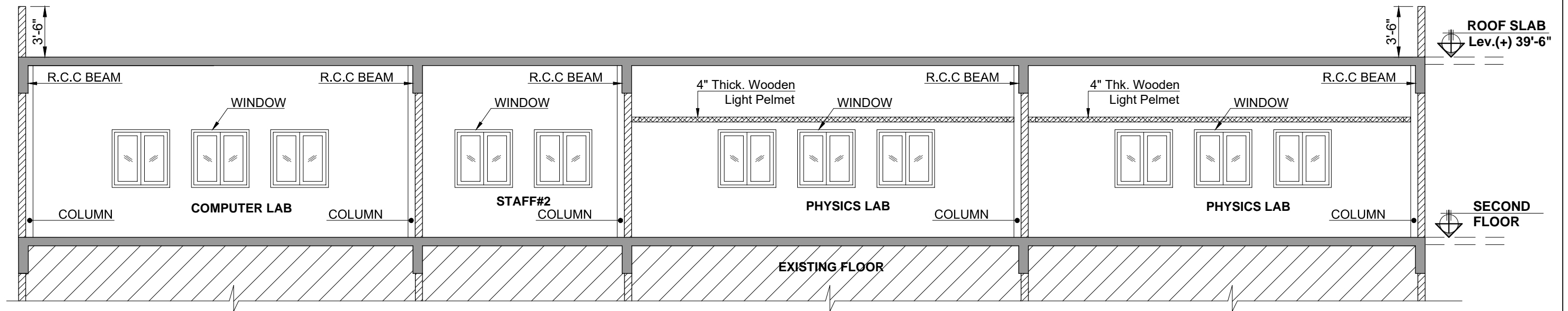
R.A.K

DATE:

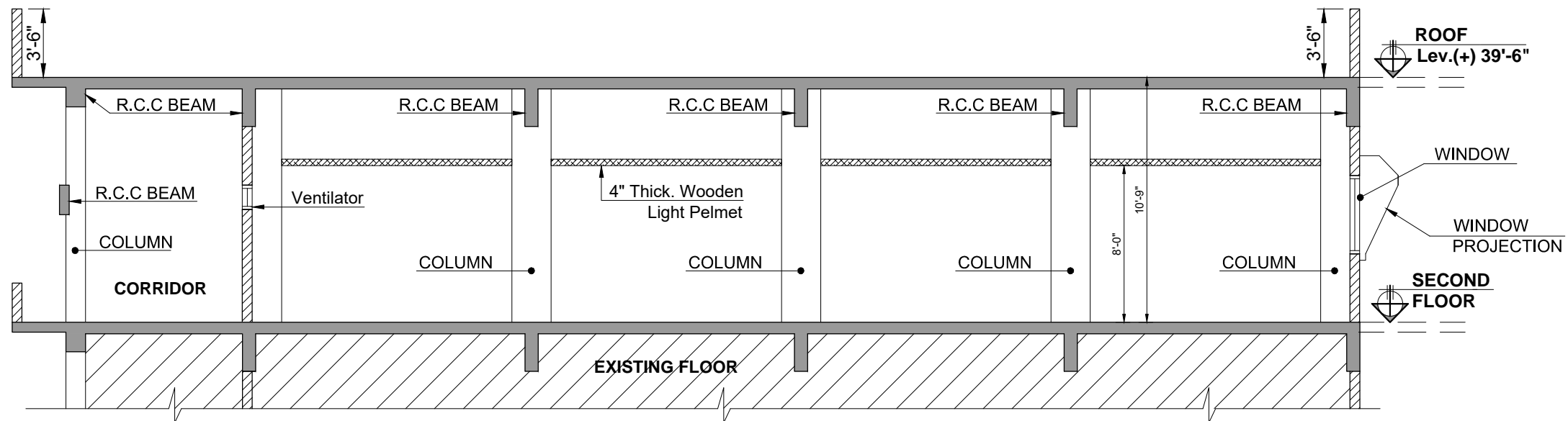
SEP, 2020

DRAWING NO.

A-01



PART SECTION 1-1



PART SECTION 2-2

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

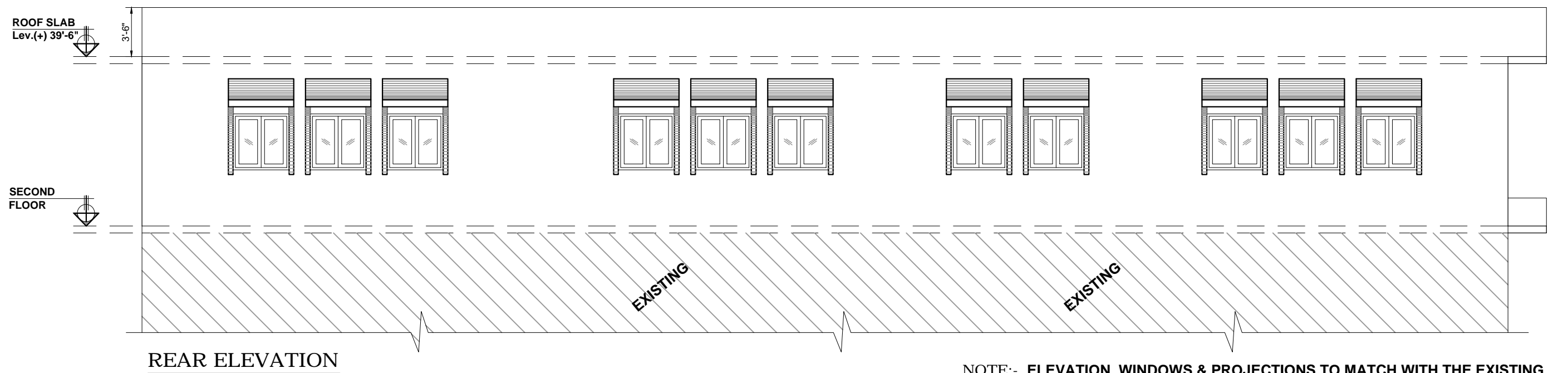
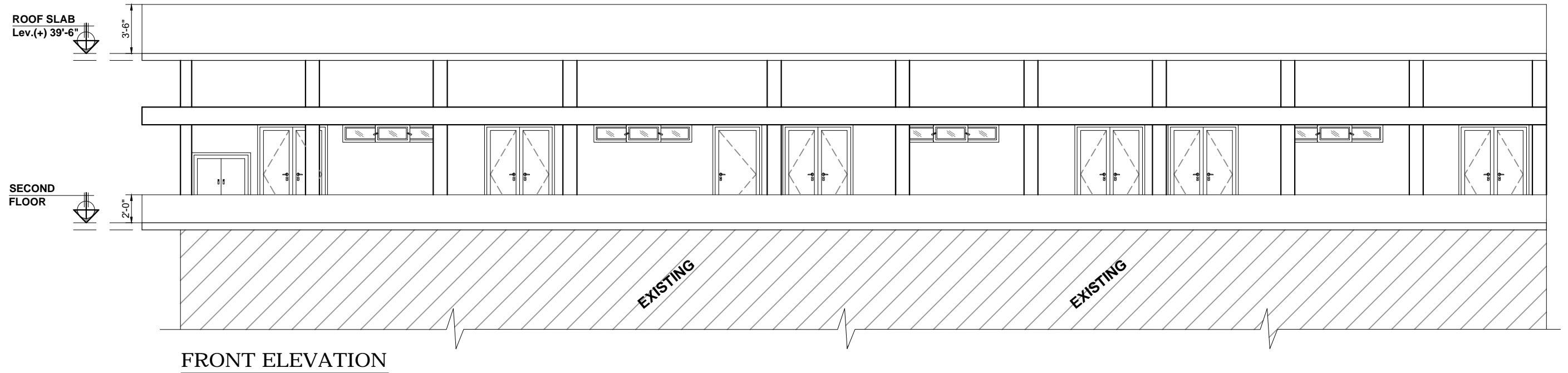
SECTION 1-1 & SECTION 2-2

DRAWN BY: SHARJEEL  
CHECKED BY: R.A  
APPROVED BY: S.M.A  
DATE: SEP, 2020

DRAWING NO.

A-02





NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

FRONT & REAR  
ELEVATION

DRAWN BY:

ATIF

CHECKED BY:

R.A

APPROVED BY:

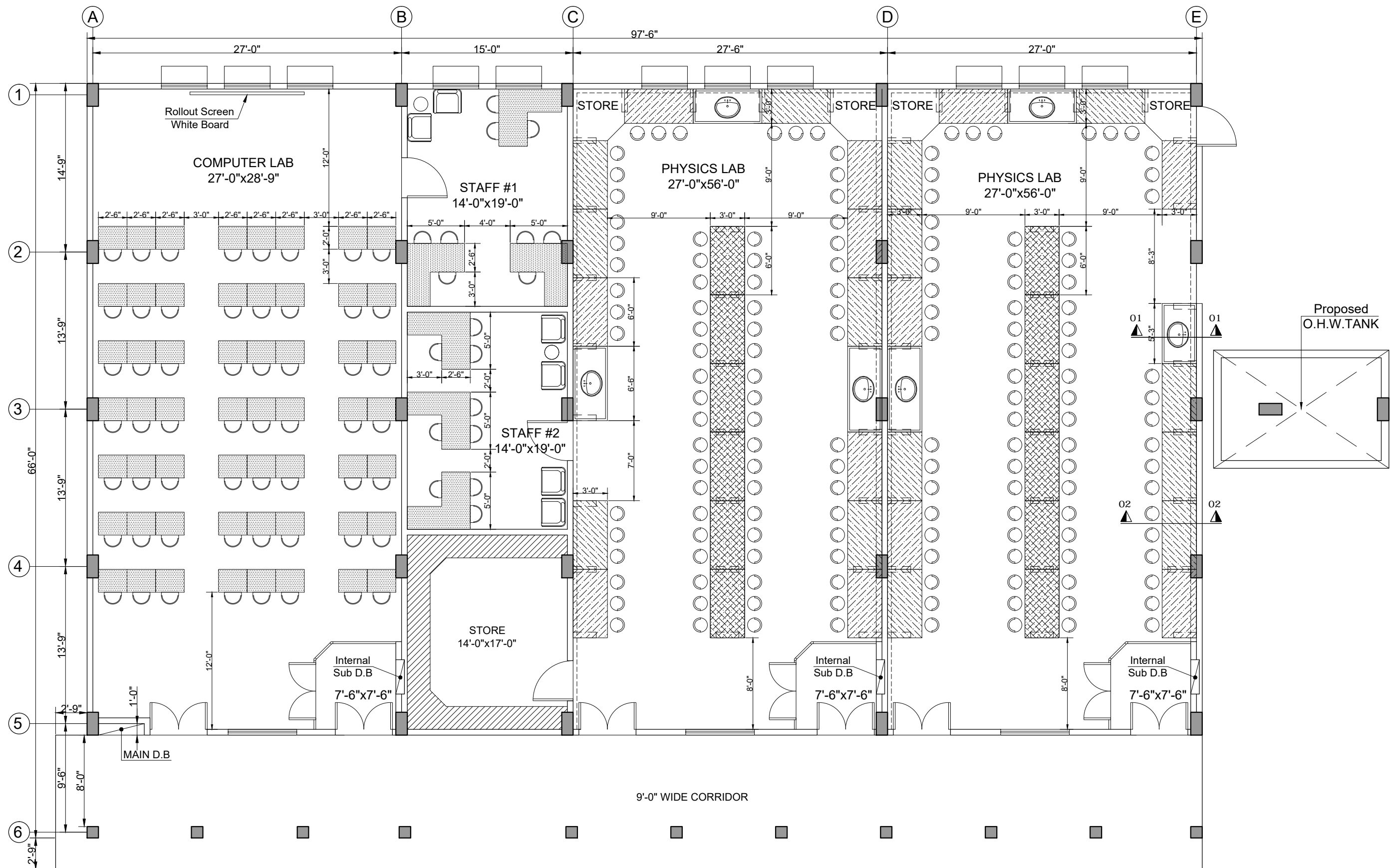
R.A.K

DATE:

SEP, 2020

DRAWING NO.

A-03



FURNITURE PLAN

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

FURNITURE PLAN

DRAWN BY:

ATIF

CHECKED BY:

R.A

APPROVED BY:

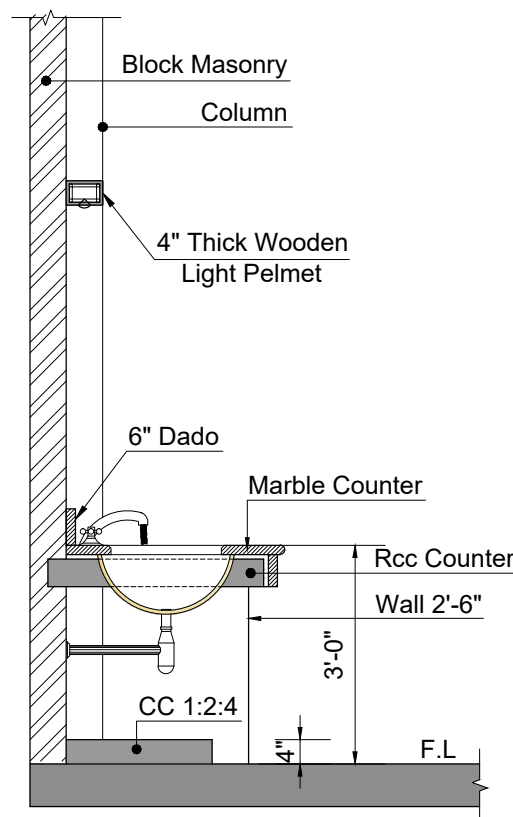
R.A.K

DATE:

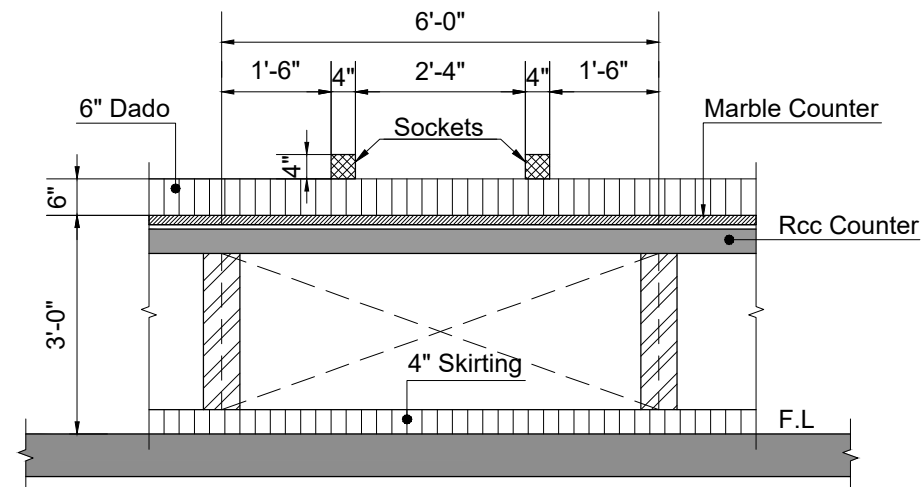
SEP, 2020

DRAWING NO.

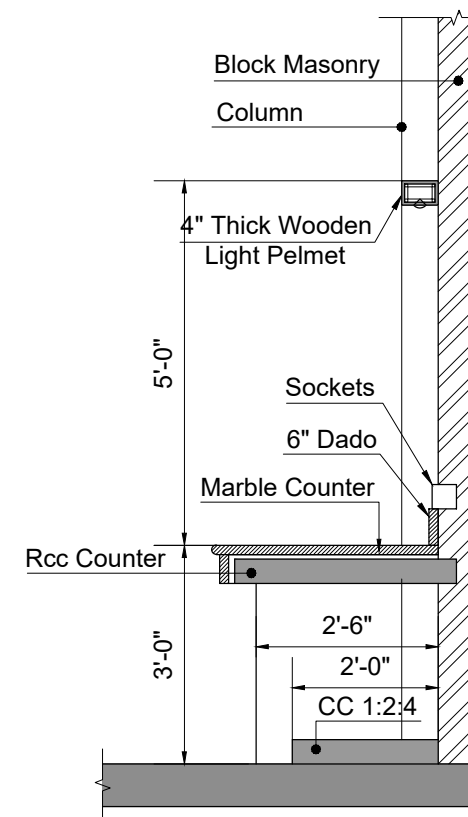
A-04



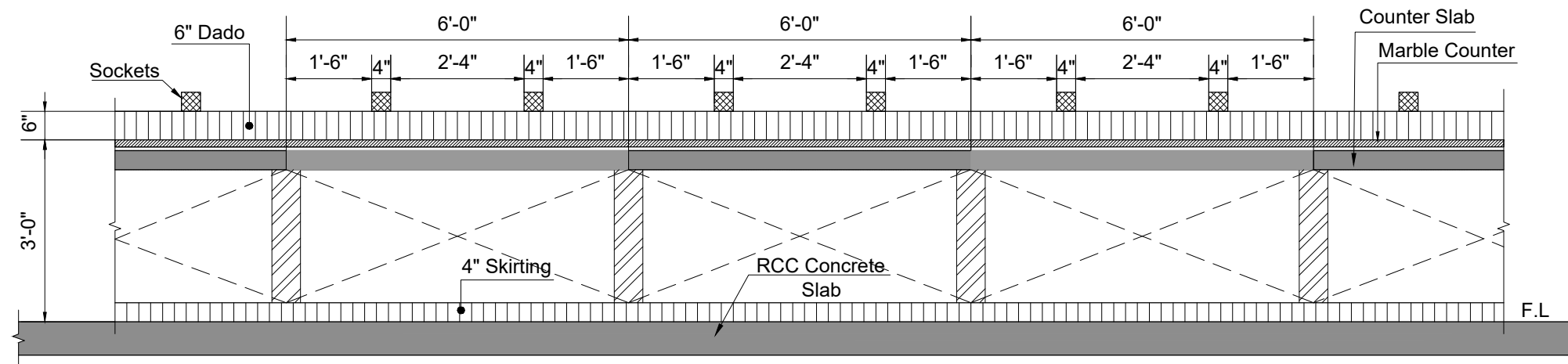
SECTION 01-01



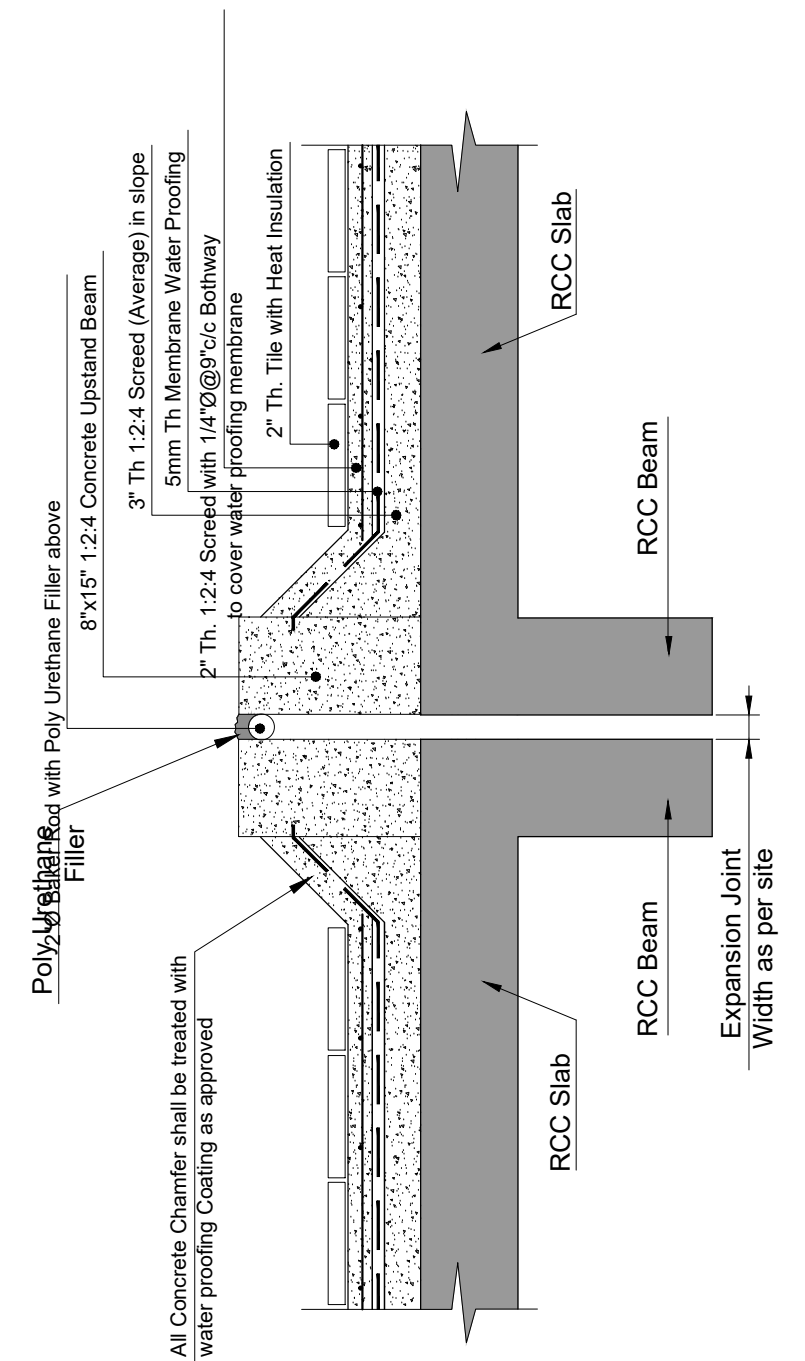
ELEVATION 01-01  
(TYPICAL RCC WORK COUNTER)



SECTION 02-02



TYPICAL ELEVATION OF COUNTER



TYPICAL EXPANSION JOINT DETAIL

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

FURNITURE SECTIONS

DRAWN BY:

ASIF

CHECKED BY:

R.A

APPROVED BY:

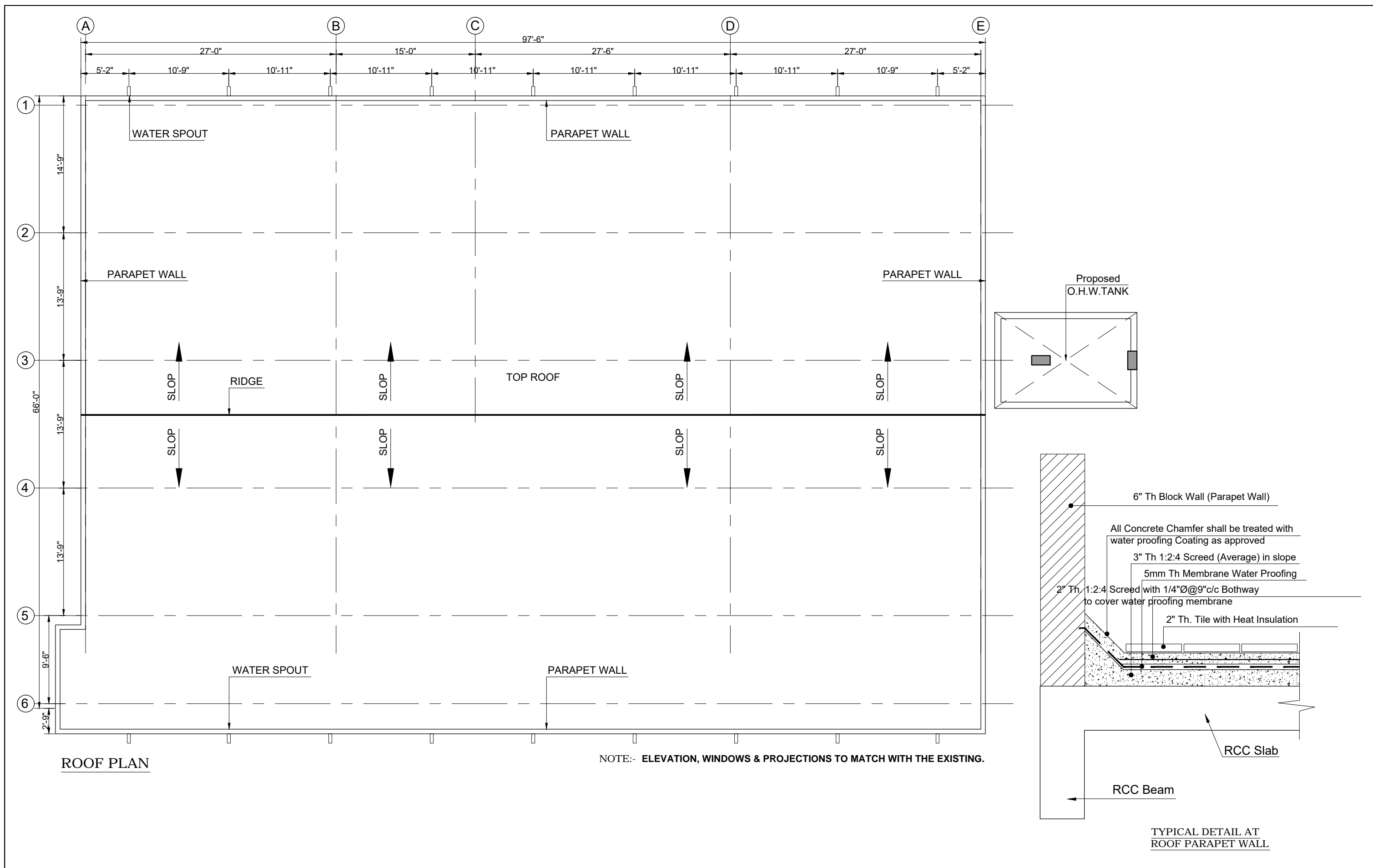
R.A.K

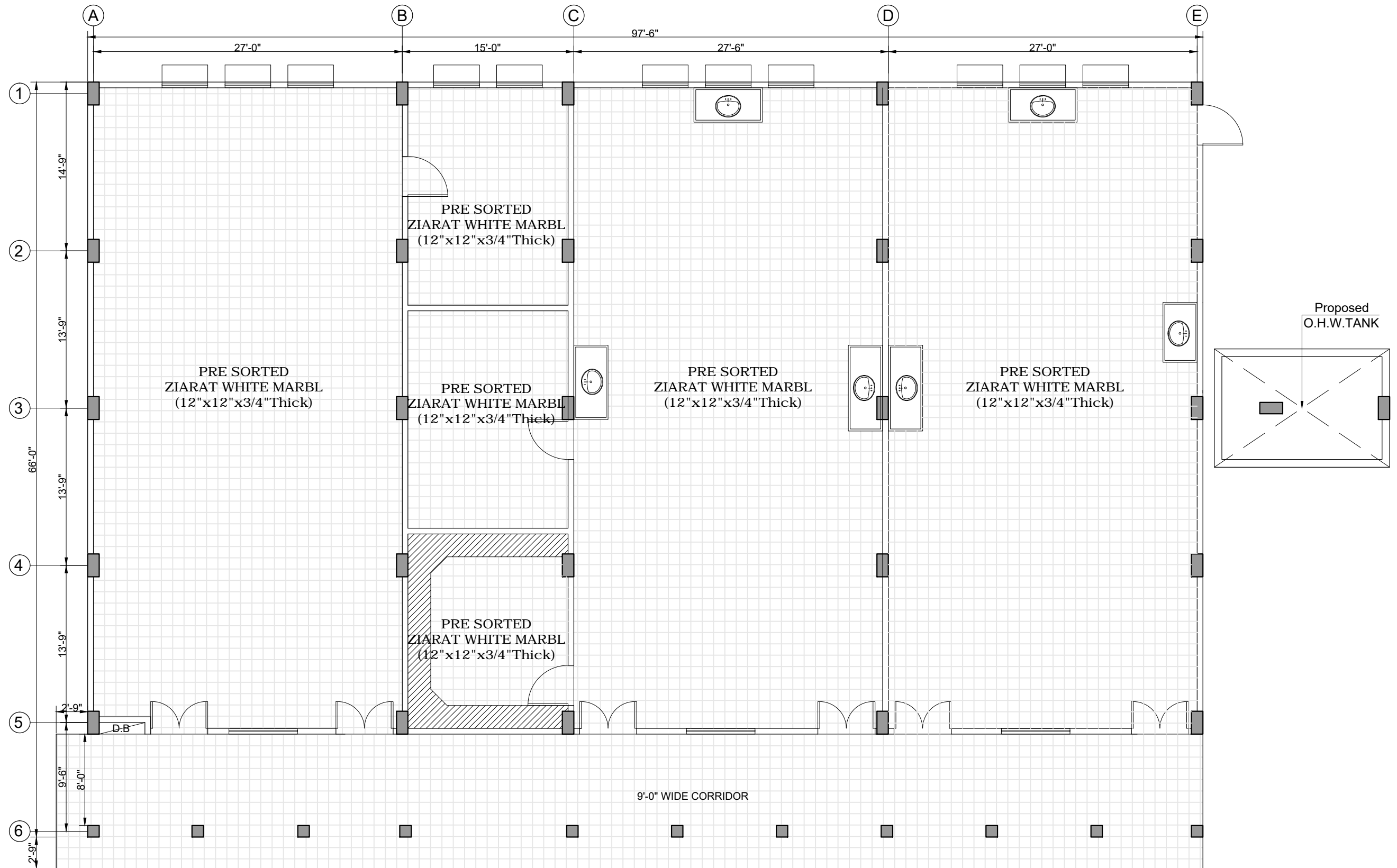
DATE:

SEP, 2020

DRAWING NO.

A-05





FLOORING PLAN

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

FLOORING PLAN

DRAWN BY:

ASIF

CHECKED BY:

R.A

APPROVED BY:

R.A.K

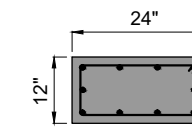
DATE:

SEP, 2020

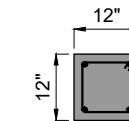
DRAWING NO.

A-07

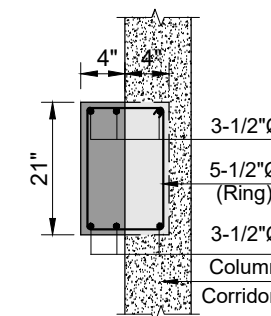
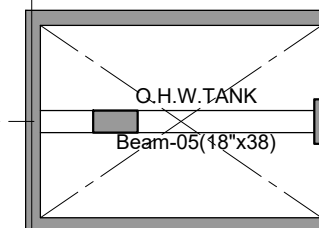
# STRUCTURAL DRAWINGS



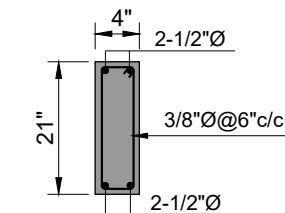
**COLUMN (12" x 24")**  
 Main Reinf: 10-3/4"Ø  
 Rings : 3/8"Ø@6"/8"c/c  
 Concrete : 4000 psi



**COLUMN (12" x 12")**  
 Main Reinf: 4-3/4"Ø  
 Rings : 3/8"Ø@6"c/c  
 Concrete : 4000 psi



**TYP. SEC. OF TIE BEAM FRONT COLUMN CONNECTION**



**TYP. SEC. OF TIE BEAM FRONT COLUMN**

**ROOF SLAB FRAMING PLAN**

**TENDER DRAWING**

CLIENT:



**NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY**  
 University Road - Karachi

CONSULTANTS



**Consult-Tech**  
 Consulting Engineers and Planners  
 11-C, Third Floor, Shahbaz Commercial Lane 2  
 Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY**

DRAWING TITLE:

**ROOF FRAMING  
PLAN**

DRAWN BY:

M.A.Y

CHECKED BY:

R.A.K

APPROVED BY:

R.A.K

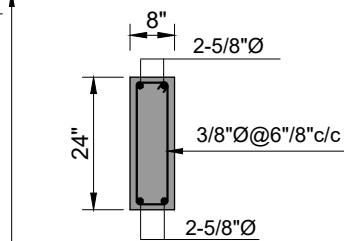
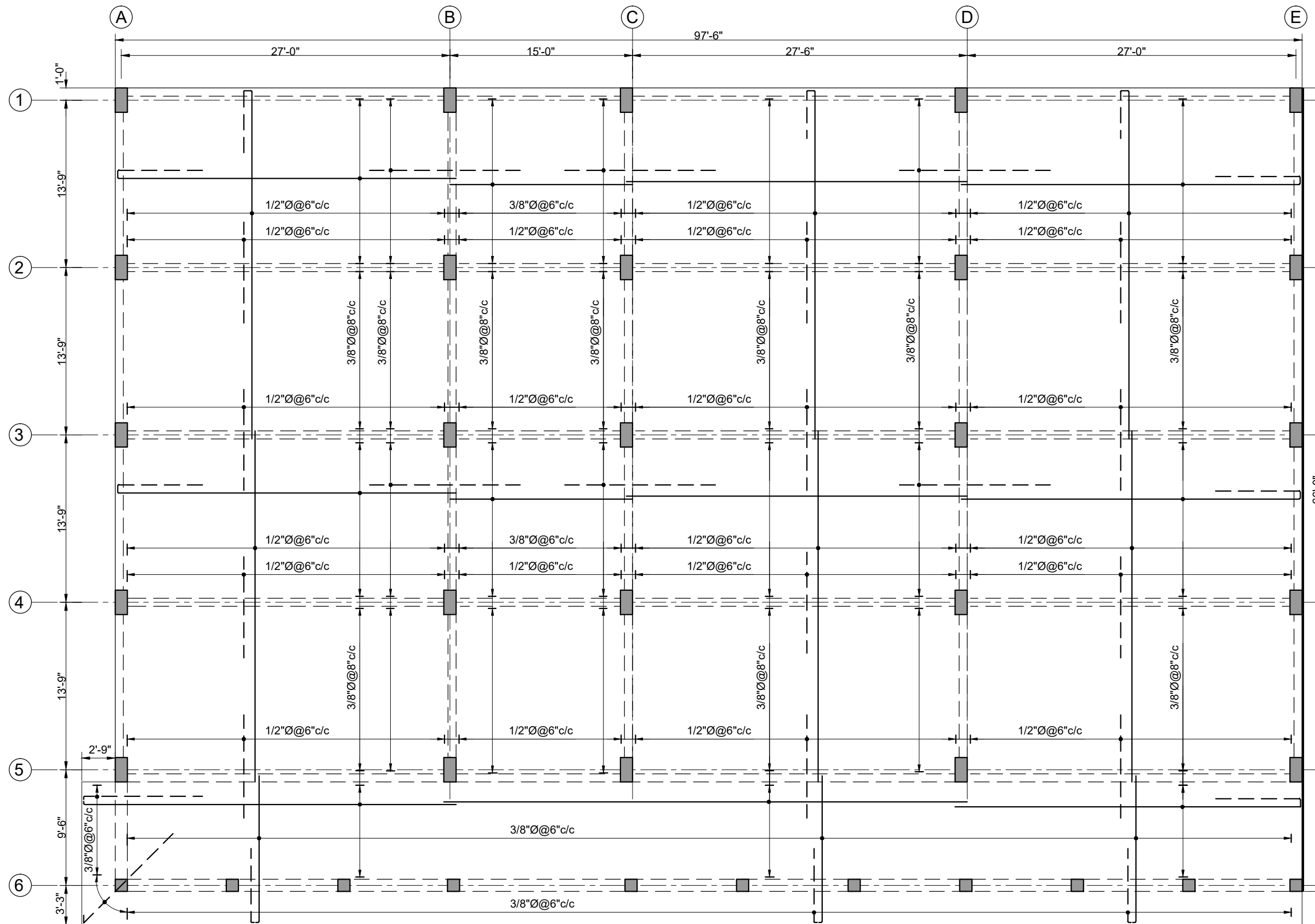
DATE:

SEP, 2020

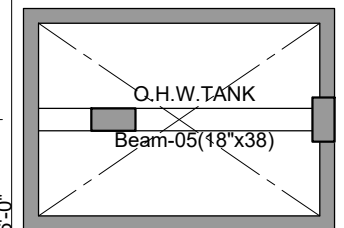
DRAWING NO.

**S-01**





TYP. SEC. OF BEAM  
WINDOW LEVEL



ROOF SLAB REINFORCEMENT PLAN

TENDER DRAWING

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY

DRAWING TITLE:

ROOF SLAB REINFORCEMENT  
PLAN

DRAWN BY:

M.A.Y

CHECKED BY:

R.A.K

APPROVED BY:

R.A.K

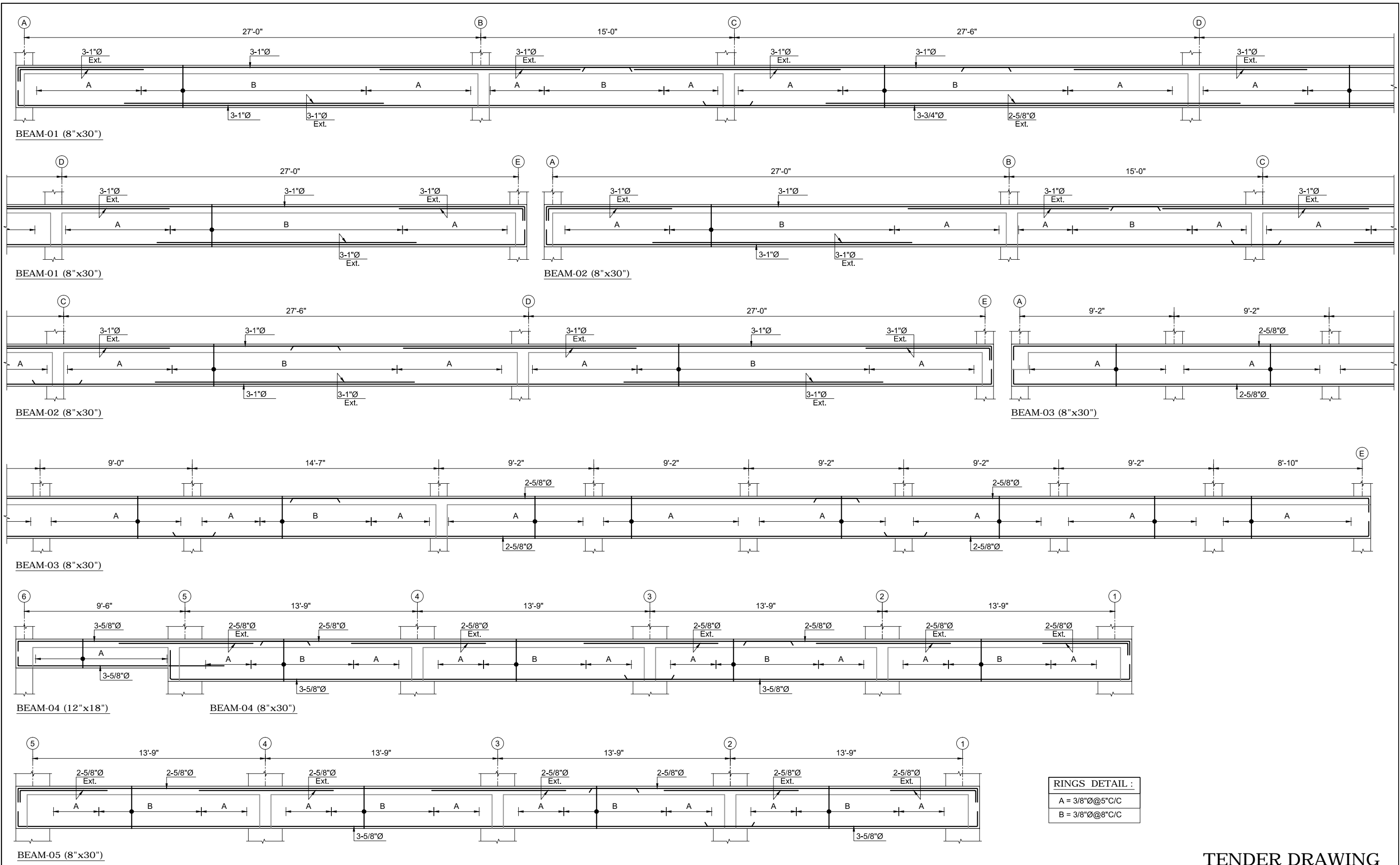
DATE:

SEP, 2020

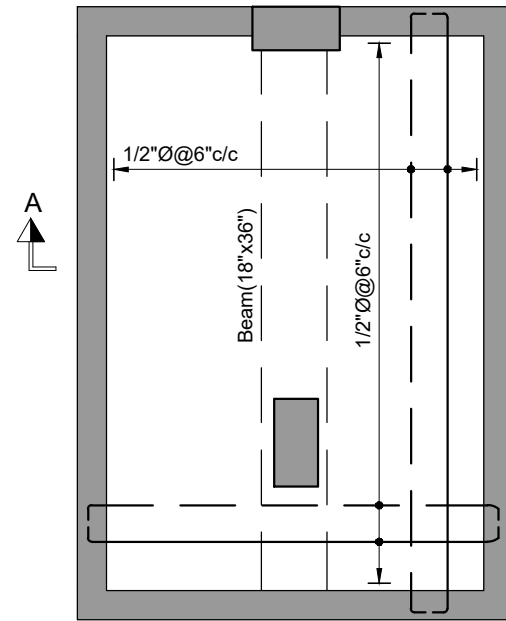
DRAWING NO.

S-02

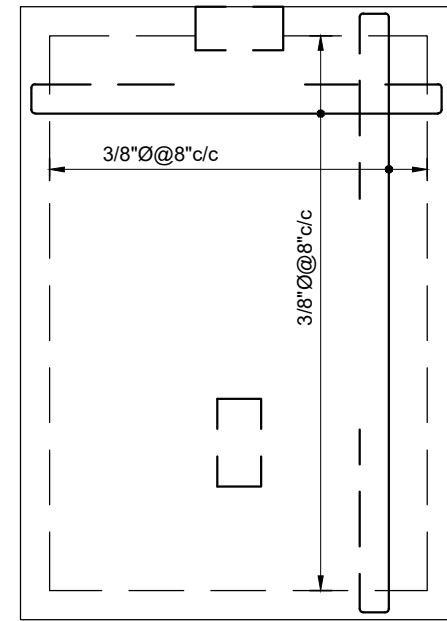




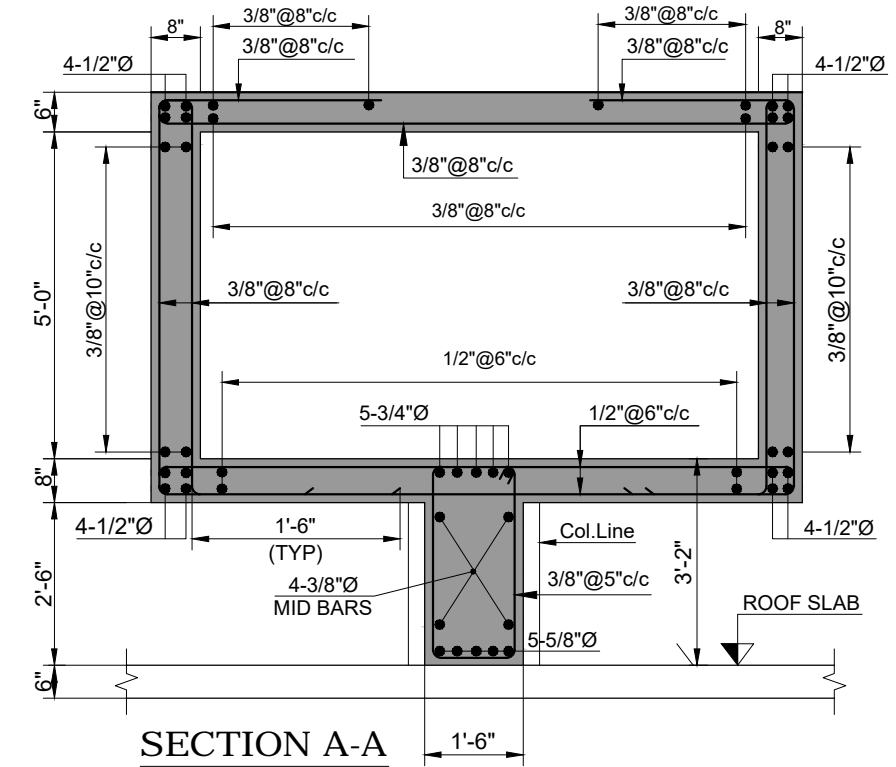
TENDER DRAWING



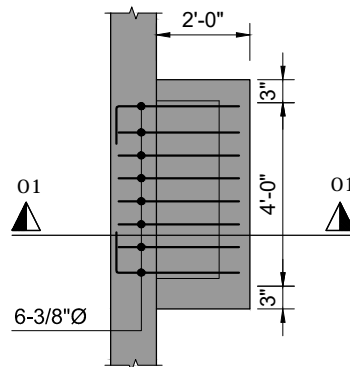
**BOTTOM SLAB OF O.H.W.TANK**  
(8"TH.SLAB)



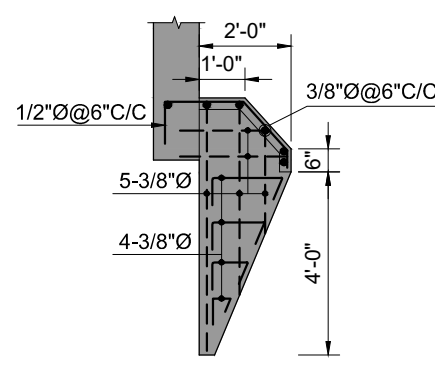
**TOP SLAB OF O.H.W.TANK**  
(6"TH.SLAB)



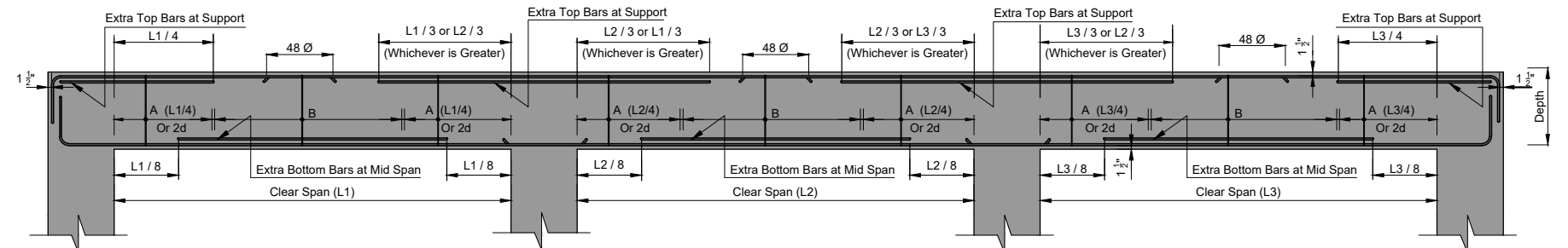
**SECTION A-A**



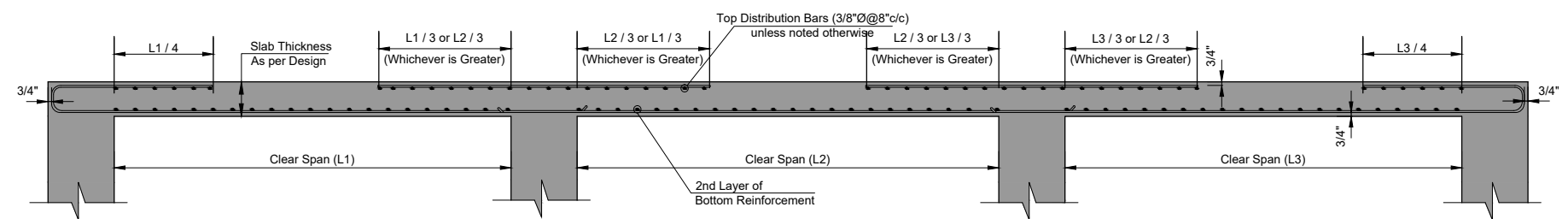
**TYP.WINDOW PROJECTION**



**SECTION AT01-01**



**TYPICAL BEAM REINFORCEMENT DETAILING**



**TYPICAL SLAB REINFORCEMENT DETAILING**

**NOTES:**

- All Levels marked on the drawings are Structural Levels. Finish Floor Levels shall be as per Arch. drawings.
- Structural Members shall have following , Cover and Formwork Removal.

| STRUCTURAL MEMBERS | CONC. CYL. STR AT 28 DAYS | CONCRETE COVER |        |        | FORMWORK REMOVAL |        |
|--------------------|---------------------------|----------------|--------|--------|------------------|--------|
|                    |                           | Bottom         | Top    | Sides  | Bottom           | Sides  |
| (a) Columns        | 4000 psi                  |                |        | 1-1/2" | 24 hrs           |        |
| (b) Tank Walls     | 3000 psi                  | 1-1/2"         | 1-1/2" | 1-1/2" | -                | 24 hrs |
| (c) R.C.C Slabs    | 3000 psi                  | 3/4"           | 3/4"   | 3/4"   | 14 days          | 48 hrs |
| (d) R.C.C Beams    | 3000 psi                  | 1-1/2"         | 1-1/2" | 1-1/2" | 14 days          | 36 hrs |

- All reinforcement shall be deformed bars with 60,000 psi yield strength conforming to ASTM 615-A Grade-60.
- All reinforcement shall be free from rust/corrosion. Reinforcement shall be tied at all intersections
- Ordinary Portland Cement shall be used for all underground concrete works.
- Do not scale drawing.

**TENDER DRAWING**

CLIENT:



**NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY**  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

**CONSTRUCTION OF 03 LABORATORIES FOR  
DEPARTMENT OF PHYSICS & CHEMISTRY**

DRAWING TITLE:

**PLAN & TYPICAL SECTION  
DETAILS**

DRAWN BY:

M.A.Y

CHECKED BY:

R.A.K

APPROVED BY:

R.A.K

DATE:

SEP, 2020

DRAWING NO.

**S-04**

# ELECTRICAL DRAWINGS

# LEGEND

| S. NO | SYMBOL | ITEM DESCRIPTION   |
|-------|--------|--|
| 01    |        | 5A SP ONE WAY GANG SWITCH OF CLIPSAL/MK WITH BACK BOXES OF 3"x3"   |
| 02    |        | 5A SWITCH/Socket OUTLET (AWAY FROM BOARD) OF CLIPSAL/MK WITH BACK BOXES OF 3"x3"                         |
| 03    |        | 20A SP SWITCH Socket OUTLET OF CLIPSAL/MK WITH BACK BOXES OF 3"x3"                                       |
| 04    |        | TECHNOLOGY BOX 2 X 13A FLAT PIN (UPS) + 1 X 5A ROUND PIN (NORMAL) + 1XRJ-45 DUALFOR DATA(AMP)&VOICE(TEL) |
| 05    |        | TECHNOLOGY BOX 2 X 5A ROUND PIN (NORMAL) + 1XRJ-11 FOR DATA  |
| 06    |        | 1X 12 WATT LED DOWN LIGHTER (RECESSED TYPE)  |
| 07    |        | 1 X 20 WATT LED TUBELIGHT (RECESSED TYPE)  |
| 08    |        | 1X 32 WATT LED TUBE LIGHT (RECESSED TYPE)  |
| 09    |        | 40 WATT CIRCUMATIC FAN   |
| 10    |        | 56"/48" SWEEP CEILING FAN  |
| 11    |        | RJ 11 TV OUTLET OF SCHNEIDER / CLIPSAL / MK WITH BACK BOXES OF 3"x3".                                    |
| 12    |        | WIFI ROUTER  |
| 13    |        | FIRE ALARM CONTROL PANEL (FACP) - 2 LOOP   |
| 14    |        | SMOKE DETECTOR - ADDRESSABLE   |
| 15    |        | MANUAL CALL POINT / BREAK GLASS + SOUNDER  |
| 16    |        | 2. & 2.5 TON WALL MOUNTED SPLIT AC INDOOR UNIT   |
| 17    |        | SPLIT AC OUTDOOR UNIT  |
| 18    |        | DOOR AIR CURTAIN   |
| 19    |        | COMRACK  |
| 20    |        | TELEPHONE JUNCTION BOX   |
| 21    |        | LIGHTING / POWER DISTRIBUTION BOARD (RECESSED TYPE)  |

# LIST OF DRAWING'S

| S NO | TITLE        | DESCRIPTION                              |
|------|--------------|--|
| 01   | UESI-NED-E00 | LEGEND, LIST OF DRAWINGS & GENERAL NOTES |
| 02   | UESI-NED-E01 | LIGHTING LAYOUT                          |
| 03   | UESI-NED-E02 | POWER LAYOUT                             |
| 04   | UESI-NED-E03 | A/C LAYOUT                               |
| 05   | UESI-NED-E04 | DATA & VOICE LAYOUT                      |
| 06   | UESI-NED-E05 | FIRE ALARM LAYOUT                        |
| 07   | UESI-NED-E06 | SINGLE LINE DIAGRAM                      |
| 08   | UESI-NED-E07 | SINGLE LINE DIAGRAM                      |
| 09   | UESI-NED-E08 | FIRE ALARM PANEL RISER DIAGRAM           |
| 10   | UESI-NED-E09 | DATA & VOICE RISER DIAGRAM               |
| 11   | UESI-NED-E10 | MISCELLANEOUS DETAILS                    |

## TENDER DRAWING

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANT:



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

MEP CONSULTANT:



**S R CONSULTANTS (IV)**  
CONSULTING ENGINEERS & ARCHITECTS  
11-A/11B, 11-B, 11-C, 11-D, 11-E, 11-F, 11-G, 11-H, 11-I, 11-J, 11-K, 11-L, 11-M, 11-N, 11-O, 11-P, 11-Q, 11-R, 11-S, 11-T, 11-U, 11-V, 11-W, 11-X, 11-Y, 11-Z, 11-AA, 11-AB, 11-AC, 11-AD, 11-AE, 11-AF, 11-AG, 11-AH, 11-AI, 11-AJ, 11-AL, 11-AM, 11-AN, 11-AO, 11-AP, 11-AQ, 11-AR, 11-AS, 11-AT, 11-AU, 11-AV, 11-AW, 11-AX, 11-AY, 11-AZ, 11-BA, 11-BB, 11-BC, 11-BD, 11-BE, 11-BF, 11-BG, 11-BH, 11-BI, 11-BJ, 11-BL, 11-BM, 11-BN, 11-BO, 11-BP, 11-BQ, 11-BR, 11-BS, 11-BT, 11-BU, 11-BV, 11-BW, 11-BX, 11-BY, 11-BZ, 11-CA, 11-CB, 11-CC, 11-CD, 11-CE, 11-CF, 11-CG, 11-CH, 11-CI, 11-CJ, 11-CL, 11-CM, 11-CN, 11-CO, 11-CP, 11-CQ, 11-CR, 11-CS, 11-CT, 11-CU, 11-CV, 11-CW, 11-CX, 11-CY, 11-CZ, 11-DA, 11-DB, 11-DC, 11-DD, 11-DE, 11-DF, 11-DG, 11-DH, 11-DI, 11-DJ, 11-DL, 11-DM, 11-DN, 11-DO, 11-DP, 11-DQ, 11-DR, 11-DS, 11-DT, 11-DU, 11-DV, 11-DW, 11-DX, 11-DY, 11-DZ, 11-EA, 11-EB, 11-EC, 11-ED, 11-EE, 11-EF, 11-EG, 11-EH, 11-EI, 11-EJ, 11-EL, 11-EM, 11-EN, 11-EO, 11-EP, 11-EQ, 11-ER, 11-ES, 11-ET, 11-EU, 11-EV, 11-EW, 11-EX, 11-EY, 11-EZ, 11-FA, 11-FB, 11-FC, 11-FD, 11-FE, 11-FG, 11-FH, 11-FI, 11-FJ, 11-FL, 11-FM, 11-FN, 11-FO, 11-FP, 11-FQ, 11-FR, 11-FS, 11-FT, 11-FU, 11-FV, 11-FW, 11-FX, 11-FY, 11-FZ, 11-GA, 11-GB, 11-GC, 11-GD, 11-GE, 11-GF, 11-GG, 11-GH, 11-GI, 11-GJ, 11-GL, 11-GM, 11-GN, 11-GO, 11-GP, 11-GQ, 11-GR, 11-GS, 11-GT, 11-GU, 11-GV, 11-GW, 11-GX, 11-GY, 11-GZ, 11-HA, 11-HB, 11-HC, 11-HD, 11-HE, 11-HF, 11-HG, 11-HH, 11-HI, 11-HJ, 11-HL, 11-HM, 11-HN, 11-HO, 11-HP, 11-HQ, 11-HR, 11-HS, 11-HT, 11-HU, 11-HV, 11-HW, 11-HX, 11-HY, 11-HZ, 11-IA, 11-IB, 11-IC, 11-ID, 11-IE, 11-IF, 11-IG, 11-IH, 11-II, 11-IJ, 11-IL, 11-IM, 11-IN, 11-IO, 11-IP, 11-IQ, 11-IR, 11-IS, 11-IT, 11-IU, 11-IV, 11-IW, 11-IX, 11-IY, 11-IZ, 11-JA, 11-JB, 11-JC, 11-JD, 11-JE, 11-JF, 11-JG, 11-JH, 11-JI, 11-JJ, 11-JL, 11-JM, 11-JN, 11-JO, 11-JP, 11-JQ, 11-JR, 11-JS, 11-JT, 11-JU, 11-JV, 11-JW, 11-JX, 11-JY, 11-JZ, 11-KA, 11-KB, 11-KC, 11-KD, 11-KE, 11-KF, 11-KG, 11-KH, 11-KI, 11-KJ, 11-KL, 11-KM, 11-KN, 11-KO, 11-KP, 11-KQ, 11-KR, 11-KS, 11-KT, 11-KU, 11-KV, 11-KW, 11-KX, 11-KY, 11-KZ, 11-LA, 11-LB, 11-LC, 11-LD, 11-LE, 11-LF, 11-LG, 11-LH, 11-LI, 11-LJ, 11-LK, 11-LM, 11-LN, 11-LO, 11-LP, 11-LQ, 11-LR, 11-LS, 11-LT, 11-LU, 11-LV, 11-LW, 11-LX, 11-LY, 11-LZ, 11-MA, 11-MB, 11-MC, 11-MD, 11-ME, 11-MF, 11-MG, 11-MH, 11-MI, 11-MJ, 11-MK, 11-ML, 11-MN, 11-MO, 11-MP, 11-MQ, 11-MR, 11-MS, 11-MT, 11-MU, 11-MV, 11-MW, 11-MX, 11-MY, 11-MZ, 11-NA, 11-NB, 11-NC, 11-ND, 11-NE, 11-NF, 11-NG, 11-NH, 11-NI, 11-NJ, 11-NK, 11-NL, 11-NM, 11-NO, 11-NP, 11-NQ, 11-NR, 11-NS, 11-NT, 11-NU, 11-NV, 11-NW, 11-NX, 11-NY, 11-NZ, 11-OA, 11-OB, 11-OC, 11-OD, 11-OE, 11-OF, 11-OG, 11-OH, 11-OI, 11-OJ, 11-OK, 11-OL, 11-OM, 11-ON, 11-OO, 11-OP, 11-OQ, 11-OR, 11-OS, 11-OT, 11-OU, 11-OV, 11-OW, 11-OX, 11-OY, 11-OZ, 11-PA, 11-PB, 11-PC, 11-PD, 11-PE, 11-PF, 11-PG, 11-PH, 11-PI, 11-PJ, 11-PK, 11-PL, 11-PM, 11-PN, 11-PO, 11-PP, 11-PQ, 11-PR, 11-PS, 11-PT, 11-PU, 11-PV, 11-PW, 11-PX, 11-PY, 11-PZ, 11-QA, 11-QB, 11-QC, 11-QD, 11-QE, 11-QF, 11-QG, 11-QH, 11-QI, 11-QJ, 11-QL, 11-QM, 11-QN, 11-QO, 11-QP, 11-QQ, 11-QR, 11-QS, 11-QT, 11-QU, 11-QV, 11-QW, 11-QX, 11-QY, 11-QZ, 11-RA, 11-RB, 11-RC, 11-RD, 11-RE, 11-RF, 11-RG, 11-RH, 11-RI, 11-RJ, 11-RK, 11-RL, 11-RM, 11-RN, 11-RO, 11-RP, 11-RQ, 11-RR, 11-RS, 11-RT, 11-RU, 11-RV, 11-RW, 11-RX, 11-RY, 11-RZ, 11-SA, 11-SB, 11-SC, 11-SD, 11-SE, 11-SF, 11-SG, 11-SH, 11-SI, 11-SJ, 11-SK, 11-SL, 11-SM, 11-SN, 11-SO, 11-SP, 11-SQ, 11-SR, 11-SS, 11-ST, 11-SU, 11-SV, 11-SW, 11-SX, 11-SY, 11-SZ, 11-TA, 11-TB, 11-TC, 11-TD, 11-TE, 11-TF, 11-TG, 11-TH, 11-TI, 11-TJ, 11-TK, 11-TL, 11-TM, 11-TN, 11-TO, 11-TP, 11-TQ, 11-TR, 11-TS, 11-TT, 11-TU, 11-TV, 11-TW, 11-TX, 11-TY, 11-TZ, 11-UA, 11-UB, 11-UC, 11-UD, 11-UE, 11-UF, 11-UG, 11-UH, 11-UI, 11-UJ, 11-UK, 11-UL, 11-UM, 11-UN, 11-UO, 11-UP, 11-UQ, 11-UR, 11-US, 11-UT, 11-UY, 11-UZ, 11-VA, 11-VB, 11-VC, 11-VD, 11-VE, 11-VF, 11-VG, 11-VH, 11-VI, 11-VJ, 11-VK, 11-VL, 11-VM, 11-VN, 11-VO, 11-VP, 11-VQ, 11-VR, 11-VS, 11-VT, 11-VU, 11-VV, 11-VW, 11-VX, 11-VY, 11-VZ, 11-WA, 11-WB, 11-WC, 11-WD, 11-WE, 11-WF, 11-WG, 11-WH, 11-WI, 11-WJ, 11-WK, 11-WL, 11-WM, 11-WN, 11-WO, 11-WP, 11-WQ, 11-WS, 11-WT, 11-WU, 11-WV, 11-WX, 11-WY, 11-WZ, 11-XA, 11-XB, 11-XC, 11-XD, 11-XE, 11-XF, 11-XG, 11-XH, 11-XI, 11-XJ, 11-XK, 11-XL, 11-XM, 11-XN, 11-XO, 11-XP, 11-XQ, 11-XR, 11-XS, 11-XT, 11-XU, 11-XV, 11-XW, 11-XX, 11-XY, 11-XZ, 11-YA, 11-YB, 11-YC, 11-YD, 11-YE, 11-YF, 11-YG, 11-YH, 11-YI, 11-YJ, 11-YK, 11-YL, 11-YM, 11-YN, 11-YO, 11-YP, 11-YQ, 11-YR, 11-YS, 11-YT, 11-YU, 11-YV, 11-YW, 11-YX, 11-YZ, 11-ZA, 11-ZB, 11-ZC, 11-ZD, 11-ZE, 11-ZF, 11-ZG, 11-ZH, 11-ZI, 11-ZJ, 11-ZK, 11-ZL, 11-ZM, 11-ZN, 11-ZO, 11-ZP, 11-ZQ, 11-ZR, 11-ZS, 11-ZT, 11-ZU, 11-ZV, 11-ZW, 11-ZX, 11-ZY, 11-ZZ, 11-AA, 11-AB, 11-AC, 11-AD, 11-AE, 11-AF, 11-AG, 11-AH, 11-AI, 11-AJ, 11-AL, 11-AM, 11-AN, 11-AO, 11-AP, 11-AQ, 11-AR, 11-AS, 11-AT, 11-AU, 11-AV, 11-AW, 11-AX, 11-AY, 11-AZ, 11-BA, 11-BB, 11-BC, 11-BD, 11-BE, 11-BF, 11-BG, 11-BH, 11-BI, 11-BJ, 11-BL, 11-BM, 11-BN, 11-BO, 11-BP, 11-BQ, 11-BR, 11-BS, 11-BT, 11-BU, 11-BV, 11-BW, 11-BX, 11-BY, 11-BZ, 11-CA, 11-CB, 11-CC, 11-CD, 11-CE, 11-CF, 11-CG, 11-CH, 11-CI, 11-CJ, 11-CL, 11-CM, 11-CN, 11-CO, 11-CP, 11-CQ, 11-CR, 11-CS, 11-CT, 11-CU, 11-CV, 11-CW, 11-CX, 11-CY, 11-CZ, 11-DA, 11-DB, 11-DC, 11-DD, 11-DE, 11-DF, 11-DG, 11-DH, 11-DI, 11-DJ, 11-DL, 11-DM, 11-DN, 11-DO, 11-DP, 11-DQ, 11-DR, 11-DS, 11-DT, 11-DU, 11-DV, 11-DW, 11-DX, 11-DY, 11-DZ, 11-EA, 11-EB, 11-EC, 11-ED, 11-EE, 11-EF, 11-EG, 11-EH, 11-EI, 11-EJ, 11-EL, 11-EM, 11-EN, 11-EO, 11-EP, 11-EQ, 11-ER, 11-ES, 11-ET, 11-EU, 11-EV, 11-EW, 11-EX, 11-EY, 11-EZ, 11-FA, 11-FB, 11-FC, 11-FD, 11-FE, 11-FG, 11-FH, 11-FI, 11-FJ, 11-FL, 11-FM, 11-FN, 11-FO, 11-FP, 11-FQ, 11-FR, 11-FS, 11-FT, 11-FU, 11-FV, 11-FW, 11-FX, 11-FY, 11-FZ, 11-GA, 11-GB, 11-GC, 11-GD, 11-GE, 11-GF, 11-GG, 11-GH, 11-GI, 11-GJ, 11-GL, 11-GM, 11-GN, 11-GO, 11-GP, 11-GQ, 11-GR, 11-GS, 11-GT, 11-GU, 11-GV, 11-GW, 11-GX, 11-GY, 11-GZ, 11-HA, 11-HB, 11-HC, 11-HD, 11-HE, 11-HF, 11-HG, 11-HH, 11-HI, 11-HJ, 11-HK, 11-HL, 11-HM, 11-HN, 11-HO, 11-HP, 11-HQ, 11-HR, 11-HS, 11-HT, 11-HU, 11-HV, 11-HW, 11-HX, 11-HY, 11-HZ, 11-IA, 11-IB, 11-IC, 11-ID, 11-IE, 11-IF, 11-IG, 11-IH, 11-II, 11-IJ, 11-IL, 11-IM, 11-IN, 11-IO, 11-IP, 11-IQ, 11-IR, 11-IS, 11-IT, 11-IU, 11-IV, 11-IW, 11-IX, 11-IY, 11-IZ, 11-JA, 11-JB, 11-JC, 11-JD, 11-JE, 11-JF, 11-JG, 11-JH, 11-JI, 11-JJ, 11-JK, 11-JL, 11-JM, 11-JN, 11-JO, 11-JP, 11-JQ, 11-JR, 11-JS, 11-JT, 11-JU, 11-JV, 11-JW, 11-JX, 11-JY, 11-JZ, 11-KA, 11-KB, 11-KC, 11-KD, 11-KE, 11-KF, 11-KG, 11-KH, 11-KI, 11-KJ, 11-KL, 11-KM, 11-KN, 11-KO, 11-KP, 11-KQ, 11-KR, 11-KS, 11-KT, 11-KU, 11-KV, 11-KW, 11-KX, 11-KY, 11-KZ, 11-LA, 11-LB, 11-LC, 11-LD, 11-LE, 11-LF, 11-LG, 11-LH, 11-LI, 11-LJ, 11-LK, 11-LM, 11-LN, 11-LO, 11-LP, 11-LQ, 11-LR, 11-LS, 11-LT, 11-LU, 11-LV, 11-LW, 11-LX, 11-LY, 11-LZ, 11-MA, 11-MB, 11-MC, 11-MD, 11-ME, 11-MF, 11-MG, 11-MH, 11-MI, 11-MJ, 11-MK, 11-ML, 11-MN, 11-MO, 11-MP, 11-MQ, 11-MR, 11-MS, 11-MT, 11-MU, 11-MV, 11-MW, 11-MX, 11-MY, 11-MZ, 11-NA, 11-NB, 11-NC, 11-ND, 11-NE, 11-NF, 11-NG, 11-NH, 11-NI, 11-NJ, 11-NK, 11-NL, 11-NM, 11-NO, 11-NP, 11-NQ, 11-NR, 11-NS, 11-NT, 11-NU, 11-NV, 11-NW, 11-NX, 11-NY, 11-NZ, 11-OA, 11-OB, 11-OC, 11-OD, 11-OE, 11-OF, 11-OG, 11-OH, 11-OI, 11-OJ, 11-OK, 11-OL, 11-OM, 11-ON, 11-OO, 11-OP, 11-OQ, 11-OR, 11-OS, 11-OT, 11-OU, 11-OV, 11-OW, 11-OX, 11-OY, 11-OZ, 11-PA, 11-PB, 11-PC, 11-PD, 11-PE, 11-PF, 11-PG, 11-PH, 11-PI, 11-PJ, 11-PK, 11-PL, 11-PM, 11-PN, 11-PO, 11-PP, 11-PQ, 11-PR, 11-PS, 11-PT, 11-PU, 11-PV, 11-PW, 11-PX, 11-PY, 11-PZ, 11-QA, 11-QB, 11-QC, 11-QD, 11-QE, 11-QF, 11-QG, 11-QH, 11-QI, 11-QJ, 11-QL, 11-QM, 11-QN, 11-QO, 11-QP, 11-QQ, 11-QR, 11-QS, 11-QT, 11-QU, 11-QV, 11-QW, 11-QX, 11-QY, 11-QZ, 11-RA, 11-RB, 11-RC, 11-RD, 11-RE, 11-RF, 11-RG, 11-RH, 11-RI, 11-RJ, 11-RK, 11-RL, 11-RM, 11-RN, 11-RO, 11-RP, 11-RQ, 11-RR, 11-RS, 11-RT, 11-RU, 11-RV, 11-RW, 11-RX, 11-RY, 11-RZ, 11-SA, 11-SB, 11-SC, 11-SD, 11-SE, 11-SF, 11-SG, 11-SH, 11-SI, 11-SJ, 11-SK, 11-SL, 11-SM, 11-SN, 11-SO, 11-SP, 11-SQ, 11-SR, 11-SS, 11-ST, 11-SU, 11-SV, 11-SW, 11-SX, 11-SY, 11-SZ, 11-TA, 11-TB, 11-TC, 11-TD, 11-TE, 11-TF, 11-TG, 11-TH, 11-TI, 11-TJ, 11-TK, 11-TL, 11-TM, 11-TN, 11-TO, 11-TP, 11-TQ, 11-TR, 11-TS, 11-TT, 11-TU, 11-TV, 11-TW, 11-TX, 11-TY, 11-TZ, 11-UA, 11-UB, 11-UC, 11-UD, 11-UE, 11-UF, 11-UG, 11-UH, 11-UI, 11-UJ, 11-UK, 11-UL, 11-UM, 11-UN, 11-UO, 11-UP, 11-UQ, 11-UR, 11-US, 11-UT, 11-UY, 11-UZ, 11-VA, 11-VB, 11-VC, 11-VD, 11-VE, 11-VF, 11-VG, 11-VH, 11-VI, 11-VJ, 11-VK, 11-VL, 11-VM, 11-VN, 11-VO, 11-VP, 11-VQ, 11-VR, 11-VS, 11-VT, 11-VU, 11-VV, 11-VW, 11-VX, 11-VY, 11-VZ, 11-WA, 11-WB, 11-WC, 11-WD, 11-WE, 11-WF, 11-WG, 11-WH, 11-WI, 11-WJ, 11-WK, 11-WL, 11-WM, 11-WN, 11-WO, 11-WP, 11-WQ, 11-WS, 11-WT, 11-WU, 11-WV, 11-WX, 11-WY, 11-WZ, 11-XA, 11-XB, 11-XC, 11-XD, 11-XE, 11-XF, 11-XG, 11-XH, 11-XI, 11-XJ, 11-XK, 11-XL, 11-XM, 11-XN, 11-XO, 11-XP, 11-XQ, 11-XR, 11-XS, 11-XT, 11-XU, 11-XV, 11-XW, 11-XX, 11-XY, 11-XZ, 11-YA, 11-YB, 11-YC, 11-YD, 11-YE, 11-YF, 11-YG, 11-YH, 11-YI, 11-YJ, 11-YK, 11-YL, 11-YM, 11-YN, 11-YO, 11-YP, 11-YQ, 11-YR, 11-YS, 11-YT, 11-YU, 11-YV, 11-YW, 11-YX, 11-YZ, 11-ZA, 11-ZB, 11-ZC, 11-ZD, 11-ZE, 11-ZF, 11-ZG, 11-ZH, 11-ZI, 11-ZJ, 11-ZK, 11-ZL, 11-ZM, 11-ZN, 11-ZO, 11-ZP, 11-ZQ, 11-ZR, 11-ZS, 11-ZT, 11-ZU, 11-ZV, 11-ZW, 11-ZX, 11-ZY, 11-ZZ

PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

LEGEND, LIST OF DRAWING  
& GENERAL NOTES

DESIGN BY:

UH

APPROVED BY:

Z.RAZI

DRAWN BY:

NA

SCALE:

NTS

CHECKED BY:

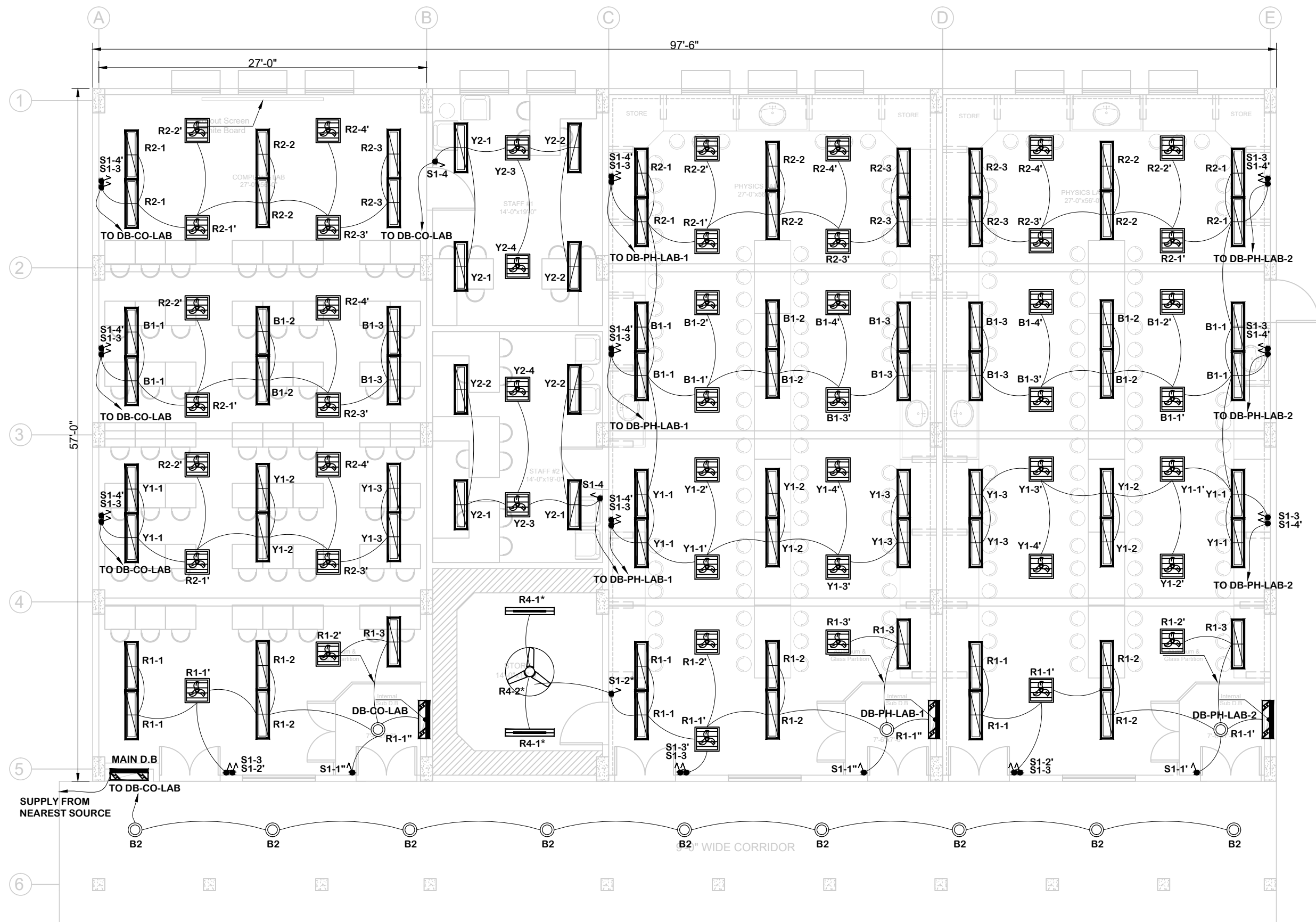
FA

DATE:

29-09-2020

DRAWING NO.

UESI-NED-E00



**LIGHTING LAYOUT**

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

TENDER DRAWING

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANT:



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

MEP CONSULTANT:



**S.R. CONSULTANTS (PVT) LTD.**  
MEP CONSULTANTS  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

LIGHTING LAYOUT

DESIGN BY:

UH

DRAWN BY:

NA

CHECKED BY:

FA

APPROVED BY:

Z. RAZI

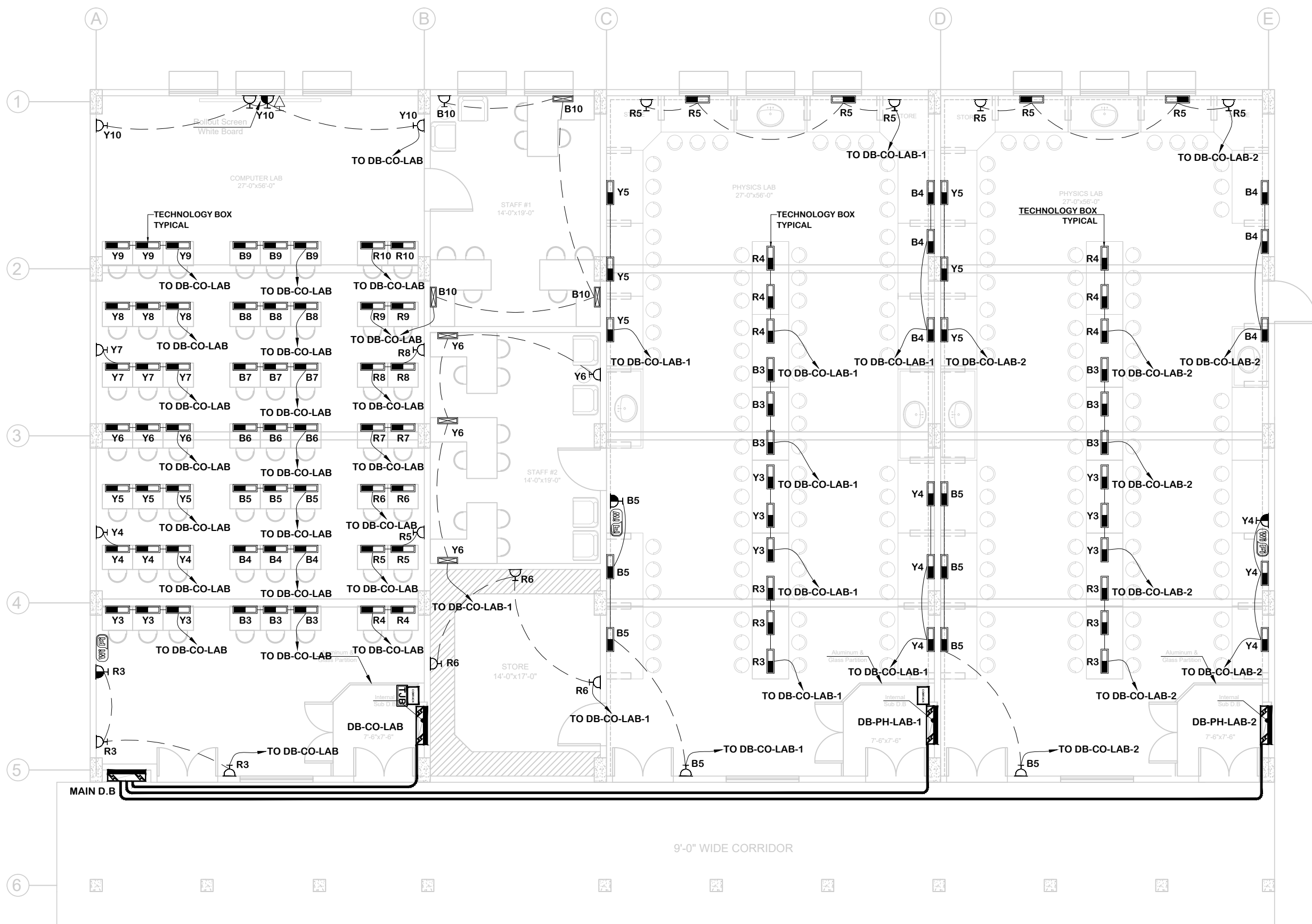
SCALE:

NTS

DATE:  
29-09-2020

DRAWING NO.:

UESI-NED-E01



**POWER LAYOUT**

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

TENDER DRAWING

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANT:



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

MEP CONSULTANT:



PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

POWER LAYOUT

DESIGN BY:

UH

APPROVED BY:

Z. RAZI

DRAWN BY:

NA

SCALE:

NTS

CHECKED BY:

FA

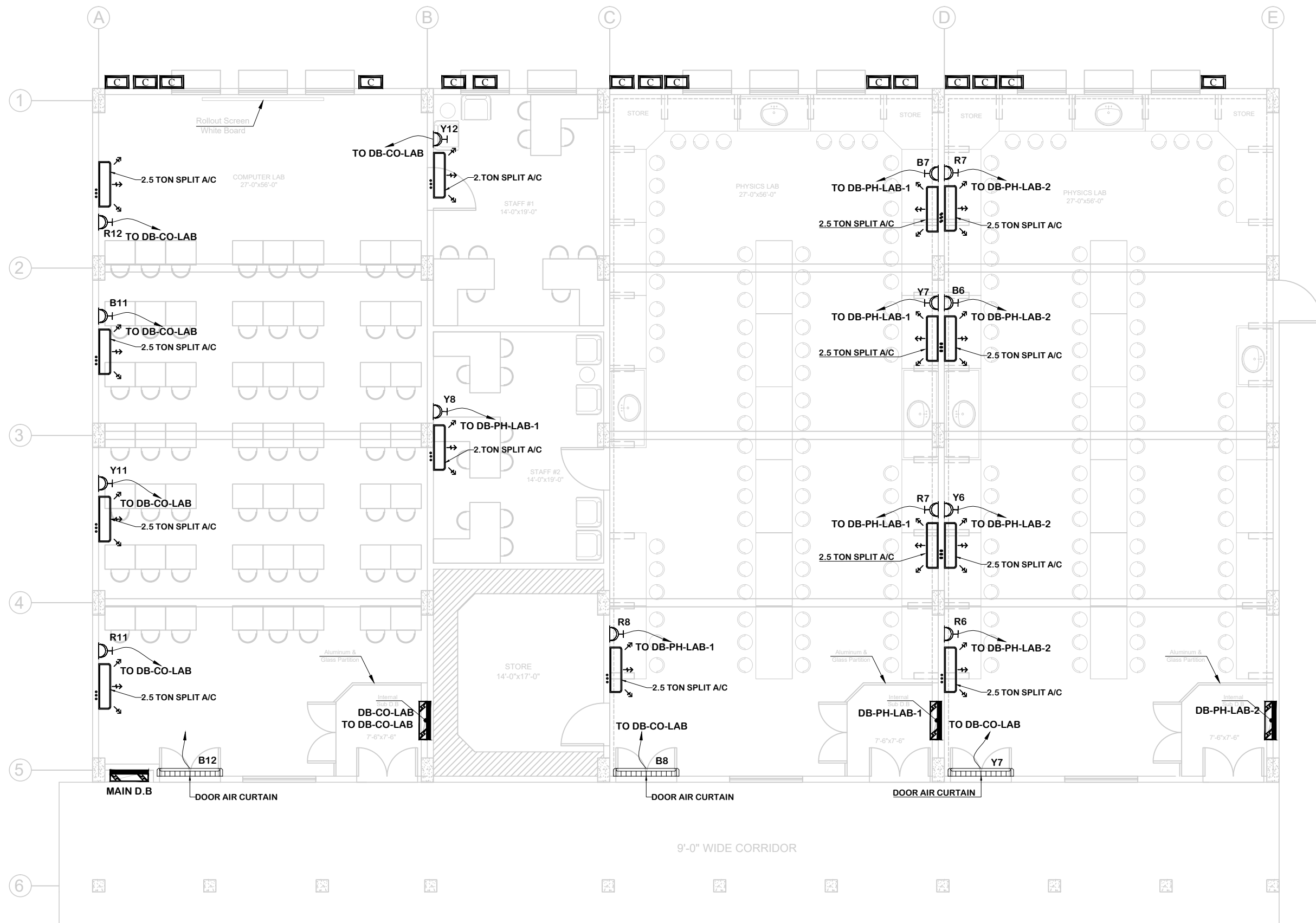
DATE:

29-09-2020

DRAWING NO.

UESI-NED-E02



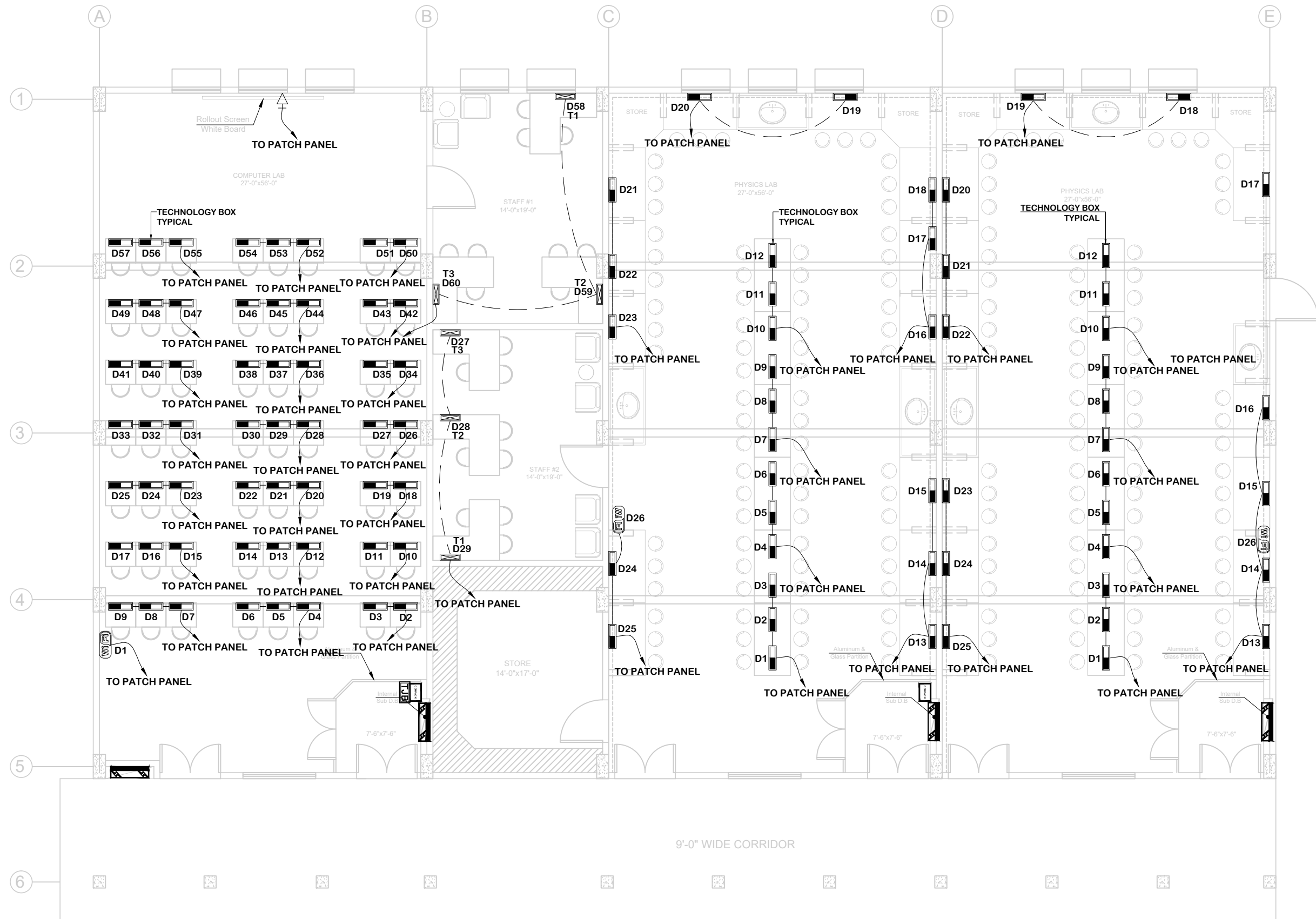


**A/C LAYOUT**

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

**TENDER DRAWING**

|  |  |   |  |   |   |  |
|--|--|---|--|---|---|--|
| <div>CLIENT:</div> <div><div>NED UNIVERSITY OF<br/>ENGINEERING AND TECHNOLOGY<br/>University Road - Karachi</div></div> | <div>CONSULTANT:</div> <div><div><b>Consult-Tech</b><br/>Consulting Engineers and Planners<br/>11-C, Third Floor, Shahbaz Commercial Lane 2<br/>Phase-VI, DHA - Karachi Ph: 35847692-93</div></div> | <div>MEP CONSULTANT:</div> <div><div><b>S.R. CONSULTANTS (IV)</b><br/>CONSULTING ENGINEERS &amp; ARCHITECTS<br/>11-C, Third Floor, Shahbaz Commercial Lane 2<br/>Phase-VI, DHA - Karachi Ph: 35847692-93</div></div> | <div>PROJECT:</div> <div>CONSTRUCTION OF LABORATORIES OF<br/>PHYSICS &amp; CHEMISTRY</div> | <div>DRAWING TITLE:</div> <div>A/C LAYOUT</div> | <div>DESIGN BY:</div> <div>UH</div> <div>APPROVED BY:</div> <div>Z.RAZI</div> <div>DRAWN BY:</div> <div>NA</div> <div>SCALE:</div> <div>NTS</div> <div>CHECKED BY:</div> <div>FA</div> <div>DATE:</div> <div>29-09-2020</div> | <div>DRAWING NO.</div> <div>UESI-NED-E03</div> |
|--|--|---|--|---|---|--|



**DATA & VOICE LAYOUT**

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING.

**TENDER DRAWING**

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANT:



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

MEP CONSULTANT:



**S.R. CONSULTANTS (IV)**  
CONSULTING ENGINEERS & ARCHITECTS  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

DATA & VOICE LAYOUT

DESIGN BY:

UH

DRAWN BY:

NA

CHECKED BY:

FA

APPROVED BY:

Z. RAZI

SCALE:

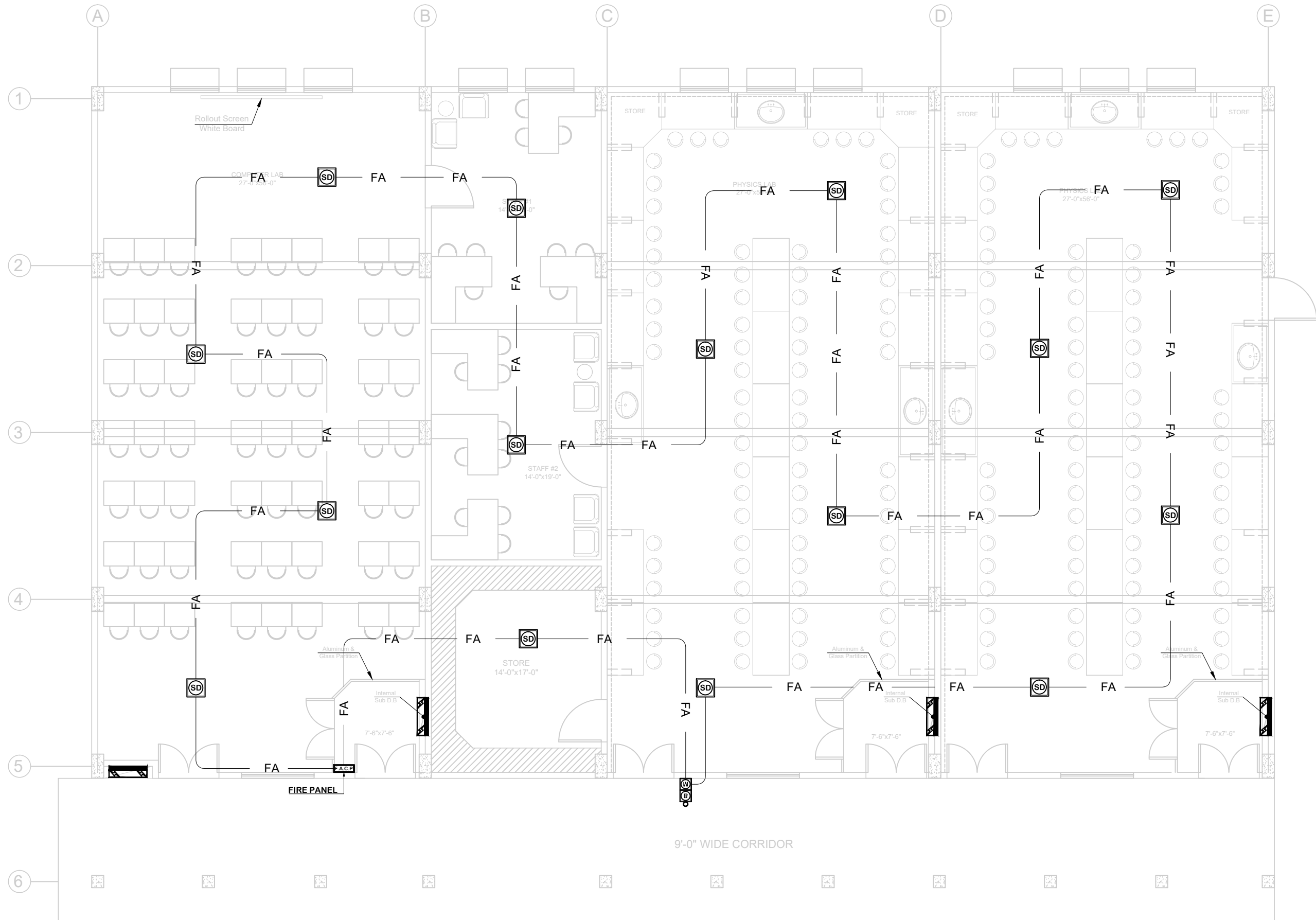
DATE:

29-09-2020

DRAWING NO.

UESI-NED-E04

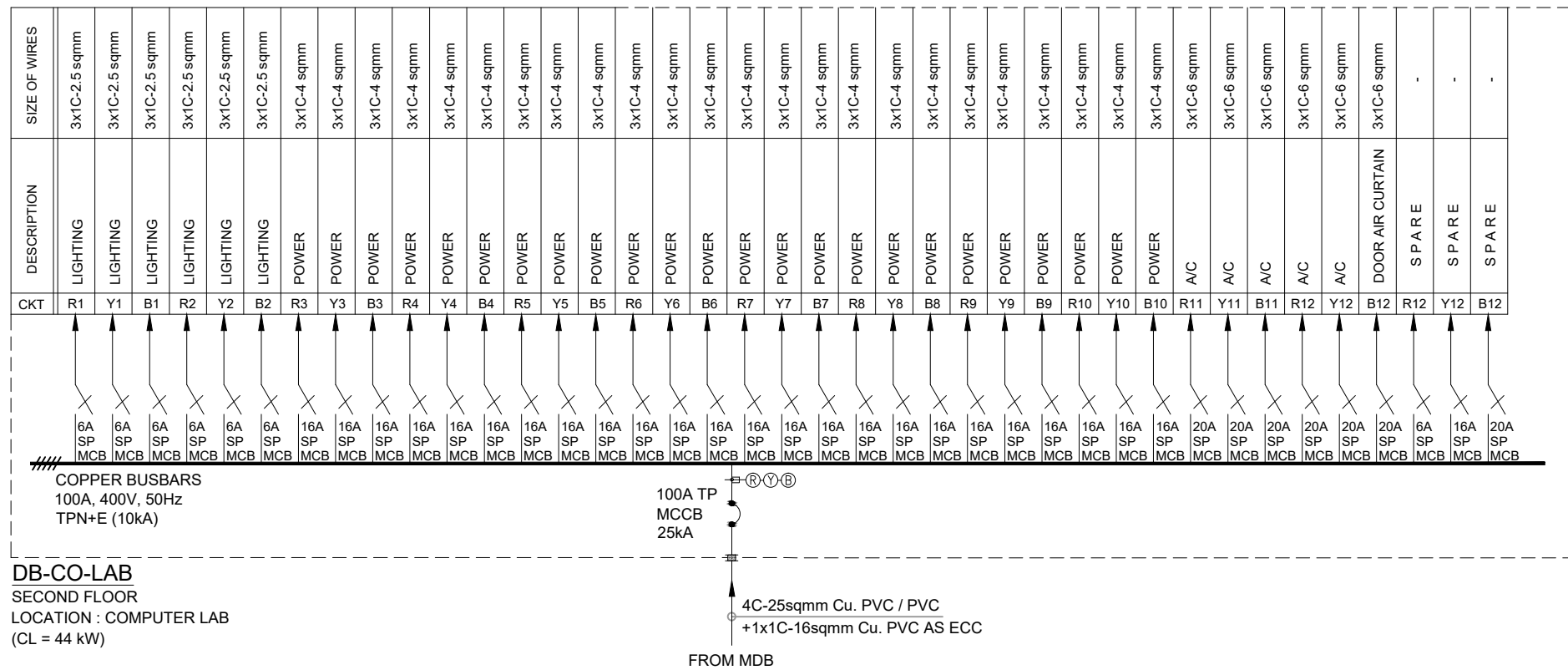
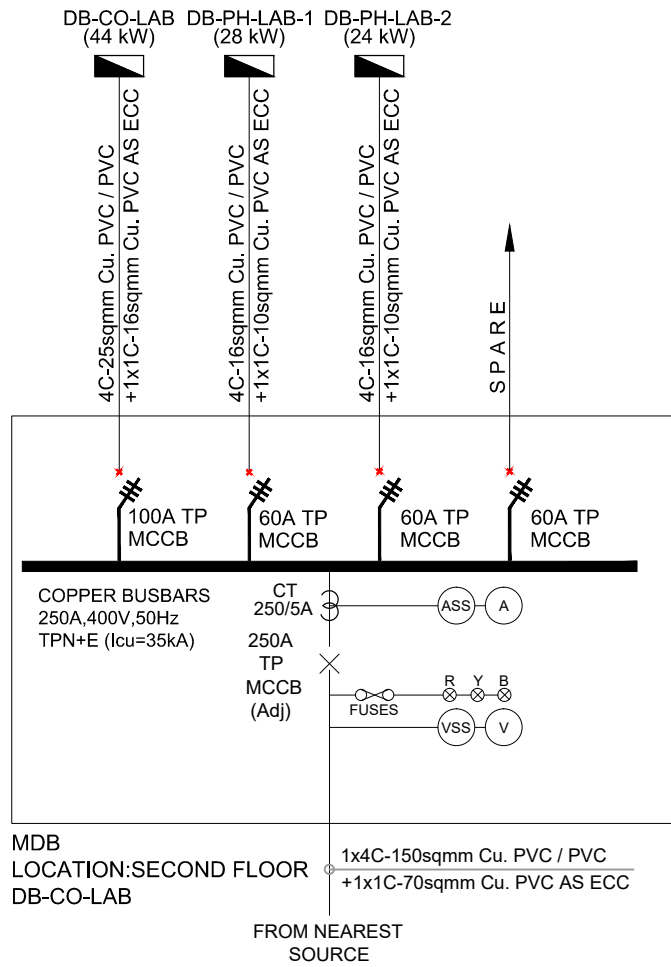




**FIRE ALARM LAYOUT**

NOTE:- ELEVATION, WINDOWS & PROJECTIONS TO MATCH WITH THE EXISTING. **TENDER DRAWING**

|   |   |  |  |  |  |            |    |              |        |           |    |        |     |             |    |       |            |  |
|---|---|--|--|--|--|------------|----|--------------|--------|-----------|----|--------|-----|-------------|----|-------|------------|--|
| <div>CLIENT:</div> <div></div> <div>NED UNIVERSITY OF<br/>ENGINEERING AND TECHNOLOGY<br/>University Road - Karachi</div> | <div>CONSULTANT:</div> <div></div> <div><b>Consult-Tech</b><br/>Consulting Engineers and Planners<br/>11-C, Third Floor, Shahbaz Commercial Lane 2<br/>Phase-VI, DHA - Karachi Ph: 35847692-93</div> | <div>MEP CONSULTANT:</div> <div></div> <div><b>S.R. CONSULTANTS (IV)</b><br/>CONSULTING ENGINEERS &amp; ARCHITECTS<br/>11-C, Third Floor, Shahbaz Commercial Lane 2<br/>Phase-VI, DHA - Karachi Ph: 35847692-93</div> | <div>PROJECT:</div> <div>CONSTRUCTION OF LABORATORIES OF<br/>PHYSICS &amp; CHEMISTRY</div> | <div>DRAWING TITLE:</div> <div>FIRE ALARM LAYOUT</div> | <table><tr><td>DESIGN BY:</td><td>UH</td><td>APPROVED BY:</td><td>Z.RAZI</td></tr><tr><td>DRAWN BY:</td><td>NA</td><td>SCALE:</td><td>NTS</td></tr><tr><td>CHECKED BY:</td><td>FA</td><td>DATE:</td><td>29-09-2020</td></tr></table> | DESIGN BY: | UH | APPROVED BY: | Z.RAZI | DRAWN BY: | NA | SCALE: | NTS | CHECKED BY: | FA | DATE: | 29-09-2020 | <div>DRAWING NO.</div> <div>UESI-NED-E05</div> |
| DESIGN BY:  | UH  | APPROVED BY:   | Z.RAZI   |  |  |            |    |              |        |           |    |        |     |             |    |       |            |  |
| DRAWN BY:   | NA  | SCALE:   | NTS  |  |  |            |    |              |        |           |    |        |     |             |    |       |            |  |
| CHECKED BY:   | FA  | DATE:  | 29-09-2020   |  |  |            |    |              |        |           |    |        |     |             |    |       |            |  |



TENDER DRAWING

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANT:



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

MEP CONSULTANT:



**S R CONSULTANTS (IV)**  
CONSULTANTS  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

SINGLE LINE DIAGRAM

DESIGN BY:

UH

APPROVED BY:

Z.RAZI

DRAWN BY:

NA

SCALE:

NTS

CHECKED BY:

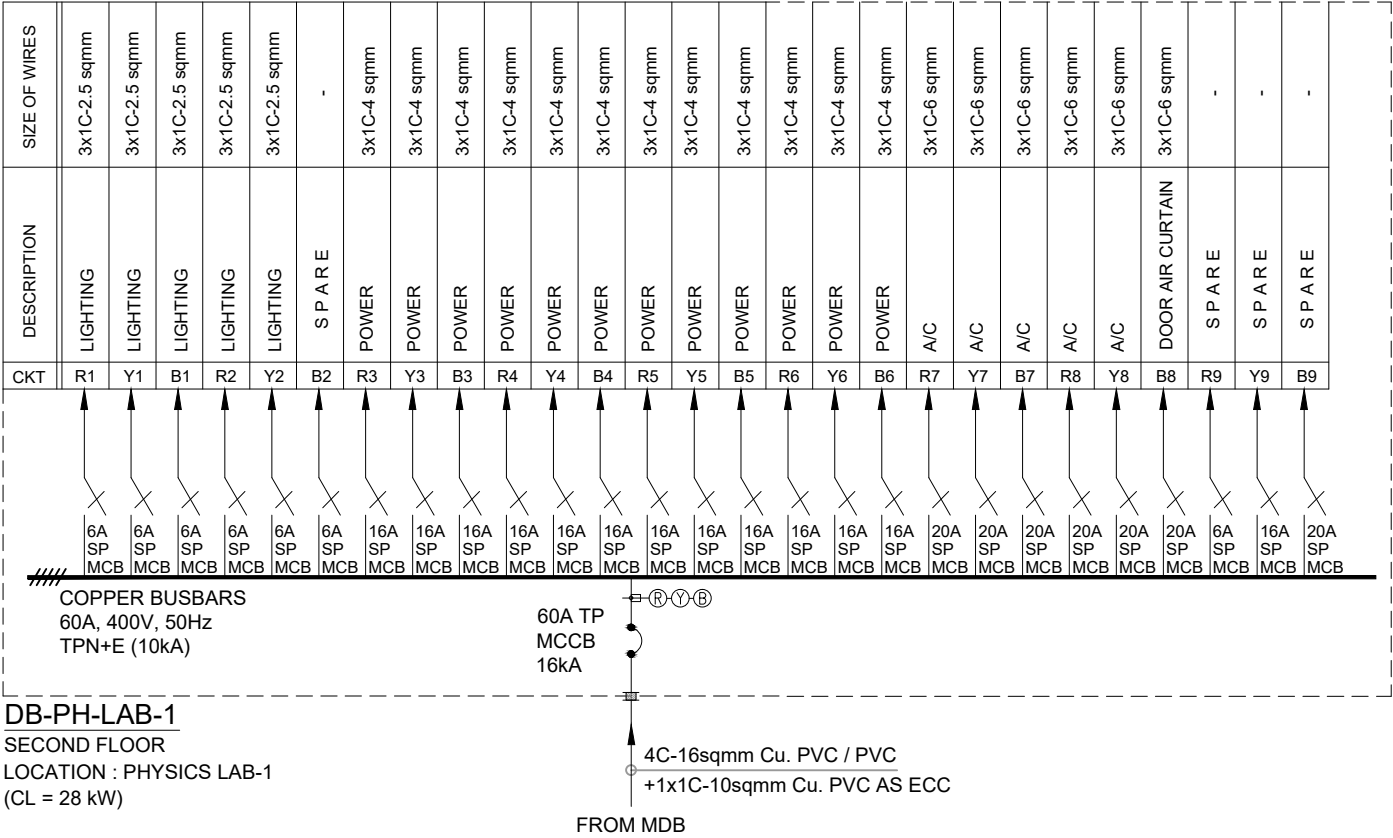
FA

DATE:

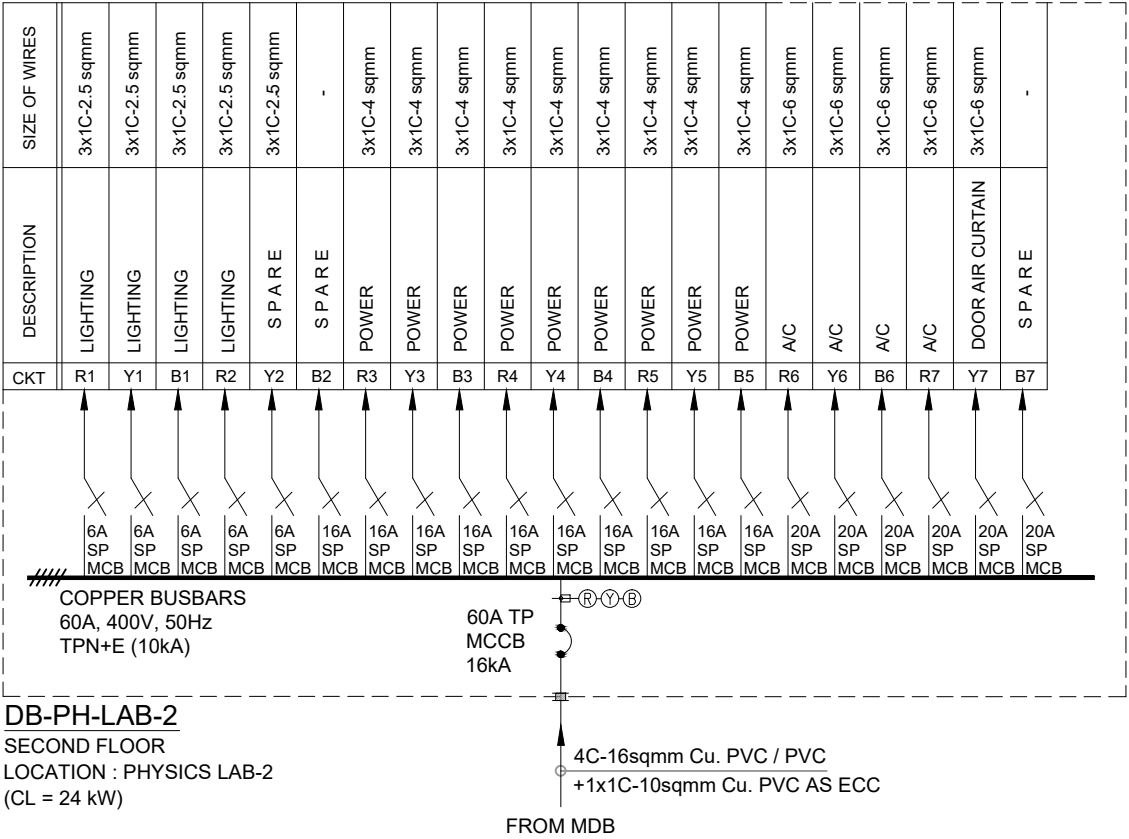
29-09-2020

DRAWING NO.

UESI-NED-E06



**DB-PH-LAB-1**  
SECOND FLOOR  
LOCATION : PHYSICS LAB-1  
(CL = 28 kW)

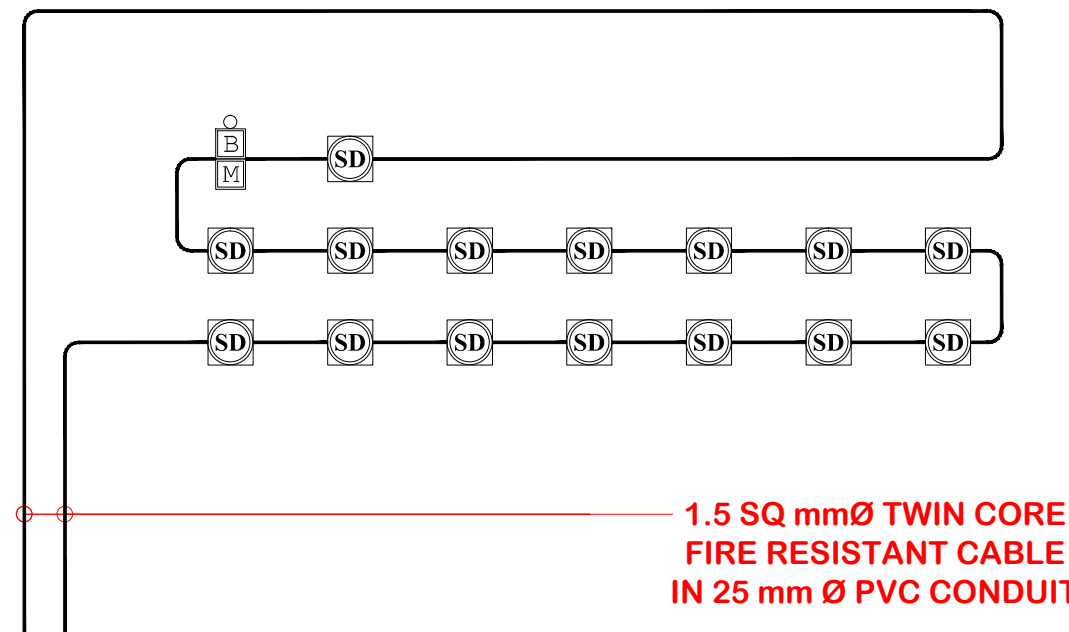


**DB-PH-LAB-2**  
SECOND FLOOR  
LOCATION : PHYSICS LAB-2  
(CL = 24 kW)

TENDER DRAWING

# ADDRESSABLE SYSTEM

15NOS SMOKE DETECTOR  
1 CALL POINT  
1 SOUNDER



INSTALLED AT  
COMP. LAB  
EXIT AREA

PROPOSED 2 LOOP F.A.C.P

GROUND FLOOR

TENDER DRAWING

CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANT:



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

MEP CONSULTANT:



**S.R. CONSULTANTS (PVT)**  
CONSULTING ENGINEERS & PLANNERS  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

FIRE ALARM PANEL  
RISER DIAGRAM  
LAYOUT

DESIGN BY:

UH

DRAWN BY:

NA

CHECKED BY:

FA

APPROVED BY:

Z. RAZI

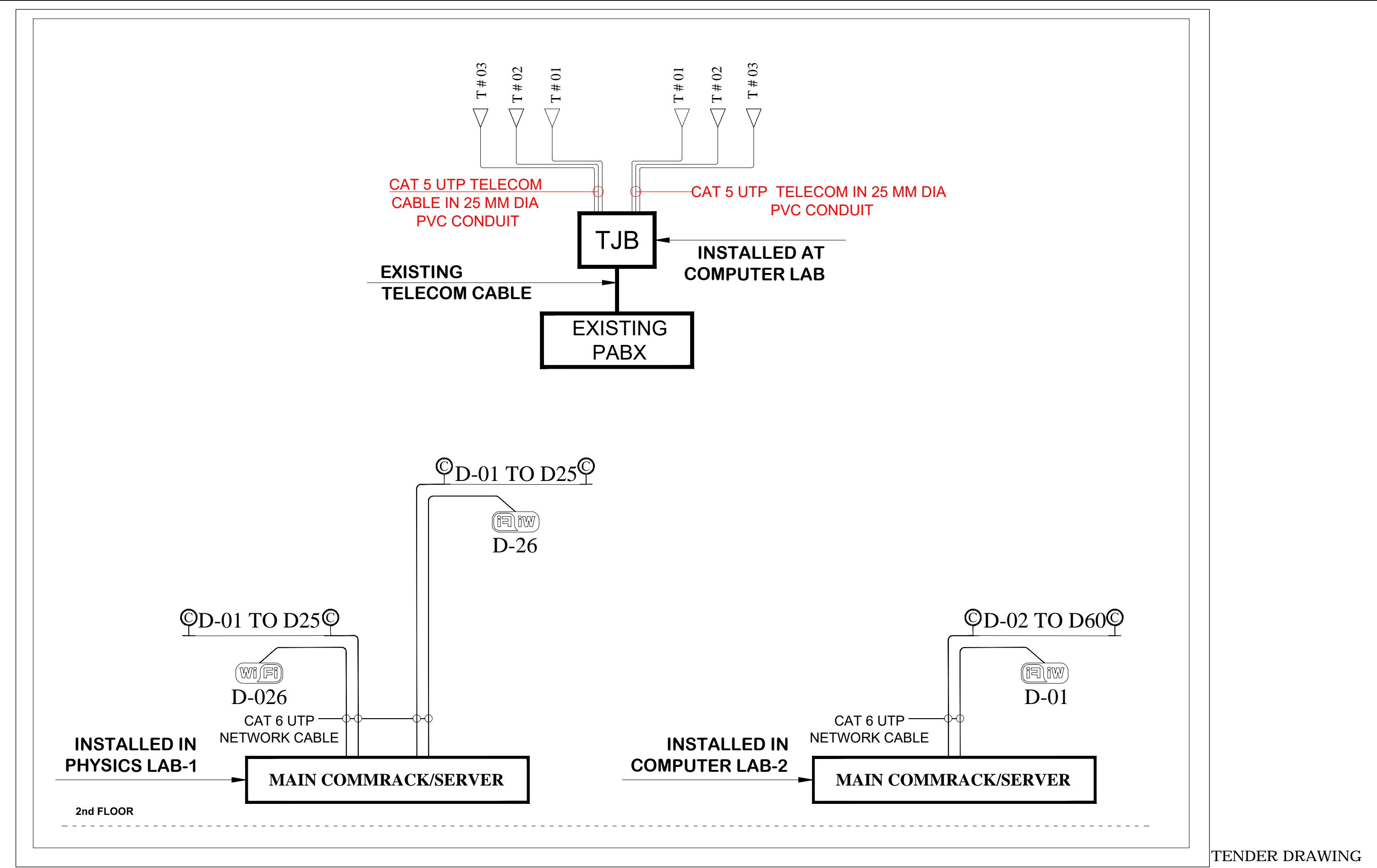
SCALE:

DATE:

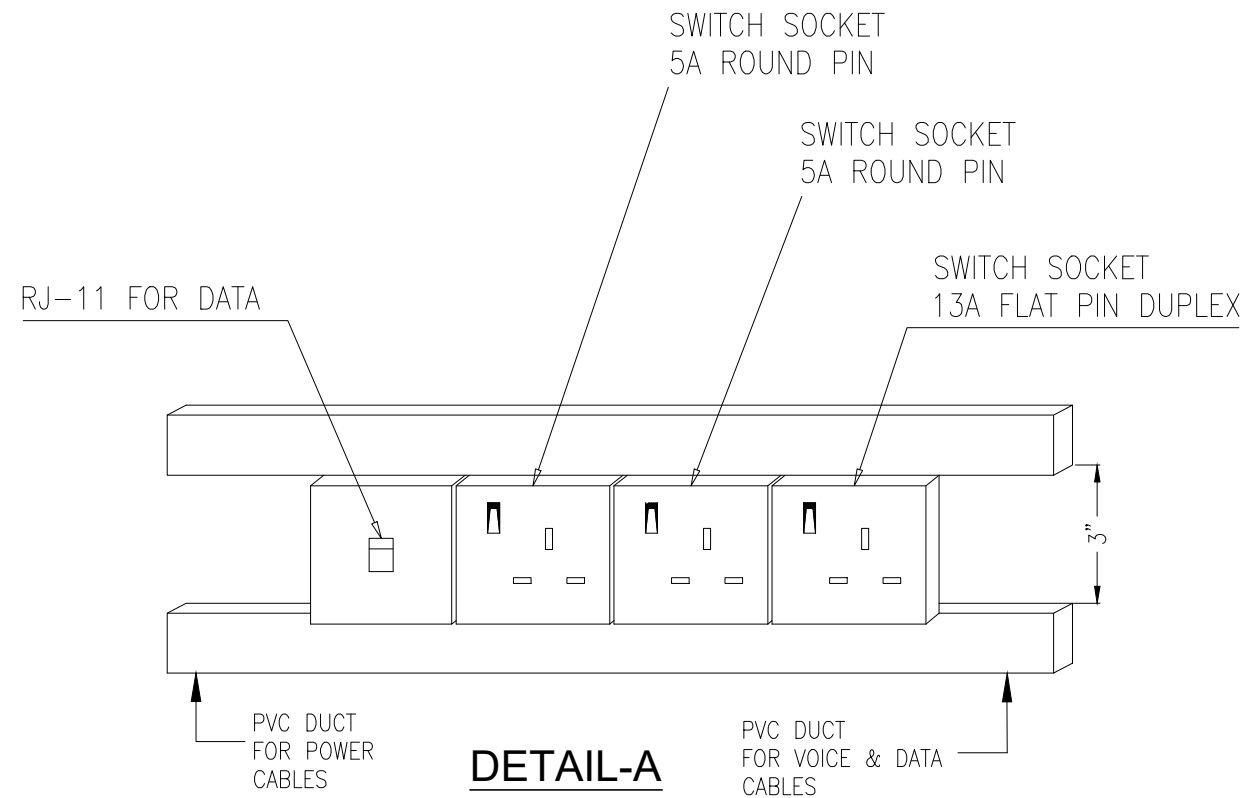
29-09-2020

DRAWING NO.:

UESI-NED-E08

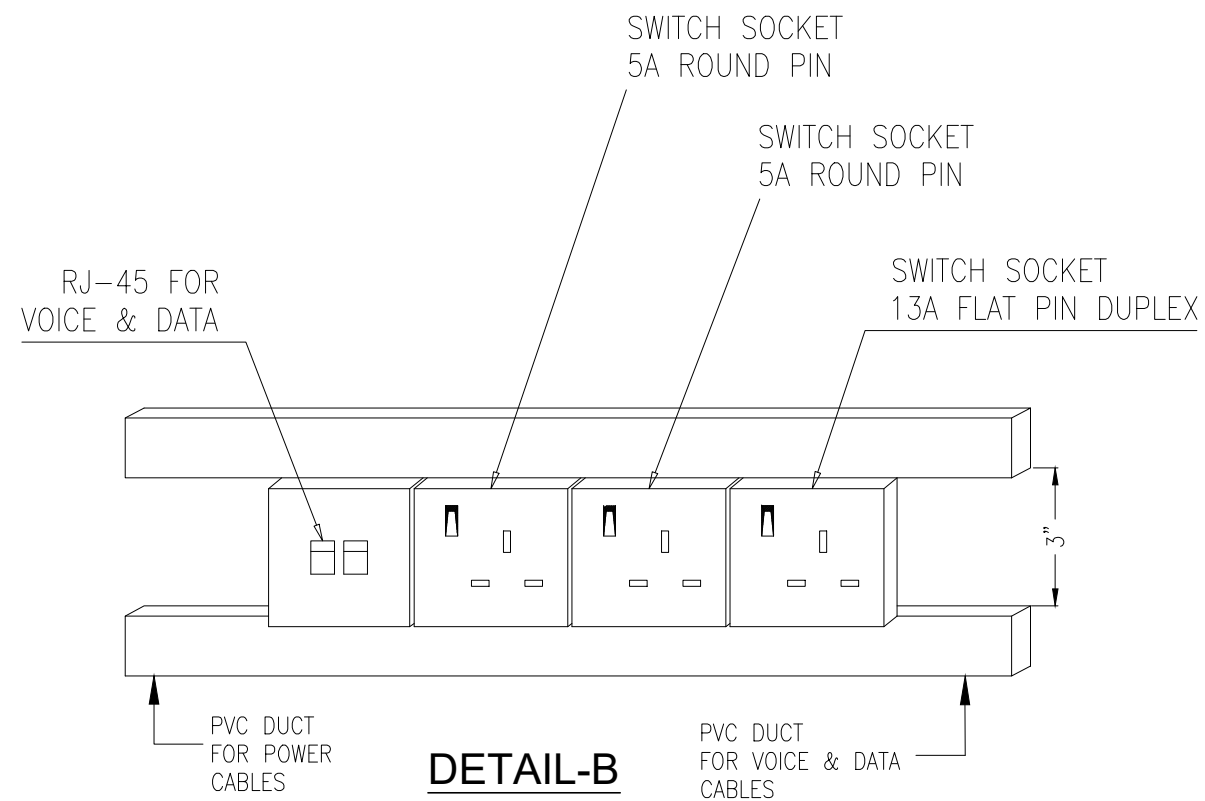


TENDER DRAWING



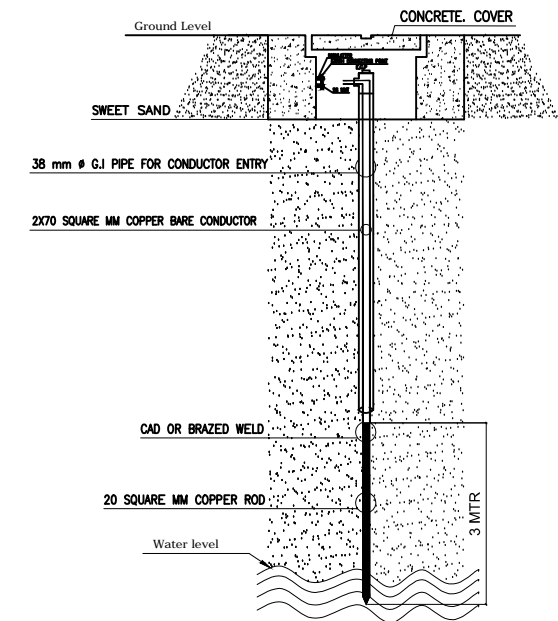
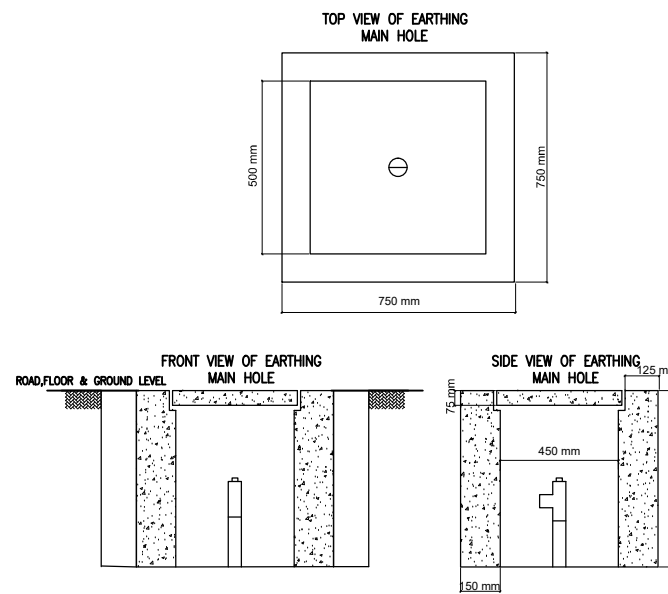
**DETAIL-A**

**FOR LABS**



**DETAIL-B**

**STAFF ROOM**



**TENDER DRAWING**

CLIENT:



**NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY**  
University Road - Karachi

CONSULTANT:



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

MEP CONSULTANT:



**S.R. CONSULTANTS (IV)**  
CONSULTING ENGINEERS & ARCHITECTS  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93  
UNITED ENGINEERING SERVICES INTERNATIONAL  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

**CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY**

DRAWING TITLE:

**MISCELLANEOUS DETAILS**

DESIGN BY:

UH

APPROVED BY:

Z. RAZI

DRAWN BY:

NA

SCALE:

NTS

CHECKED BY:

FA

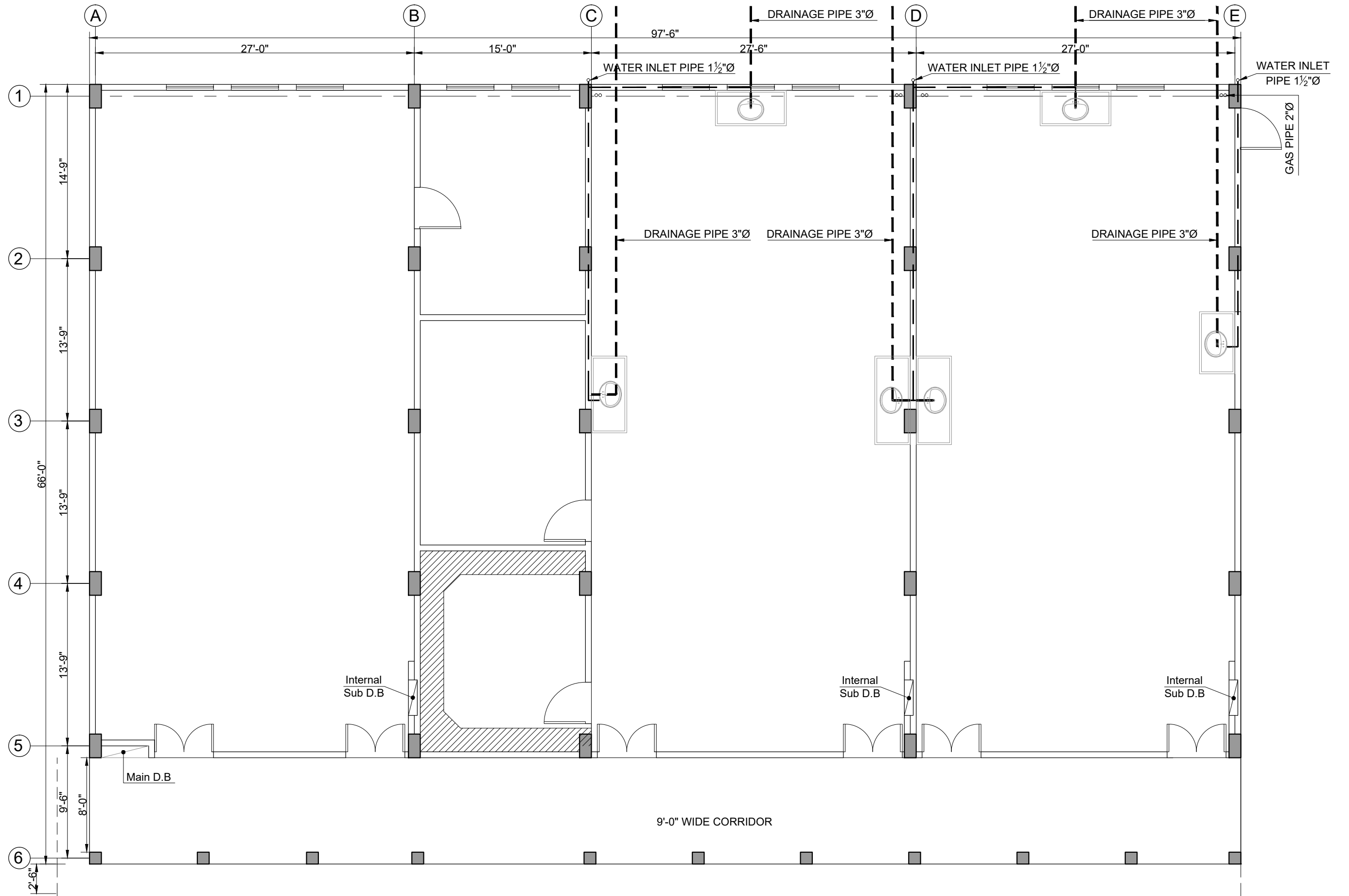
DATE:

29-09-2020

DRAWING NO.:

**UESI-NED-E10**

PLUMBING  
DRAWINGS



CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

PLUMBING FLOOR  
DRAWING

DRAWN BY:

M.S.R

CHECKED BY:

K.K

APPROVED BY:

R.A.K

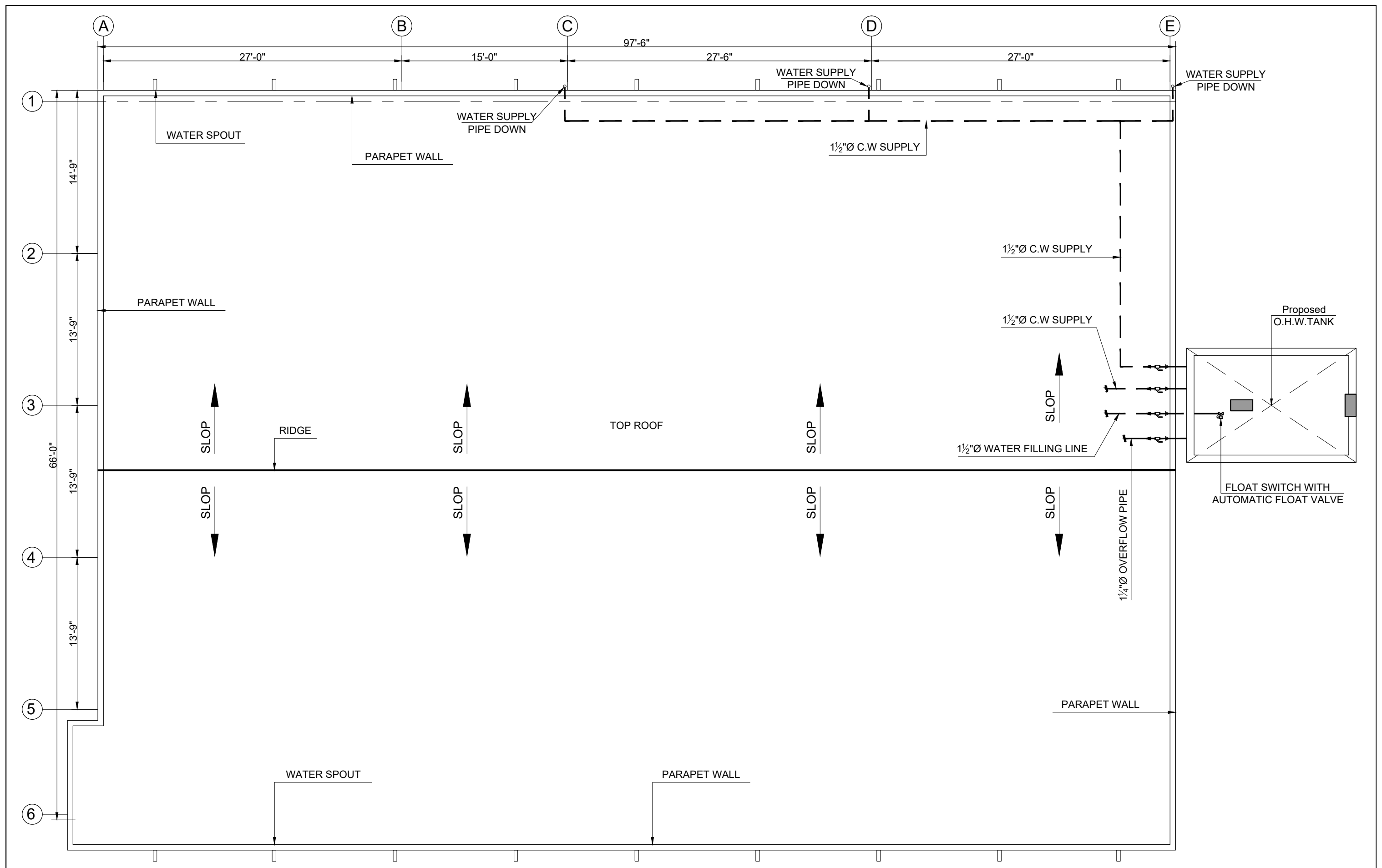
DATE:

JULY, 2020

DRAWING NO.

**P-01**





CLIENT:



NED UNIVERSITY OF  
ENGINEERING AND TECHNOLOGY  
University Road - Karachi

CONSULTANTS



**Consult-Tech**  
Consulting Engineers and Planners  
11-C, Third Floor, Shahbaz Commercial Lane 2  
Phase-VI, DHA - Karachi Ph: 35847692-93

PROJECT:

CONSTRUCTION OF LABORATORIES OF  
PHYSICS & CHEMISTRY

DRAWING TITLE:

PLUMBING ROOF  
DRAWING

DRAWN BY:

M.S.R

CHECKED BY:

R.A

APPROVED BY:

R.A.K

DATE:

SEP, 2020

DRAWING NO.

**P-02**

# NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

No. DR (Estab)/(1003)/1990

Dated: 12/02/2016

## OFFICE ORDER

The University Administration has constituted the Procurement Committee comprising of the following officers for Construction, Renovation and Rehabilitation of work and Services

- |    |   |          |
|----|---|----------|
| 1. | <b>Prof. Dr. Abdul Jabbar Sangi</b><br>Professor<br>Dept. of Civil Engg.                              | Convener |
| 2. | <b>Engr. Khurshid Akhtar</b><br>Deputy Director of Services (Civil)<br>Services Department            | Member   |
| 3. | <b>Engr. Sadia Jabeen</b> <i>Asst. m.</i><br>Senior Civil Engineer (HFJ)<br><i>University Karachi</i> | Member   |

*12/2/16*  
Ag. REGISTRAR

To:

The Convener & all members

Copy for information to:

1. Dean (CEA)
2. Chairman, Dept. of Civil Engg.
3. Director of Services
4. Director Finance
5. Resident Auditor

*Saleem*

# NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

No. DR (Estab)/(1003)/5730

Dated: 27/05/2016

## OFFICE ORDER

In supersession of this office order No. DR (Estab)/(1003)/11418 dated 02-11-2015, the University Administration has constituted the Complaint Redressal Standing Committee comprising of the following officers to address complaints regarding all procurement issues in the University in pursuance of Clause 31(1) of the SPPRA rules:

- |    |   |          |
|----|---|----------|
| 1. | <b>Prof. Dr. Saad Ahmed Qazi</b><br>Dean (ECE)          | Convener |
| 2. | <b>Independent Professional from the relevant field</b> | Member   |
| 3. | <b>Nominee of Accountant General Sindh</b>              | Member   |

  
Ag. REGISTRAR 27/5/2016

To:

**The Convener & all members**

Copy for information to:

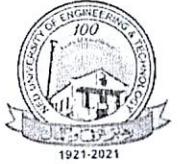
- 1 Dean (ECE)
- 2 Director Planning & Projects
- 3 Director Finance
- 4 Director, Procurement Cell
- 5 Ag. Resident Auditor



**NED UNIVERSITY OF ENGINEERING & TECHNOLOGY  
PROCUREMENT CELL**

Tele # 99261261- 2291, (Ext. 2471) Fax # 99261255,

E-mail: [dp@neduet.edu.pk](mailto:dp@neduet.edu.pk)



**Director Procurement**

**"Say NO to Corruption"**

No. DP/NED/116812/6663/ 2131

Dated: 12-10-2021

**The Director Information Advertisement  
Government of Sindh,  
Information Department  
Directorate of Advertisement  
Karachi.**

**SUBJECT: PUBLICATION OF NOTICE INVITING TENDER**

Enclosed kindly find herewith the Notice Inviting Tender (NIT) for publication in three newspapers for job mentioned below:

|                              |   |
|------------------------------|---|
| Notice<br>Inviting<br>Tender | Construction of 03 Laboratories for Department of Physics & Chemistry at<br>NEDUET.<br>Tender No. PC/NED/DWS/Construction/6663-B/2021 |
|------------------------------|---|

Kindly ensure the publication of the aforementioned NIT as under:

| Name of Newspapers  | Ordinary Page | Date of Publication        |
|---|---------------|----------------------------|
| Daily "Dawn" - English,<br>Daily "Jang" - Urdu<br>Daily "Awami Awaz" - Sindhi | Black & White | On or before<br>15-10-2021 |

The aforesaid NIT please be published on or before 15-10-2021. The bill along-with tear sheet of newspapers may be sent to Director Finance of this University for payment.

Copy to DF

R&I Incharge  
Advertisement Department  
Information Department  
Govt. of Sindh  
12/10/21

Director Procurement

12/10/21





# NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

## PROCUREMENT CELL

Phone # 99261261-68, (Ext 2471 & 2501) Fax # 99261255, Email: dp@neduet.edu.pk



NO: DP/PHD-116812/6663-B/2131

October 12, 2021

Director Procurement

## NOTICE INVITING TENDER

NED University of Engineering and Technology invites sealed bids on single stage one envelope procedure from reputable and well experienced firms/Comanches to carry out following works:

| S. No. | Tender / Number  | Tender Schedule — Date and Time |            |                         |                         | Estimated Cost (Rs. in million) | Tender Fee Rs. | Time of Completion |
|--------|--|---------------------------------|------------|-------------------------|-------------------------|---------------------------------|----------------|--------------------|
|        |  | Issue / Sale                    |            | Submis-<br>sion         | Opening                 |                                 |                |                    |
|        |  | From                            | To         |                         |                         |                                 |                |                    |
| 1.     | Construction of 03 Laboratories for Department of Physics & Chemistry at NEDUET.<br>Tender No. PC/NED/DWS Construction/6663-B/2021 | 18.10.2021                      | 03.11.2021 | 04.11.2021<br>10:30 A.M | 04.11.2021<br>11:00 A.M | 19.905                          | 5,000/-        | 13 Month           |

### Eligibility Criteria:

1. Registered with Sindh Revenue Board and FBR.
2. Documentary evidence of similar work executed and works in progress.
3. Financial statement (Summary) and Income Tax Returns for the last 03 years/
4. Valid Registration with Pakistan Engineering Council (PEC) in category C-4 and above, specialization code CE-10.
5. Affidavit that firm has not been blacklisted or involved in any litigation by any government, semi-government or autonomous bodies on non-judicial stamp paper.

**Method of Procurement:** Single Stage, One Envelope Procedure.

### Terms & Conditions

**a) Under following conditions bid shall be rejected:**

- i. Blacklisted firm/companies
- ii. Bid received after specified time and date.
- iii. Incomplete, conditional, electronic and Telegraphic Bid / Tender
- iv. Bids not accompanied by Bid security of required amount and form.

**b) Bid Validity Period:** (90) days from the date of opening of tender

**c) Bid Security:** 2% of bid cost in the form of deposit at Call or pay order or demand draft or a bank guarantee issued by a scheduled bank in Pakistan in favour of Director Finance NEDUET, Karachi.

Tender fee in shape of Pay Order / Bank Draft should be in favour of Director Finance NEDUET, Bidding Documents can be obtained and shall be submitted in the office of ADP-II in the University as per above schedule. Bidders are requested to give their best and final price as "No Negotiations" is permitted. Bidding Documents containing detailed terms and conditions are available at Websites [www.neduet.edu.pk](http://www.neduet.edu.pk) and [www.ppm.spprasindh.gov.pk](http://www.ppm.spprasindh.gov.pk). In case of public holiday or any holiday or non-working day due to Force Majeure, the next official working day shall be deemed to be date for issuance, submission and opening of tenders. NEDUET shall not be responsible for any cost or expenses incurred by bidders. Procuring Agency reserves the right to reject all or any bid subject to the relevant provision of Sindh Procurement Rules 2010 (Amended upto date).

**Say No to Corruption**

INF/KRY: No. 3872/2021

ماںک لگائیں - کرنا چاہیں - ماسک لگائیں - محفوظ رہیں  
ماسک لگائیں - زندگی بچائیں - ماسک لگائیں - محفوظ رہیں

**Director Procurement**

**WEAR MASK-SAVE LIFE**