

**COLLECTORATE OF CUSTOMS ENFORCEMENT, KARACHI**

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F  
CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH  
MAZAR KEAMARI KARACHI**

**BIDDING DOCUMENTS**

**VOLUME-I**

**TENDER**

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**INVITATION  
FOR  
BIDS**

## INVITATION FOR BIDS

Date: \_\_\_\_\_

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

1. The Procuring Agency, Collectorate of Customs Enforcement invites sealed bids, under Single Stage-Single Envelope bidding procedure, from eligible firms or persons licensed by the Pakistan Engineering Council in the category C4 or above valid till June 2026 & registered in relevant disciplines CE-10, CE-09, EE-11(vi), CE-11(ix), BC-04 and BC-02 for the work Renovation / Rehabilitation / Repair of Block C and D Chaudhary Shareef Complex behind Pir Gayeb Shah Mazar Keamari Karachi.
2. Eligible Bidders may obtain further information, inspect and acquire the Bidding Documents from the Office of the Procuring Agency, Collectorate of Customs Enforcement, Karachi, 6th Custom House, Eduljee Dinshaw Road, Karachi.
3. The tender documents can be collected from office of Procuring Agency, Collectorate of Customs Enforcement, Karachi, 6th Custom House, Eduljee Dinshaw Road, Karachi upon payment of Rs.2000/- (Non-Refundable) up to \_\_\_\_\_, 2026 during office hours. Payments are to be made in favor of "The Director Finance-Pakistan Customs" in the shape of Pay Order / Bank Draft.
4. All bids must be accompanied by a Bid Security equivalent to 2% of the bid price in the form of pay order/bank guarantee from the scheduled bank. Interested firms are requested to submit their duly completed bids on or before 11:00 am, \_\_\_\_\_, 2026 at office of The Procuring Agency, Collectorate of Customs Enforcement. The bids will be opened on the same day at 11:30 am at the same venue in the presence of Pakistan Customs Procurement Committee and the representatives of contractors.

**INSTRUCTIONS  
TO  
BIDDERS**

## **INSTRUCTIONS TO BIDDERS**

(Note: These Instructions to Bidders along with Bidding Data Sheet will not be part of the Contract and will cease to have effect once the contract is signed.)

### **A. GENERAL**

#### **IB.1 Scope of Bid**

- 1.1 The Employer as defined in the Bidding Data Sheet hereinafter called “the Employer” wishes to receive bids for the construction and completion of works as described in these Bidding Documents, and summarized in the Bidding Data Sheet hereinafter referred to as the “Works”.
- 1.2 The successful bidder will be expected to complete the Works within the time specified in Appendix-A to Bid.

#### **IB.2 Source of Funds**

- 2.1 The Employer has applied for/received a loan/credit from the source (s) indicated in the Bidding Data in various currencies towards the cost of the project specified in the Bidding Data and it is intended that part of the proceeds of this loan/credit 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 relevant to the value of the Works.

#### **IB.4 One Bid per Bidder**

- 4.1 Each bidder shall submit only one bid either by himself, or as a partner in a joint venture. A bidder who 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.

#### **IB.6 Site Visit**

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

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

## **B. BIDDING DOCUMENTS**

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

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

1. Instructions to Bidders.
2. Bidding Data Sheet.
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 and Form of Indemnity Bond for Secured Advance
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 28 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 IB 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 Sheet 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 Comprising 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

And

- 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 JV shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in

the event of a successful bid shall be signed by all partners and submitted with the bid, together with a copy of the proposed agreement. The role to be played by each partner to be specified therein. Bids submitted by a joint venture of two (2) or more firms shall comply with the following requirements:

- (a) In case of a successful bid, the Form of JV Agreement shall be signed so as to be legally binding on all partners within 7 days of the receipt of letter of acceptance failing which the contract and the letter of acceptance shall stand void and redundant.
- (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 JV Agreement 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 JV Agreement (in case of a successful bid); and
- (e) A copy of JV agreement shall be submitted before signing of the Contract, stating the conditions under which JV 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. The JV Agreement shall be made part of the contract. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partners without prior written consent of the Employer.

11.3 The Bidder shall furnish, as part of the Technical Bid, a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated Bidding Forms, in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time referred to in Sub-Clause 1.2 hereof.

#### **IB.12 Bid Prices**

12.1 Unless stated otherwise in the Bidding Documents, the Contract shall be for the whole of the Works as described in IB 1.1 hereof, based on the unit rates 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.
- 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 the 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. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country (referred to as the "Foreign Currency Requirements") shall indicate the same in Appendix-B to Bid. The proportion of the Bid Price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the Bidder's home country or, (ii) at the bidder's option, entirely in Pak rupees provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in his bid.
- 13.2 The rates of exchange to be used by the bidder for currency conversion shall be the TT & OD Selling Rates published or authorized by the State Bank of Pakistan prevailing on the date 28 days prior to the deadline for submission of bids. For the purpose of payments, the exchange rates used in bid preparation shall apply for the duration of the Contract.

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

- 14.1 Bids shall remain valid for the period stipulated in the Bidding Data Sheet 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 Sheet in Pak Rupees or an equivalent amount in a freely convertible currency.

- 15.2 The Bid Security shall be, at the option of the bidder, in the form of Deposit at Call 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 IB 22.1;
  - (b) If the bidder does not accept the correction of his Bid Price pursuant to IB 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;
    - (ii) Sign the Contract Agreement, or
    - (iii) Furnish the required JV agreement within 7 days of the receipt of letter of acceptance.

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

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

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

- 17.1 The Employer may, on his own motion or at the request of any prospective bidder(s), hold a pre-bid meeting to clarify issues and to answer any questions on matters related to the Bidding Documents. The date, time and venue of pre-bid meeting, if convened, is as stipulated in the Bidding Data Sheet. All prospective bidders or their authorized representatives shall be invited to attend such a pre-bid meeting.
- 17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Employer not later than seven (7) days before the proposed pre-bid meeting.

- 17.3 Minutes of the pre-bid meeting, including the text of the questions raised and the replies given will be transmitted without delay to all purchasers of the Bidding Documents. Any modification of the Bidding Documents listed in IB 7.1 hereof, which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause IB.9 and not through the minutes of the pre-bid meeting.
- 17.4 Absence at the pre-bid meeting will not be a cause for disqualification of a bidder.

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

- 18.1 Bidders are particularly directed that the amount entered on the Letter of Price Bid shall be for performing the Contract strictly in accordance with the Bidding Documents.
- 18.2 All appendices to Bid are to be properly completed and signed.
- 18.3 No alteration is to be made in the Letters of Price and Technical Bids 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 The Bidder shall prepare one original of the Technical Bid and one original of the Price Bid comprising the Bid as described in Bidding Data Sheet against IB 11 and clearly mark it "ORIGINAL - TECHNICAL BID" and "ORIGINAL - PRICE BID". In addition, the Bidder shall submit two (2) copies of the Bid and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.
- 18.5 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the Bidding Data Sheet and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the Bid, except for unamended printed literature, shall be signed or initialed by the person signing the bid.
- 18.6 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.
- 18.7 Bidders shall indicate in the space provided in the Letter of Technical and Price Bids, their full and proper addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the Contract is to be sent.
- 18.8 Bidders should retain a copy of the Bidding Documents as their file copy.

#### **D. SUBMISSION OF BIDS FOR SINGLE STAGE SINGLE ENVELOPE BIDDINGPROCEDURE**

#### **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 IB 19.2 hereof.
- (c) The technical bid should comprise of documents listed in IB11.1 (A) & the price bid should comprise of documents listed in IB 11.1 (B) which shall be placed in single envelopes in accordance with IB 11.1.

19.2 The inner and outer envelopes shall:

- (a) Be addressed to the Employer at the address provided in the Bidding Data Sheet;
- (b) Bear the name and identification number of the contract as defined in the Bidding Data Sheet; and
- (c) Provide a warning not to open before the time and date for bid opening, as specified in the Bidding Data Sheet.

19.3 In addition to the identification required in IB 19.2 hereof, the inner envelope shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to Clause IB.21

19.4 If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the Bid.

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

- 20.1 (a) Bids must be received by the Employer at the address specified no later than the time and date stipulated in the Bidding Data Sheet.
- (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. (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 IB 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 FOR SINGLE STAGE SINGLE ENVELOPE BIDDING PROCEDURE**

##### **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 bidder's 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 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 before the announcement of bid evaluation report which shall be done at least ten 10 days prior to issue of Letter of Acceptance. The announcement to all Bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated. Any effort by a bidder to influence the Employer's processing of bids or award decisions may result in the rejection of such bidder's bid. Whereas any bidder feeling aggrieved may lodge a written complaint not later than fifteen (15) days after the announcement of the bid evaluation report. However mere fact of lodging a complaint shall not warrant suspension of the procurement process.

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

- 25.1 To assist in the examination, evaluation and comparison of bids, the 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.
- 25.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its bid may be rejected.

#### **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; (iv) Includes signed Integrity Pact where required as per clause IB.35 and (v) 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 bidders obligations under the Contract; (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids. Only substantially responsive bid shall be considered for further evaluation.
- 26.3 If a bid is not substantially responsive, it may not subsequently be made responsive by correction or withdrawal of the non-conforming material deviation or reservation. The Employer may, however, seek confirmation/ clarification in writing which shall be responded in writing.

#### **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 Letter of Price 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 IB.15.6 (b) hereof.

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

### **DETAILED TECHNICAL EVALUATION CRITERIA**

S.No.	Category	Weightage/ Marks/ Points	
		Maximum	Minimum A
1.	Professional Experience Record	30	20
2.	Financial Soundness	30	20
3.	Personnel Capabilities	25	20
4.	Equipment Capabilities	15	10
	<b>Total:</b>	<b>100</b>	<b>70</b>

*Note: To qualify, applicants must receive not less than an aggregate 70% points of maximum 100 points.*

*If two or more than two bidders quote the same price and the situation of tie up has arisen then work shall be awarded to the bidder having higher technical soundness.*

### **1. Mandatory Requirements**

All the applicants shall be subjected to initial scrutiny using the following criteria:

- Registration with Pakistan Engineering Council in Category C-4 or above and at least in specialization codes CE-10, CE-09, EE-11(vi), CE-11(ix), BC-04 and BC-02. The contractor should enclose PEC Registration Certificate, valid till June 2026 at the bid submitting time.
- The Bidder should be registered with FBR and Sindh Revenue Board - SRB for both Income and Sales Tax, with company name appearing on the active taxpayer list (ATL). The contractor should also submit copy of Registration Certificate of NTN and SNTN and print from ATL
- The bidder shall submit affidavit of no litigation history, affidavit of non-blacklisting, affidavit of never indulge in any corrupt, fraudulent and collusive practices. The bidder shall also submit affidavit that the information and documents provided with this pre-qualification document is correct.

## 2. Professional Experience Record

Experience for Projects Completed will be evaluated as below.

### General

(Information regarding similar / comparable projects completed is to be supported by documents such as Taking over / Completion Certificate, Maintenance / Defects Liability Certificate and any other relevant document).

Sr. No.	Description	Maximum Points
1.	At least 03 Projects executed of Rs. 100.00 Million or above during last five years.	15
2.	At least 03 Projects in hand of Rs. 100.00 Million or above.	15
	<b>Sub Total:</b>	<b>30</b>

## 3. Financial Soundness

Tendering Capability of an applicant will be taken as follows:

- The Audited Balance Sheets and Annual Turn Over for the last three years from Chartered Accountant firm must be submitted and should demonstrate the soundness of the applicant's financial position, showing long term profitability. Where necessary, the Employer will make inquiries with the applicant's bankers.
- Points shall be awarded under this category based on the following criteria:

Sr. No.	Description	Marks Assigned	Criteria for Marks Obtained
a)	Average Annual Turnover for Last five (05) Years	10	<ul style="list-style-type: none"><li>• Five (05) Points are given if the average annual turnover is equal to Rs. 75 Million.</li><li>• One (01) additional point is given for every Rs. 15 Million increase in the turnover.</li><li>• Full Points are given in case of turnover exceeding Rs. 150 Million.</li></ul>
b)	Working Capital in last 5 Years	10	<ul style="list-style-type: none"><li>• Five (05) Points are given if the working capital is equal to Rs. 75 Million.</li><li>• One (01) additional point is given for every Rs. 15 Million increase in the working capital.</li><li>• Full Points are given in case of capital exceeding Rs. 150 Million.</li></ul>

c)	Years Available Bank Credit Line	10	<ul style="list-style-type: none"> <li>Five (05) Points are given if the available bank credit line limit is equal to Rs. 75 Million</li> <li>One (01) additional point is given for every Rs. 15 Million increase in the credit line.</li> <li>Full Points are given in case of limit exceeding Rs. 150 Million.</li> </ul>
<b>Total Marks Allocated</b>		<b>30</b>	

#### 4. Personnel Capabilities

- **Brief Discussion of Personnel Capabilities**

Personnel deputed on site will be evaluated on the basis of following points:

(Information regarding education qualification, total work experience and specific work experience is to be supported by documents such as copy of education qualification certificate / degree and CVs of concerned personnel proposed position, duly signed and, any other relevant documents).

Sr. No.	Description	Maximum Points
1.	Resident Engineer (B.E Civil registered with Pakistan Engineering Council with at least 10 Years Relevant Experience of buildings)	7
2.	Site Engineer (B. Tech Civil with 5 Years relevant Experience or D.A.E Civil with 10 years relevant experience of buildings.)	3
3.	Lab Technician (D.A.E Civil with at least 05 Years Relevant Experience of buildings)	3
4.	Quantity Surveyor (D.A.E Civil with at least 05 Years Relevant Experience of buildings)	3
5.	Surveyor (D.A.E Civil with at least 05 Years Relevant Experience of buildings)	3
6.	Site Supervisor (D.A.E Civil with at least 05 Years Relevant Experience of buildings)	3
7.	Site Supervisor (D.A.E Electrical with at least 05 Years Relevant Experience of buildings)	3
<b>Sub Total:</b>		<b>25</b>

- The Engineer having B.E Civil must be affiliated with the company.
- All the other staff must have their last six months' pay slip attached.
- All Safety measures will be the responsibility of Resident Engineer.

#### 5. Equipment Capabilities

The applicant should own, or have assured access to (through rented, lease, purchase agreement or other means), the following key equipment (limited to only major items of equipment) in full working order, and must demonstrate that, based on known commitments, these will be available for deployment on the proposed contract or works. The applicant may also list alternative equipment which he

would propose for the contract together with an explanation of the alternate proposal.

Points will be given on the basis of the following criteria:

<b>Sr. No.</b>	<b>Description</b>	<b>Max. Points</b>
1	Concrete Mixer Machine (Nos:2)	2
2	Lift Set for Concrete (Nos:2)	2
3	Concrete Vibrator (Nos:4)	1
4	Tractor Trolley (Nos:3)	1
5	Excavator (Nos:2)	2
6	Rebar / Steel Cutting and Bending Machine (Nos:4)	1
7	Steel Formwork (Shuttering Plates, Scaffolding, pipes and accessories) <i>0.5 mark for each lot of 50,000 sqft</i>	1
8	Earth Rammer	1
9	Electric Generator( <i>Minimum capacity 100 KVA</i> )	1
10	Survey Equipment 1 GPS 1 Total Station 2 Level Machine	1.5
11	Wooden Formwork <i>0.5 mark for each lot of 50,000 sq. ft</i>	1.5
<b>Total Maximum Points</b>		<b>15</b>

- 28.1 The 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.

## **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 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 bidder's capacities, may require the bidders 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 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.

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.

31.4 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 successful bidder shall furnish to the Employer a Performance Security in the form

and the amount stipulated in the Bidding Data Sheet and the Conditions of Contract within a period of 28 days after the receipt of Letter of Acceptance.

- 32.2 Failure of the successful bidder to comply with the requirements of IB.32.1 or 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, inter alia, reject his bid and/or refer the case to the Pakistan Engineering Council (PEC). Upon such reference, PEC in accordance with its rules, procedures and relevant laws of the land take such action as may be deemed appropriate under the circumstances of the case including black listing of such Bidder and 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 SHEET**

## Bidding Data Sheet

### 1.1 Name and address of the Employer:

#### 1.1 Name of the Project & Summary of the Works:

Renovation / Rehabilitation / Repair of Block C and D Chaudhary Shareef Complex behind Pir Gayeb Shah Mazar Keamari Karachi.

#### 2.1 Name of the Borrower/Source of Financing/Funding Agency:

The Employer has arranged funds from its own sources.

#### 10.1 Bid language:

English

#### 11.1 (A) The Bidder shall submit with its Technical Bid the following documents:

- (a) Letter of Technical Bid
- (b) Bid Security (IB.15)
- (c) Pending litigation information
- (d) Special Stipulations (as filled by the Employer) (appendix –A)
- (e) Proposed Construction Schedule (appendix –E)
- (f) Availability of Critical Equipment (appendix –G)
- (g) Organization Chart for Supervisory Staff (appendix –K)
- (h) Integrity Pact (appendix –L)
- (i) Financial Competence and Access to financial Resources (appendix –M)
- (j) Past Performance, Current Commitment, Qualification and Experience (appendix –N)

#### 11.1(B) The Bidder shall submit with its Price Bid the following documents:

- (a) Letter of Price Bid
- (b) Foreign Currency Requirements (appendix –B)  
(If required and only in case of International Bidding)
- (c) Price Adjustment under Clause 70 (Not Applicable) (appendix –C)
- (d) Bill of Quantities (appendix –D)
- (e) Estimated Progress Payments (appendix –J)

413.1 Bidders to quote entirely in Pak. rupees but specify the percentages of foreign currency they require.

14.1 Period of Bid Validity:

Period of Bid Validity is 30 days after the date of bid opening.

15.1 Amount of Bid Security:

Amount of Bid Security shall be 2% of the Bid Price in Pak Rupees.

18.4 Number of copies of the Bid to be completed and returned:

One Original plus Two Copies

19.2(a) Employer's address for the purpose of Bid submission:

Collectorate of Customs Enforcement, Karachi, 6th Custom House, Eduljee Dinshaw Road,  
Karachi

20.1(a) Deadline for submission of bids:

As mentioned in the Notice Inviting Tender-NIT

23.1 Venue, time, and date of Bid opening:

As mentioned in the Notice Inviting Tender-NIT

**Letters of Technical Bid/ Price Bid,  
And  
Appendices to Bid**

## Letter of Technical Bid

Date: .....

Bid Reference No: .....  
(Name of Contract/Works)

To: .....

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (IB) 9;
- (b) We offer to execute and complete in conformity with the Bidding Documents the following Works:
- (c) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of ..... days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (d) As security for due performance of the under takings and obligations of our bid, we submit here with a Bid security, in the amount specified in Bidding Data Sheet, which is valid (at least) 28 days beyond validity of Bid itself.
- (e) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process, other than alternative offers submitted in accordance with IB16 (as applicable).

- (f) We agree to permit Employer or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors. This permission is extended for verification of any information provided in our Technical Bid which comprises all documents enclosed herewith in accordance with IB.11.1 of the Bidding Data Sheet.

Name .....

In the capacity of .....

Signed .....

.....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

.....

Address.....

## Letter of Price Bid

Date: .....

Bid Reference No: .....  
(Name of Contract/Works)

To: .....

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (IB)9;
- (b) The total price of our Bid, excluding any discounts offered in item (c) below is:
- (c) The discounts offered and the methodology for their application are:
- (d) Our Bid shall be valid for a period of ..... days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (e) If our Bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;

- (f) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed and we do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other bidder for the Works.
- (g) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.
- (h) We agree to permit Employer or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors. This permission is extended for verification of any information provided in our Technical Bid which comprises all documents enclosed herewith in accordance with IB.11.1 of the Bidding Data Sheet.
- (i) If awarded the contract, the person named below shall act as Contractor's Representative.

Name .....

In the capacity of .....

Signed .....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

Address.....

**SPECIAL STIPULATIONS**  
**Clause**  
**Conditions of Contract**

1.	Employer's name and address	1.1.2.2 & 1.3	Office of The Collectorate Of Customs Enforcement, Karachi, 6th Custom House, Eduljee Dinshaw Road, Karachi.
2	Engineer's name and address	1.1.2.4 & 1.3	ESS-I-AAR Planning Engineering & Services Consultants Suite No. 314 3 <sup>rd</sup> Floor Mashriq Centre, Gulshan-e-Iqbal Block 14 Karachi
3.	Law applicable	5.1(b)	The law to be applied is the law of Islamic Republic of Pakistan
4.	Minimum amount of Third Party Insurance	23.2	Rs. 200000 per occurrence with number of occurrences unlimited
5.	Amount of Performance Security	10.1	10% of the Contract Price stated in the Letter of Acceptance, to be provided in the form of a guarantee issued by an insurance company having a minimum AA rating from PACR/JCR.
6.	Time for Furnishing Programme	14.1	Within 21 days from the date of receipt of Letter of Acceptance.
7.	Time for Commencement	41.1	Within 14 days from the date of receipt of Engineer's Notice to Commence which shall be issued within fourteen (14) days after signing of Contract Agreement.
8.	Time for Completion	43.1, 48.2	06 months from the date of receipt of Engineer's Notice to Commence.
	a) Amount of Liquidated Damages	47.1	Rs. 25000 for each day of delay in completion of the works subject to a maximum of 10% of the Contract Price stated in Letter of Acceptance.
	b) Amount of Bonus	47.3	Rs 10000 for each day the works are completed before the specified completion date of the works subject to a maximum of 5 % of contract price in the Letter of Acceptance.
9.	Defects Liability Period	49.1	6 months (180 days) Days from the effective date of Taking Over Certificate.
10.	Percentage of Retention Money	60.3	5 % of the amount of Interim Payment Certificate.
11.	Limit of Retention Money	60.3	5% of Contract Price stated in the Letter Of Acceptance.
12.	Minimum amount of Interim Payment Certificate (Running Bills)	60.2	Rs. 35 Millions
13.	Minimum amount of Running Account Bills	60.2	As per actual progress of work
14.	Time of Payment from delivery of Engineer's Interim Payment Certificate to the Employer	60.10	30 days in case of local currency or 42 days in case of foreign funded projects.
15.	Mobilization Advance	60.12	10% of Contract Price as stated in the Letter of Acceptance. Mobilization advance shall be interest free and be based on bank guarantee.

**FOREIGN CURRENCY REQUIREMENTS**  
**(If required and only in case of International Bidding)**

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

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

Not Applicable

**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	0.25	
(ii)	Local Labour		Government of Pakistan (GP) Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin.
(iii)	Cement – in bags		“ “ “
(iv)	Reinforcing Steel		“ “ “
(v)	High Speed Diesel (HSD)		“ “ “
(vi)	Bricks		“ “ “
(vii)	Bitumen		“ “ “
(viii)			
	Total	1.00	

**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.

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(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 in accordance with provisions of 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, labour, supervision, materials, execution, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract. Furthermore all duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as on the date 28 days prior to deadline for submission of Bids, shall be included in the 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. As per attached Bill of Quantities

**PROPOSED CONSTRUCTION SCHEDULE (If  
Required by the Employer)**

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	_____ days (If applicable)
c) Part-B	_____ days (If applicable)
d) _____	_____ days
e) _____	_____ 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.
4. Quality control / Quality assurance measures to be adopted including procedures to be followed for carrying out all tests required under specifications.

**LIST OF MAJOR EQUIPMENT – RELATED ITEMS**

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

**LIST OF MAJOR EQUIPMENT**

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

**Equipment:**

The Bidder must demonstrate that it has the key equipment listed hereafter:

No.	PLANT/EQUIPMENT				
	Equipment Type and Characteristics	Total Nos. available	Under Utilization on other projects, if applicable	Nos. waiting to be shifted to new project(s)	Min. Number Required for this Project
1					
2					
3					
4					
5					
6					

### **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.). The Contractor should mention here what are his proposed environmental measures for the project as per EPA rules like treatment of wastewater and water quality etc. The Contractor shall submit a detailed EMP (Environmental Management Plan) to describe how materials are removed from site and disposed off at a safe location, prevention for the contamination of ground and surface water in neighboring areas etc. including remedial measures for adoption.
  
6. Detail of testing Lab with testing equipment etc.

**LIST OF SUBCONTRACTORS**

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

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

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

**ESTIMATED PROGRESS PAYMENTS**

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

<b>Quarter/ Year/ Period</b>	<b>Amounts (1,000 Rs.)</b>
<b>1</b>	<b>2</b>
Ist Quarter	
2 <sup>nd</sup> Quarter	
3 <sup>rd</sup> Quarter	
4 <sup>th</sup> Quarter	
.....	
.....	
.....	
.....	
.....	
<b>Bid Price</b>	

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

**(INTEGRITY PACT)**

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

Contract No. \_\_\_\_\_ Dated \_\_\_\_\_  
Contract Value: \_\_\_\_\_  
Contract Title: \_\_\_\_\_

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

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

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

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

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

Name of Employer: .....  
Signature: .....  
[Seal]

Name of Contractor: .....  
Signature: .....  
[Seal]

**FORMS**

**BID SECURITY  
PERFORMANCE SECURITY  
CONTRACT AGREEMENT  
MOBILIZATION ADVANCE GUARANTEE/BOND  
AND  
INDEMNITY BOND FOR SECURED ADVANCE**

**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 therefore, 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 fulfillment 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.

**SURETY (Bank)**

WITNESS:

Signature \_\_\_\_\_

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

Name \_\_\_\_\_

\_\_\_\_\_

Title \_\_\_\_\_

Corporate Secretary (Seal)

Corporate Guarantor (Seal)

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

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

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

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

[Letter by the Guarantor to the 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.

	_____ Guarantor (Bank)
Witness:	
1. _____	Signature _____
_____	Name _____
Corporate Secretary (Seal)	Title _____
2. _____	
_____	
Name, Title & Address	Corporate Guarantor (Seal)

**FORM OF CONTRACT AGREEMENT**

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the \_\_\_\_\_ day of \_\_\_\_\_ (month) 20\_\_\_\_ between \_\_\_\_\_ (hereafter called the ("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 witnesses 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 / Clarification as agreed or otherwise, if any, except those parts relating to Instructions to Bidders shall be deemed to form and be read and construed as part of this Contract, 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 O);
  - (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

Signature of Employer

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

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

Signed, Sealed and Delivered in the presence of:

Witness:

Witness:

\_\_\_\_\_

\_\_\_\_\_

(Name, Title and Address)

(Name, Title and Address)

**MOBILIZATION ADVANCE GUARANTEE/BOND**

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

WHEREAS \_\_\_\_\_ (hereinafter called the '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 fulfillment 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)

**INDEMNITY BOND  
FOR SECURED ADVANCE  
AGAINST MATERIALS BROUGHT AT SITE**

(ON RS.40 NONJUDICIAL STAMP PAPER)

This Deed of Indemnity is issued by M/s. \_\_\_\_\_  
 \_\_\_\_\_ (Name of the Contractor) in favour of  
 M/s. \_\_\_\_\_ (Name of the Employer).

**Whereas** \_\_\_\_\_ (hereinafter called the Employer) has paid the Secured Advance against the cost of material through any Bank or like agency by any other method by virtue of the terms of the contract existing between the parties. The details of the material and their price for which secured advance is being sought for the period \_\_\_\_\_ till consumption of the material is as under:-

1. \_\_\_\_\_ at Rs. \_\_\_\_\_ per \_\_\_\_\_ = Rs.
2. \_\_\_\_\_ at Rs. \_\_\_\_\_ per \_\_\_\_\_ = Rs.
3. \_\_\_\_\_ at Rs. \_\_\_\_\_ per \_\_\_\_\_ = Rs.
4. \_\_\_\_\_ at Rs. \_\_\_\_\_ per \_\_\_\_\_ = Rs.

**THEREFORE THIS DEED OF INDEMNITY WITNESSETH AS FOLLOWS:**

I/We \_\_\_\_\_ of M/s. \_\_\_\_\_ do hereby indemnify M/s \_\_\_\_\_ for all losses due to thefts, arson, pilferage, loss due to flood and inundation, shortage, deterioration and depreciation etc. through any act of Man or God or slump in the Market of any or all the materials financed or paid by the Employer on our request for financing payment against material.

I/We \_\_\_\_\_ shall indemnify \_\_\_\_\_ against any or all claims, action damages arising out of or resulting to the said material.

I/We \_\_\_\_\_ further declare that we will faithfully abide by the above declaration and solemnly affirm that we will not remove, sell, pilferage any of the materials against which M/s \_\_\_\_\_ has paid us such a secured advance and will not pledge the same with any Bank, Finance Corporation, Firm, Company, Individual or the like agency or create any change whereon in any from what so ever.

I/We \_\_\_\_\_ do hereby also declare that in the event of my/our infringement of the declaration made above \_\_\_\_\_ will be entitled to forfeit all such material and also proceed against me/us according to the relevant clause pertaining to breach of contract and further invoke the power or seek any remedies secured of \_\_\_\_\_ under the contract Agreement signed with us or otherwise available under law.

Place \_\_\_\_\_ Dated \_\_\_\_\_

Contractor \_\_\_\_\_

## [Notes on the Conditions of Contract]

The Conditions of Contract comprise two parts:

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

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 International 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.\*

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\* 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/book](http://FIDIC.org/book)



FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS

**CONDITIONS OF CONTRACT**

**FOR WORKS OF CIVIL**

**ENGINEERING CONSTRUCTION**

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

NOT TO BE

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

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**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 **Collectorate Of Customs Enforcement, Karachi, 6th Custom House, Eduljee Dinshaw Road, Karachi**
- (a) (iv) The Engineer is **M/s ESS-I-AAR Consultants.**

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  
Accordance with Sub-Clause 14.1 and any approved revisions thereto.
- (e) (i) The text is deleted and substituted with the following:

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

**2.1 Engineer's Duties and Authority**

With reference to Sub-Clause 2.1(b), the following provisions shall also apply:  
The Engineer shall obtain the specific approval of the Employer before carrying out his duties in accordance with the following Clauses. The Employer may further vary according to need of the project;

- (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-Clauses 12.2 “Not Foreseeable Physical Obstructions or conditions”
- (iii) Any action under Clause 10 “Performance Security” and Clauses 21,23,24 & 25 “Insurance” of sorts.
- (iv) Any action under Clause 40 “Suspension”
- (v) Any action under Clause 44 “Extension of Time for Completion”
- (vi) Any action under Clause 47 “Liquidated Damages for Delay” or payment of Bonus for Early Completion of Works (PCC Sub-Clause 47.3)
- (vii) Issuance of “Taking over Certificate” under Clause 48.
- (viii) Issuing a Variation Order under Clause 51 except:
  - a) in an emergency\* situation, as stated here below, or
  - b) if such variation would increase the Contract Price by 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 Clause
- (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**

Add the following paragraph:

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."

## **4.1 Subcontracting**

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

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

- (a) The Contract Documents shall be drawn up in the English language.
- (b) The Contract shall be subjected 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 at least 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.

#### **12.1 Not Foreseeable Physical Obstructions or Conditions**

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.

#### **14.1 Programme to be submitted (If required by the Employer)**

The programme shall be submitted within 28 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) Labor Employment;
  - (3) Local Material Procurement;
  - (4) Material Imports, if any; and
  - (5) Other details as required by the Engineer.
- (b) During the period of the Contract, the Contractor shall submit to the Engineer not later than the 8<sup>th</sup> day of the following month, 10 copies each of Monthly Progress Reports covering:
- (1) A Construction Schedule indicating the monthly progress in percentage;
  - (2) Description of all work carried out since the last report;
  - (3) Description of the work planned for the next 56 days sufficiently detailed to enable the Engineer to determine his programme of inspection and testing;
  - (4) Monthly summary of daily job record;
  - (5) Photographs to illustrate progress; and
  - (6) Information about problems and difficulties encountered, if any, and proposals to overcome the same.
- (c) During the period of the Contract, the Contractor shall keep a daily record of the work progress, which shall be made available to the Engineer as and when requested. The daily record shall include particulars of weather conditions, number of men working, deliveries of materials, quantity, location and assignment of Contractor's equipment.

The following Sub-Clauses 15.2 and 15.3 are added:

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

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

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

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

The Contractor's authorized representative at Site shall be authorized 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 labor 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 authorize 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:

**22.1 Damage to Persons and Property**

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.

**22.2 Exceptions**

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, is 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.

### **23.1 Third Party Insurance (including Employer's Property)**

The Contractor shall, without limiting his or the Employer's obligation 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.

### **23.2 Minimum Amount of Insurance**

Such insurance shall be for at least the amount stated in the Appendix to Tender.

### **23.3 Cross Liabilities**

The insurance policy shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Employer as separate insureds.

### **24.1 Accident or Injury to Workmen**

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.

### **24.2 Insurance Against Accident to Workmen**

The Contractor shall insure against such liability and shall continue such insurance during the whole of the time that any persons are employed by him on the Works.

Provided that, in respect of any persons employed by any Subcontractor, the Contractor's obligations to insure as aforesaid under the 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.

### **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 Labor**

The Contractor shall pay rates of wages and observe conditions of labor not less favorable 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 labor so established, the Contractor shall pay rates of wages and observe conditions of labor which are not less favorable 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 labor 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 Labor**

Save insofar as the Contract otherwise provides, the Contractor shall provide and maintain such housing accommodation and amenities as he may consider necessary for all his supervisory staff and labor, employed for the purposes of or in connection with the Contract including all fencing, electricity supply, sanitation, cookhouses, fire prevention, water supply and other requirements in connection with such housing accommodation or amenities. On completion of the Contract, these facilities shall be

handed over to the 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 labor at all times throughout the period of the Contract. The Contractor shall further ensure that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygiene requirements.

#### **34.6 Epidemics**

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

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

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

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

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

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

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

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

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

#### **34.11 Disorderly Conduct**

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst staff and 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.

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

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

### **40.1 Suspension of Work**

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 of 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 the risks defined in Sub-Clause 20.4), Sub-Clause 40.2 shall apply.

#### **40.2 Engineer's Determination following Suspension**

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.

#### **40.3 Suspension lasting more than 84 Days**

If the progress of the Works or any part thereof is suspended on the written instructions of the Engineer and if permission to resume work is not given by the Engineer within a period for 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 terminates his employment under the Contract in accordance with the provisions of Sub-Clause 69.1, whereupon the provisions of Sub-Clause 69.2 and 69.3 shall apply.

#### **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:

**43.1 Time for Completion**

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 48.1, 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 44.1.

**44.1 Extension of Time for Completion**

In the event of:

- (a) the amount or nature of extra or additional work,
- (b) any cause of delay referred to in these Conditions,
- (c) exceptionally adverse climatic conditions,
- (d) any delay, impediment or prevention by the Employer, or
- (e) other special circumstances which may occur, other than through a default of or breach of contract by the Contractor or for which he is responsible,

Being such as fairly to entitle the Contractor to an extension of the Time for Completion of the Works, or any Section or part thereof, the Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of such extension and shall notify the Contractor accordingly, with a copy to the Employer.

**47.1 Liquidated Damages for Delay**

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.

**47.2 Reduction of Liquidated Damages**

If, before the Time for Completion of the whole of the Works or, if applicable, any

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

#### **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".

#### **48.1 Taking-Over Certificate**

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.

#### **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".

#### **49.1 Defects Liability Period**

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 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.

#### **50.1 Contractor to Search**

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 a 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.

#### **51.1 Variations**

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

#### **51.2 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.

## **52.1 Instructions for Variations**

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

## **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:

## **56.1 Works to be Measured**

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 authorized agent, who shall:

- (a) forthwith attend or send a qualified representative to assist the Engineer in making such measurement, and
- (b) supply all particulars required by the Engineer.

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

review the records and drawings and either confirm or vary them.

#### **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) satisfies the Engineer in writing that he has reasonable cause for withholding or refusing to make such payment, and
- (b) produces to the Engineer reasonable proof that he has so informed such nominated Subcontractor in writing,

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”.

#### **60.3 Payment of Retention Money**

- (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 part 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 Clause 49 and 50, in respect of the Works, the Engineer shall be entitled to withhold certification until completion of such work of so much of the balance of the Retention Money as shall, in the opinion of the Engineer, represent the cost of the work remaining to be executed.

#### **60.8 Final Payment Certificate**

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.

#### **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.

## **60.12 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 10-15 % 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 installments; first installment at the expiry of third month after the date of payment of first part of Advance and the last installment two months before the date of completion of the Works as per Clause 43 hereof.

#### Alternative Two: Mobilization/ Demobilization Cost

Mobilization Cost shall be paid to the Contractor as a part of the priced Bill of Quantities. This cost shall not exceed 10-15 % of the Tender Price and shall be paid to the Contractor as follows:

- (i) 80 % of the Mobilization Cost shall be paid for mobilization at Site. This payment shall be in three stages as follows:
- Stage I: 20 % of Mobilization Cost upon obtaining and furnishing of Performance Security and insurance policies and construction of camp and housing facilities as required under the Contract;
  - Stage II: 30 % of Mobilization Cost upon providing & installing preliminary requirements of Contractor's Equipment, materials and temporary structures for the commencement of Works to the satisfaction of the Engineer and achieving 3 % value of the Works (excluding payment under Stage-I);
  - Stage III: 30 % of Mobilization Cost upon providing balance Contractor's Equipment to complete full requirement for the entire work and after achievement of progress to the extent of 6 % value of the Works (excluding payments under Stages I and II); and
- (ii) 20 % of Mobilization Cost shall be paid for operation and maintenance of the

constructed facilities and for demobilization as per schedule of payment to be submitted by the Contractor in accordance with Clause 57.2 and approved by the Engineer.

#### Alternative Three: Materials Supplied by Employer

The Employer shall supply to the Contractor materials, like cement, steel, bitumen or any other material whichever deemed necessary to complete the project; and the cost thereof shall be recovered from the Contractor through monthly statements on the basis of actual consumption.

The list of materials, quantities and rates to be charged to the Contractor shall be provided along with Appendix-A to Bid "Special Stipulations".

(Employer may opt either "Secured Advance on Materials" or "Financial Assistance to Contractor")

#### **62.1 Defects Liability Certificate**

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 Defects Liability Period, or, if different defects liability periods shall become applicable to different Sections or parts of the Permanent Works, the expiration of the latest such period, or as soon thereafter as any works instructed, pursuant to Clause 49 and 50, have been completed to the satisfaction of the Engineer. Provided that the issue of the Defects Liability Certificate shall not be a condition precedent to payment to the Contractor of the second portion of the Retention Money in accordance with the conditions set out in Sub-Clause 60.3.

#### **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.

#### **63.3 Payment after Termination**

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 thereafter until the costs of execution, completion and remedying of

any defects, damages for delay in completion (if any) and all other expenses incurred by the 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.

#### **63.4 Assignment of Benefit of Agreement**

Unless prohibited by law, the Contractor shall, if so instructed by the Engineer within 14 days of such entry and termination referred to in Sub-Clause 63.1, assign to the 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.

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

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.

#### **65.2 Special Risks**

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.

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

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.

#### **65.4 Projectile, Missile**

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, munition, or explosive of war, shall be deemed to be a consequence of the said special risks.

#### **65.5 Increased Costs arising from Special Risks**

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 Work (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.

#### **65.6 Outbreak of War**

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 endeavor 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.

#### **65.7 Removal of Contractor's Equipment on Termination**

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.

#### **65.8 Payment if Contract Terminated**

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 portion 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 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.

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

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

**67.2 Amicable Settlement**

Where notice of intention to commence arbitration as to a dispute has been given in accordance with Sub-Clause 67.1, the parties shall attempt to settle such dispute amicably before the commencement of arbitration. 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, even if no attempt at amicable settlement thereof has been made.

**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.

**67.4 Failure to Comply with Engineer's Decision**

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-Clause 67.1 and 67.2 shall not apply to any such reference.

**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 addresses are:

- a) The Employer: Collectorate Of Customs Enforcement, Karachi

.....  
(to be filled in by the Employer as appropriate)

b) The Engineer: M/s ESS-I-AAR Consultants

.....  
(to be filled in by the Employer as appropriate)

**69.1 Default of Employer**

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 obstructing 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 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.

**69.2 Removal of Contractor's Equipment**

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.

**69.3 Payment on Termination**

In the event of such termination the Employer shall be under the same obligations to the Contractor in regard to payment as if the Contract had been terminated under the provisions of Clause 65, but, in addition to the payments specified in Sub-Clause 65.8, the 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.

**70.1 Increase or Decrease of Cost**

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

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

**(a) Other Changes in Cost**

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

**(b) Adjustment Formula**

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

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

Where:

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

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

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

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

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

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

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

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

The base cost indices or prices shall be those prevailing on the day 28 days prior to the latest date for submission of bids. Current indices or prices shall be those prevailing on the day 28 days prior to the last day of the period to which a particular monthly statement is related. If at any time the current indices are not

available, Provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.

**(e) Adjustment after Completion**

If the Contractor fails to complete the Works within the Time for Completion prescribed under Clause 43, adjustment of prices thereafter until the date of completion of the Works shall be made using either the indices or prices relating to the prescribed time for completion, or the current indices or prices, whichever is more favorable to the 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:

**72.1 Rates of Exchange**

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.

**72.2 Currency Proportions**

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.

**72.3 Currencies of Payment for Provisional Sums**

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

accordance with the provisions of Clauses 58 and 59.

### **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 labor 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**

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**COLLECTORATE OF CUSTOMS ENFORCEMENT, KARACHI**

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F  
CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH  
MAZAR KEAMARI KARACHI**

**BIDDING DOCUMENTS**

**VOLUME-II**

**TECHNICAL SPECIFICATIONS**

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## **CIVIL WORKS**

## **SECTION-0      GENERAL REQUIREMENTS**

### **0.01      GENERAL DESCRIPTION**

#### **0.1.01      Location of Site**

The site of the project is located in Keamari, Karachi, Sindh.

#### **0.1.02      Work Under This Contract**

The work under this Contract comprises the Construction, Completion, Handing over and Maintenance of Structure, Architectural, Finishes, Building Services relating to Electrical, Water Supply and Sewerage, Communication, security, site work and / or any other discipline necessary to be executed together with or incorporated in the structure works including but not limited to pipe sleeves, embedded parts, conduits, earthing pits, tube wells etc. as specified by the Contract / necessitated by the project requirements / instructed by the Engineer.

The Contractor shall be required to plan and execute the works in a manner such that the project is completed within the time specified in the Contract and in conformity with the provisions contained in the documents of Contract. The Contractor shall furnish a detailed construction programme along with a list of plant and equipment with capacities and capabilities for the approval of the Engineer. The Contractor shall also be required to submit a site supervisory / management chart.

#### **0.1.03      Execution of Work**

All Work shall be executed in accordance with the requirements and in a manner set forth in the documents of Contract and in accordance with the instructions of the Engineer or Engineer's Representative. The Contractor shall confine his operations to the areas that are actually designated, for the Works, by the Employer. The Contractor shall be required to supply and maintain his own storage facilities, site office, sanitary facilities, and all temporary connections for electricity, water, sewerage and telephone etc. at his cost, subject to the approval of the Engineer.

### **0.02      APPLICABLE STANDARDS**

Unless specified otherwise in the Contract Documents, all the Work and materials shall conform to the requirements of American Society for Testing Materials (ASTM) Specifications, American Concrete Institute (ACI) and British Standard Specifications (BSS) and as per the Drawings and Specifications.

### **0.03      TEST LABORATORY AND TESTING**

0.03.1      Testing unless specified otherwise in the Contract, shall be performed by an approved testing agency as proposed by the Contractor and at no extra cost to the Employer. The Engineer may require all testing to be carried out under his supervision.

0.03.2      The quality control testing shall be arranged and performed by the Contractor's competent personnel in accordance with a Site Testing and Quality Control Programme / Facility to be established by the Contractor, and approved by the Engineer. The Contractor shall keep complete record of all the quality tests performed including the date and time of testing and submit the same to the Engineer. All quality control and related tests shall be carried out in accordance with applicable standards and codes under the supervision of the Engineer. The Contractor shall establish a laboratory on site which shall have equipment for testing Compressive Strength of concrete, Sieve Analysis and Compaction Test, as per the instructions and to the satisfaction of the Engineer.

### **0.04      STORAGE AND HANDLING FACILITY**

The Employer shall assign the Contractor storage space for the storage of plant, equipment and materials for Contract Works. However, the Contractor shall ensure that, on no account shall such temporary installation conflict / interfere with any of the permanent installations, services and any operational function of the Employer. The handling and storage of all plants, equipment and materials at Site shall

be the responsibility of the Contractor and at no risk or cost to the Employer.

The Contractor shall protect all materials against corrosion, damage of any kind or deterioration during storage and also during erection on Site. The protection methods shall be to the approval of the Engineer.

**0.05 TEMPORARY FACILITIES**

The Contractor shall provide, erect / install, maintain, alter as and when necessary and remove on completion except as otherwise directed by the Engineer all temporary facilities and services as described hereinafter and / or in the Contract documents and / or as instructed and approved by the Engineer, all at his own cost and expenses.

**0.05.1 Contractor's Site Office**

The Contractor's temporary site office and stores etc. including all buildings, utilities and facilities shall be available for use not later than 15 days after the date of the Site handing over.

**0.05.2 Temporary Fencing & Lightning**

The Contractor shall provide and maintain at his own cost all temporary lights, guards, fencing and watching to the approval of the Engineer for the safety and protection of the Works.

**0.05.3 Site Sign Boards**

Before manufacturing and installing sign boards at site, the Contractor shall present a design and obtain the approval of the Engineer.

**0.05.4 Temporary Services**

a. Water & Electricity

The Contractor shall make his own arrangement at his cost for water for construction, drinking and other purposes and shall also provide temporary power for the operation of construction equipment and lighting. The Contractor shall be responsible for the supply, maintenance, repair and operation of these services at his own costs throughout the construction period. The Contractor shall also provide adequate sanitary facilities for the use of his staff and Workmen and remove these services upon completion of Works at his own cost.

b. First Aid

The Contractor shall provide and maintain First Aid Facilities on the Site. First Aid kits of the type, model and number, equipped properly according to the requirements of the local health authorities and as approved by the Engineer must be furnished by the Contractor at Site.

c. Fire Fighting

The Contractor shall provide and maintain adequate firefighting facilities on the Site at his own cost to the approval of the local Fire Authority and Civil Authority and the Engineer. Firefighting equipment like fire buckets, fire extinguishers or other effective means ready for instant use shall be installed at suitable places at the project.

**0.06 FACILITIES FOR THE ENGINEER**

**0.06.1 Supervisory Staff Site Office**

- a. The Contractor shall provide and maintain suitably furnished Supervisory Staff Site Office for the Engineer and his staff as per the details approved by the Engineer.  
The site office shall be air-conditioned and provided with ceiling fans, utilities, security, kitchen and toilet facilities. The floor area and design of the site office shall be as approved by the Engineer. This duly furnished office shall be ready for possession of the Engineer within 15 days of Receipt of Engineer's notice to commence the work.
- b. It shall be provided with Office attendants, Computers, printers, photocopy machines, phones, necessary office stationery etc. as listed in the tender documents.

- c. The Kitchen shall be equipped with all necessary Kitchen equipment, microwave oven and fridge.
- d. Telephone and fax facilities as at (b) above shall be provided by the Contractor and all the installation and running costs shall be deemed to be included in the rates of the Contractor.
- e. The Contractor shall provide and would be responsible for the daily cleaning, as well as the running and maintenance of the site office including, electricity supply, water, sewerage disposal etc.
- f. The Site Office shall be removed from the site when the project is complete, leaving the site neat and clean and/or all as required by the Engineer. The cost on this account shall be deemed to be included in the unit rates of the Contractor.

**0.06.2 Supervisory Staff Transport**

The Contractor shall provide new air-conditioned vehicles as listed in the tender document along with drivers for the use of the Engineer and his staff till the completion of the project. The Contractor shall be responsible for all the running and maintenance costs of the said vehicles. No separate payment shall be allowed on this account and all such costs shall be deemed included in the unit rates of the Contractor. All maintenance and repair work during the currency of the project shall be carried out promptly by the Contractor failing which all such works shall be got done by the Engineer at the cost of the Contractor.

**0.07 PROJECT RECORD DOCUMENTS**

The Contractor will submit shop drawings showing work sequence, work methodology, including location of construction joints, pouring sequences for the approval of Engineer prior to start of work on each stage of the project or at any time if requested by the Engineer.

The Contractor will maintain complete, accurate log of all construction work as it progresses through recording progress on the approved work-plan, progress reports and construction photographs stage wise.

The Contractor will submit weekly and monthly progress reports to the engineer, on approved format with photographs.

On completion of foundation, retaining walls and other major construction milestones, prepare certified As-built drawing showing work done, dimensions, locations, angles and elevations of construction and site work.

**0.08 MEASUREMENTS AND PAYMENT**

No separate payment shall be made for the services and performance provided under this section of Specifications.

The Contractor is deemed to have covered the costs of all related supplies and performance in the unit prices of other contract items.

**\*\* END OF SECTION\*\***

## **SECTION-1 CLEARING, GRUBBING & SETTING OUT OF WORKS**

### **1.01 SCOPE OF WORK**

The Work covered by this section of Specifications consists of furnishing all labour, materials, necessary equipment, services, miscellaneous and necessary items, required to satisfactorily complete the clearing, grubbing and setting out of the Works, as indicated on Drawings, specified herein and subject to the terms and conditions of the Contract.

### **1.02 CLEARING**

Clearing shall consist of cutting up or trimming of trees, if any, and the satisfactory disposal of trees and other vegetation designated for removal, together with the down timber, snags, bushes, and rubbish occurring within the areas to be cleared. Trees, other vegetation, stumps, roots, and bushes in areas to be clear shall be cut-off below the original ground to extract the roots except such individual trees, groups of trees and vegetation as may be indicated on the Drawings or designated by the Engineer to be left standing. Individual trees, groups of trees, and other vegetation, to be standing, shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances required, and as approved by the Engineer. Clearing operations shall be conducted so as not to cause any damage or harm to existing structures and installations and to those under construction, and so as to provide for the safety of employees and others.

### **1.03 GRUBBING**

Grubbing shall consist of the removal and disposal of all occurring stumps, roots larger than 38 mm in diameter, matted roots in the designated grubbing areas, stumps, roots, logs or other timber more than 38 mm in diameter, matted roots and other debris shall be excavated and removed to a depth not less than 450 mm below any subgrade, shoulder or slope. In areas where the cut is over 1.0m, grubbing shall not be necessary. In areas to be paved or in areas indicated on the Drawings or designated by the Engineer as future paved areas where excess excavation from grading operations is placed, grubbing will be necessary.

### **1.04 DISPOSAL**

Unless directed otherwise, timber and other refuse shall be disposed of by burning at locations approved by the Engineer in a manner that will avoid all hazards such as damage to existing structures, construction in progress, trees and vegetation's. The Contractor shall be responsible for compliance with all pertinent laws and regulations pertaining to the burning of fires and observance of any security regulations applicable thereto.

Disposal by burning shall be kept under constant attendance until the fires have burned out or have been extinguished. No materials will be permitted to be pushed or placed on adjacent property without prior written approval of the owner of such property.

### **1.05 SETTING OUT OF WORKS**

The Contractor shall set out the Works and shall be responsible for true and perfect levels and setting out of the same and for correctness of the direction, positions, levels, dimensions and alignments of all parts thereof. If any error in this respect shall appear during the progress of the Work, the Contractor shall at his own expense rectify such error to the satisfaction of the Engineer. Any checking by the Engineer shall not relieve the Contractor from his complete unshared responsibility for correct setting out of Works. The Contractor shall construct and maintain accurate bench marks so that the lines and levels can be easily checked by the Engineer.

### **1.06 DRAINAGE DITCHES / DEWATERING**

The Contractor shall construct and maintain such ditches / drains in addition to those shown on Drawings or as may be ordered by the Engineer to adequately drain the areas under construction of the water from any source including subsoil water in foundations. If due to any negligence the area is flooded the same shall be drained with adequate measures by the Contractor at his own cost.

### **1.07 MEASUREMENT AND PAYMENT**

The quantities for grubbing, clearing, disposal and protection works shall be taken into account on lump sum basis and payment shall be made accordingly at the rate entered in the Bill of Quantities.

No separate payment shall be made for setting out of Works. The Contractor shall be deemed to cover the costs for this item of work in the unit price of other Contract items.

Disposal of surplus material beyond initial 1000m lead.

**\*\* END OF SECTION\*\***

## **SECTION-2 EXCAVATION AND BACKFILLING**

### **2.01 SCOPE OF WORK**

The Work covered by this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with excavation, de-watering, filling, back-filling, stock piling of suitable excavated material and disposal of all surplus and unsuitable material for construction works and foundations for structure & services line trenches, complete, in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract and as per existing laws imposed by the local authorities.

### **2.02 SUB-SOIL CONDITIONS**

2.02.1 The Contractor shall acquaint himself with the nature of the ground, existing structures, foundations and subsoil conditions, which might be encountered during excavation or earthworks on the Site and his bid shall be fully covering the works involved. The Employer does not guarantee or warrant in any way that the materials to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Geotechnical Report, Drawings or in any other Contract Documents or to material obtained from boring or trial holes.

2.02.2 The Contractor shall make his own deductions for sub-surface conditions which may affect methods or cost of constructions of the work hereunder and he shall make no claim whatsoever for damages or compensation, should he find conditions during the progress of the Work, different from those as calculated and/or anticipated by him.

2.02.3 The Contractor shall be deemed to have made local and independent inquiries as to and shall take the whole risk of the nature of the ground, subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground, subsoil or material.

### **2.03 EXCAVATION**

2.03.1 The Contractor shall perform a joint survey with the Engineer's Representative, of the area where earthwork is required, plot the ground levels on the drawings and obtain approval from the Engineer before starting the earthwork.

2.03.2 Excavation shall include the removal of all material of every name and nature. If rock or concrete is encountered, it should be removed carefully and without excessive noise and vibration. Use of explosives shall not be permitted and no extra rates or any payment in such a case shall be made to the Contractor.

2.03.3 The Contractor shall give reasonable notice to commence any excavation and he shall submit to the Engineer full details of his proposals. If the Engineer may require modifications to be made in the Contractor's proposals, the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

2.03.4 For major excavations, the Contractor shall submit for the prior approval of the Engineer full details and Drawings showing the proposed method and procedure for supporting and strutting, dewatering and maintenance of adjacent structures. The design, provision, installation, erection, maintenance and removal of such temporary works shall be the responsibility of the Contractor and all costs in these respects shall be deemed to be included in the rates quoted by the Contractor.

2.03.5 The Contractor's attention is drawn particularly to his obligations under the General Conditions of Contract in respect of those works which are in close proximity to existing buildings/structures.

2.03.6 The Contractor, if he deems necessary, for large excavations in soil including soft rock, can use excavators, caterpillars, backhoes and/or other excavating machinery as approved by the Engineer, to facilitate efficient operations on site.

- 2.03.7 The excavation shall conform to the dimensions and elevations as indicated on the Drawings or as directed by the Engineer. Foundations on made up ground shall have to be taken down to natural bottom soil as per Drawings, direction and approval of the Engineer.
- 2.03.8 Excavation shall extend to a sufficient distance from wall and footings to allow for placing and removal of forms, installation of services and for inspection but the same shall not be paid separately and is deemed to be included in the unit rates of the Contractor.
- 2.03.9 In the event of any excavations being carried out wider than the required/specified dimensions, the same shall be filled in by the Contractor at his own cost to the required levels with properly compacted well graded sand free from any deleterious substance as per directions of the Engineer.
- 2.03.10 No excavation shall be back-filled nor any Permanent Work commenced until the foundation has been inspected by the Engineer and his permission to proceed given.
- 2.03.11 In case, any excavation is carried out and the pits and trenches, are filled with accumulated sand or debris from blowing windstorm, dust-storms, moving sand dunes or by any other reasons thereof after the levels were checked by Engineer, then the excavation or leveling shall have to be carried out again in the same manner as before unless and until concreting is done in the foundation/trenches. No separate payment shall be made on any such accounts.
- 2.03.12 The Contractor shall construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction.

**2.04 SHORING AND BRACING**

The Contractor shall provide at his own cost, where required, all shoring, bracing, walls, supports etc. to the sides of the excavation to prevent sliding or any movement. Where necessary, excavated sides shall be sloped as directed by the Engineer with no extra cost to the Employer.

Shoring including sheet piling, where required during excavation, shall be installed to protect workmen and the banks, adjacent, structures, paving and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor selects to adopt with prior approval of the Engineer, for upholding the sides of excavation against the side of public roadways and adjoining properties in existing hardcore or any other material. The Contractor will be held responsible for upholding the sides of all excavations and no claim for additional excavation, concrete or other material will be considered in this respect and shall be deemed to be included in his rates.

**2.05 DEWATERING AND DRAINAGE**

If water is met with in the excavations due to springs, seepage, rain or any other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry at all times. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the contractor, if any such damage is caused, it shall be the sole responsibility of the contractor to repair/restore to the original condition at his own cost or compensate for the damage.

The Contractor shall control at his own cost all the grading in the vicinity of the Site of Work in order to prevent any water from running into the excavated areas.

The Contractor shall, at his own cost, keep bone dry all pits and trenches during construction and all dewatering and pumping out whether due to ground water seepage or otherwise shall be included in the rates as quoted by the Contractor. The method employed in all cases shall be approved and agreed by the Engineer.

**2.06 PROTECTION OF UTILITY LINES**

When any existing utility lines whether to be retained or to be removed are encountered within the area of operations, the Contractor shall notify the Employer/Engineer, and shall not proceed until necessary measures are taken for protection or removal of the lines and instructions are obtained from the Engineer/Employer. This will be done at no extra cost to the Employer.

**2.07 FILL AND BACKFILL**

- 2.07.1 After completion of foundations, footings, walls, slabs and other construction below the elevation of the final grades and prior to backfilling, forms shall be removed and excavation shall be cleaned of trash and debris. No backfilling shall be done until the entire foundations and footings etc. have been cured, inspected, approved and measured by the Engineer. Backfill shall be placed in horizontal layers not more than 6l thick and shall have a proper moisture content for the required degree of compaction of 95%. Each layer shall be compacted by mechanical tampers or by other suitable equipment approved by the Engineer. Backfill shall be brought to a suitable elevation above grade to provide for anticipated settlement and shrinkage thereof.
- 2.07.2 Where concrete slabs, floors and pavements are to be placed on the ground, any loam, organic and other unsuitable materials shall be removed.
- 2.07.3 Filling shall consist of approved selected material from excavation or approved granular material, free from lumps, debris, rubbish, wood, organic or other unsuitable matter and capable of compaction by approved means.
- Fill, where required to raise the sub-grade for concrete slabs, shall be clean unadulterated earth, free from deleterious and organic substances and shall also be free from wood, stones and other debris. In case, sand shall be provided for filling, the same shall be clean and free from harmful substances.
- 2.07.4 All materials, when used in fill shall be compacted to 95% modified AASHTO density by power roller, mechanical rammer, or other approved equipment, in layers not more than 6l thick. In sand filling, each layer shall be uniformly spread, saturated with water or dried and then compacted. The Contractor shall arrange at his own cost the testing of the filling.
- 2.07.5 Backfill shall not be placed against foundation walls etc. before 14 days and not prior to the damp proofing /water proofing treatment as specified elsewhere in these documents. Backfills shall be brought up evenly on each side of structures as far as practicable. Heavy equipment for spreading and compacting backfill shall not be operated closer to the structures less than the distance equal to the height of the backfill above the top of footing.
- 2.07.6 The filling material shall be subject to the approval of the Engineer and shall conform to AASHTO Soil Classification System.
- 2.07.7 Filling around pipes and cables shall be carried out carefully by placing fine material to cover the pipe or cable completely before the normal filling is placed.

**2.08 COMPACTION**

Fill and/or backfill within the building or wherever required within the premises shall be compacted to a density of not less than 95% of the maximum density at optimum moisture content.

**2.09 ROUGH GRADING**

- 2.09.1 Necessary rough grading shall be carried out by the Contractor to establish the finish grade or construction requirements of the Site, grades not otherwise indicated shall be uniform levels or slopes between points on existing and finished grades. Abrupt changes in slopes shall be rounded. Additional fill required to complete rough grading shall be provided as directed by the Engineer.
- 2.09.2 Where pavings or slabs are specified, all rough grading shall be done to the sub-grade of the base course, removing all large stones and debris and shall be compacted uniformly to the correct lines and levels ready to receive the paving or slab. Refilling, where required shall be executed with suitable selected materials in layers not exceeding 6l in thickness and thoroughly compacted to the required density.

**2.10 BOTTOM ELEVATIONS OF FOOTINGS/FOUNDATIONS**

The elevations as noted in the Drawings are only approximate and must be adjusted in the field with the approval of the Engineer depending on the soil conditions encountered. No concreting shall begin until the design soil bearing capacity is substantiated by visual inspection by the Engineer. Where suitable foundation material is found lower than the underside of footings as detailed, the space between the founding material and footing soffit shall be backfilled with well compacted gravel/soling. Where soling is provided below the foundations, it shall be well compacted and the interspaces shall be properly filled with lean concrete.

The Contractor in planning his work shall make arrangements and provision to construct the lowest level footing first.

**2.11 DISPOSAL OF SURPLUS EARTH AND RUBBISH**

All surplus earth, unsuitable material and rubbish shall be disposed of the Site as directed by the Engineer. The term disposal shall include all operations of loading, unloading, stacking, spreading, re-handling, filling depressions, leveling and grading as per instructions of the Engineer. The maximum limit for disposal of surplus material shall be 18 miles.

**2.12 SAND FILLING IN TRENCHES AND/OR UNDER FLOORS**

Sand filling shall be done in layers not more than 4l (100 mm) thick and shall be rammed after saturation to such an extent that 4l (100 mm) layer is reduced to about 2.7l (68 mm) after compaction.

The required in situ density w.r.t. maximum density to optimum moisture content shall be in compliance with test 12 of B.S 1377-1967.

The base shall be perfectly level. A slope of 1:64 shall be provided in verandahs and bathrooms is required.

Sand shall conform in all respect to the specifications for fine aggregate except for its grading, i.e., shall pass through a Sieve No. 16 and not more than 30% shall pass through a Sieve No. 100.

**2.13 GRAVEL LAYER UNDER FOOTINGS**

A gravel layer, as shown in drawings, will be provided below footings/ rafts as a drainage layer. It shall conform to conditions set out in Section 29 of this specification.

**2.14 HARD ROCK EXCAVATION**

Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and un-stratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the ENGINEER. Trees shall be supported during excavation by any means previously reviewed by the ENGINEER.

It is expected that nearly all excavation can be accomplished using conventional equipment.

- a. For general excavation, a D-9N Caterpillar tractor with a single shank ripper, or equivalent equipment, is considered conventional equipment, if it can rip at a production rate of at least 300 bank cubic yards per hour.
- b. For trench excavation, a 235C Caterpillar excavator with a medium stick and a rock ripping bucket, or equivalent equipment, is considered conventional equipment, if it can excavate at a production rate of at least 30 bank cubic yards per hour.

If material is encountered which the Contractor believes cannot be excavated by conventional equipment, the Engineer shall be immediately notified.

The Contractor shall provide performance tests of the specified conventional or equivalent equipment. If the Engineer confirms in writing that the specified conventional equipment cannot perform at the production rates specified, the excavation shall be considered rock excavation.

In areas to be later rip-rapped, large rock found during excavation of the stream channel may, upon approval of the Engineer, be left in place, excavated around and incorporated into the final riprap.

Should the Contractor encounter bedrock or excessive large boulders within the project site, which will require extensive excavation to achieve final grade, the Contractor shall immediately notify the Engineer. The Engineer shall review the hydraulic requirements of the stream in the affected area in a timely manner and advise the Contractor on acceptable alternate excavation.

The Contractor shall adopt a method of working such that at any time, control perimeter blasting operations including the drilling of perimeter holes do not advance by more than one panel ahead of bulk blasting operations and more than two panels ahead of mucking operations to remove all blasted materials to the perimeter face, unless specially approved by the Engineer, in order that adjustments to drilling, charging and detonation can be made, appropriate to the conditions being encountered.

Rock on the cut face that is loose, hanging, or creates a potentially dangerous situation during or upon completion of the excavation in each lift shall be removed or stabilized. No drilling for the next lift shall be carried out until this work is completed. Stabilization shall be performed at Contractor's own expense if caused by the Contractor's blasting operations.

Slopes of cuttings formed in rock are to be cleaned of all rock fragments which move when pressed with a crowbar.

#### **Explosives and Blasting**

It is not anticipated that blasting will be required for this project. Should the Contractor exhaust conventional equipment and methods for rock excavation and removal and desire to use explosives to accomplish this work, it shall comply with the following:

- a. Blasting and storage and handling of explosives shall be in accordance with the Construction Safety Orders of the Division of Industrial Safety of the California Department of Industrial Relations, Federal Safety Requirements, the San Mateo County Sheriff, and other authorities which have jurisdiction.
- b. The Contractor shall obtain all necessary permits and furnish copies to the Engineer before explosives are transported to the site. The Contractor shall pay for permits at no additional cost to the Owner.
- c. Blasting shall be done only by skilled operators under the direction of a licensed foreman.
- d. The Contractor shall identify all property, structures, and persons which may be affected by blasting and shall take all safety precautions and protective measures to prevent damage or injury to same. All personal injury or damage to persons or property of any nature, whether in the WORK or appurtenant to it, shall be the responsibility of the Contractor.
- e. The Contractor agrees by submission of a bid to indemnify and hold the Owner, its officers, agents, employees, and the Engineer harmless from any and all liability claims, costs and expenses including expenses of investigation and defending against same in regard thereto.
- f. Blasting shall only be permitted in hours approved by the Engineer and regulatory agencies having jurisdiction. Blasting will not be permitted on legal holidays.

#### **Blasting**

- a. The Contractor shall perform instrumented seismographic monitoring on blasting. A seismograph shall be placed at [the nearest structure to the blast] to monitor the ground motion particle velocity and frequency during each blast. One copy of each daily seismograph chart shall be furnished to Engineer.
- b. Fly rock from blasting shall be contained within the project site and shall not represent a hazard to persons, vehicles, existing improvements, or vegetation.
- c. The blasting site shall be cleaned of all debris at the end of each day.
- d. No blasting shall be done within 100-feet of concrete which has been placed in less than 7 days, except by permission of the Engineer.

#### **Post-Blasting**

The Contractor shall submit an As-built layout plan showing the extent of the rock excavation/blasting area (Before and after excavation within the claiming period) with indication of hard rock area rock's spot levels.

The independent inspector shall investigate each complaint of property damage and a written report shall be furnished to the Engineer within 30 days of receipt of the complaint.

**2.15 MEASUREMENT & PAYMENT**

Excavation shall be measured per cubic Meter/ft on the assumption of vertically excavated walls required for the nominal concrete dimensions of the structural members of the foundation shown on the Drawings and paid for at the unit rates entered in the Bill of Quantities, inclusive of backfilling, compaction, disposal of surplus earth, dewatering, bracing, shoring etc.

All horizontal measurements shall be taken from established reference point. At the option of the Engineer-in-charge, the contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken.

Disposal of surplus material beyond initial 100 ft lead up to a maximum of 18 miles, shall be paid separately, at the rate approved by the Engineer.

Dewatering shall not be paid separately. All dewatering and pumping out whether due to groundwater seepage or otherwise shall be included in the rates as quoted by the Contractor.

**\*\* END OF SECTION\*\***

## **SECTION-3 TERMITE CONTROL**

### **3.01 SCOPE OF WORK**

The Work covered by this section of Specifications consists of furnishing all labour, materials, equipment, services, miscellaneous and necessary items required to complete Termite Control Work, related works as indicated on Drawings, specified herein, in the Bill of Quantities and subject to the terms and conditions of the Contract.

The work for anti-termite treatment will include injection of insecticide in sides and bottom of excavated foundation, trenches, spraying on stockpiled backfill material, filled up earth, injections of the insecticide in floor sub-grade of the building and any other operation, which the specialized firm may consider necessary in context to their guarantee obligations. The scope also covers treatment of all wood works with insecticides before installation in position.

### **3.02 MATERIALS**

3.02.1 The chemicals approved by Pakistan Council of Scientific and Industrial Research (PCSIR) like Fiprokil, Biflex, Agenda, Dursban etc, or approved equivalent, emulsifiable concentrate insecticide, specially formulated to prevent infestation by termites.

3.02.2 The chemical will be diluted with water as per manufacturer/ supplier instructions. Fuel oil will not be permitted as diluents.

3.02.3 Pure turpentine shall be used for dilution of insecticide, in approved proportion for application to woodwork.

### **3.03 METHOD OF APPLICATION**

Pesticide solution shall be applied with approved pressure spraying equipment maintaining a pressure of 1N/mm<sup>2</sup> (10 Kg/cm<sup>2</sup>) to all applications on or in earth. Spraying to wood shall be done by hand compression sprayers with an approximate pressure of 0.15 N/mm<sup>2</sup> (1.5 Kg/cm<sup>2</sup>).

Mixing and dilution of the concentrate insecticide with water shall be done at site and as per manufacturer recommendations. This solution shall be sprayed over 500 square feet of surface area.

Rate of application of the solution shall be as per the recommendations of the manufacturer. Insecticide shall penetrate to a depth of 1 inch. (25mm) minimum in porous earth at bottom and at least 50mm at the sides of excavations

### **3.04 EXTENT OF APPLICATION**

3.04.1 Soil treatment shall begin after all work of preparation of earth prior to installation of concrete has been done. After application, no additional earth moving or work upon sub grade should be done. No covering of earth or concrete should be applied over soil treatment until at least 24 hours after treatment has been made.

3.04.2 Insecticide solution should not be applied during wet weather, or when the earth surface is excessively wet. Application should be made to all areas beneath concrete slabs-on-grade, including sidewalks and paving abutting buildings for distance of at least 6 feet beyond building line.

3.04.3 Contractor to ensure a continuity of treatment under and around the footings and up to the slab on grade in the form of an envelope.

3.04.4 Care shall be exercised to insure that no marks or damage occurs to the finished structure as a result of the work under this section.

3.04.5 All woodwork for the entire project is to be insecticide treated (before application of solignum). Insecticide shall be sprayed on all surfaces of all the wooden work viz., door frames, blocking, furring, planks, boards etc. before installation. Spraying is to be done at the site, after delivery and before installation. No spraying shall be necessary after field sawing, jointing or installation of such material.

3.04.6 Sides of foundation excavations, grade beam, and similar areas shall be treated with solution at a rate of 0.5 lit per square feet upon inner sides of such excavations, and at all locations where concrete slabs for platforms and similar work about the building. Similar treatment shall be made at all locations where expansion Joints, control joints, column bases and similar work occur at or below grade slabs.

- 3.04.7 In the areas of application signs shall be fixed to show that soil treatment has been applied. Such signs shall be removed when areas are covered by other construction.
- 3.04.8 All excavations, all walls and bottoms of all pits or trenches for footings or foundations are to be sprayed. Pesticide shall penetrate to a depth of 12" minimum in porous earth at bottom and 3" minimum at sides of excavations.
- 3.04.9 Stockpiled excavated material to be used as backfill is to be spray treated as above. After backfilling to plinth level, area of the whole building up to 10 ft. outside the building line is again to be sprayed penetrating a minimum of 12" into soil.
- 3.04.10 After grading, compaction and leveling and before formation of hard core/soling under floor slabs, all areas to receive slabs shall be sprayed with pesticides, penetrating a minimum of 12" into soil.

### **3.05 LOCATION AND SCHEDULING**

- 3.05.1 Saturation of earth is to be done by adequate personnel and in such a manner as to in no way disrupt the progress of Work.
- 3.05.2 Care shall be exercised to ensure that no marks or damage occurs to the finished building as a result of the work under this section and the Contractor shall verify and ensure that no material used herein will impede the growth of grass or plants at areas where spraying is done.

### **3.06 APPLICABLE STANDARDS**

All methods of termite protection used herein shall be in accordance with best standard practices of National Pest Control Association, USA and the British Wood Preserving Association.

### **3.07 QUALITY ASSURANCE**

In addition to the requirements of these specifications, the contractor shall comply with manufacturer's instructions and recommendations for the work, including preparation of substrata and application.

A professional operator shall be engaged who shall have license in accordance with regulations of governing authorities for application of soil treatment solution.

### **3.08 GUARANTEE**

The Contractor is to guarantee that the building shall be free from termite (white ants), wood bores and other pests or rodents which cause damage to wood or other organic material for at least 10 years from the date of acceptance of the building.

In the event of any damage caused within the guarantee period, the Contractor shall replace at his own cost such damaged material, finishes and affected portion thereof and suitably preserve and treat the entire premises with the best method known to the trade to prevent the spreading of termites.

### **3.09 TESTING**

The Contractor shall supply samples of all the materials to be used for insecticide control for approval of the Engineer-in-charge.

All materials and samples shall be subject to standard testing in accordance with the standards specified herein and shall be rejected if found below these standards. Rejected materials shall be removed from the Site immediately.

### **3.10 MEASUREMENT AND PAYMENT**

Only the top surface area of the finished floor or pavement shall be measured for the payment of termite proofing work of the whole project carried out under this section. The measurement will be made in square feet/ meter and paid for at the unit rates entered in the Bill of Quantities.

**\*\* END OF SECTION\*\***

## SECTION-4 PLAIN AND REINFORCED CONCRETE

### 4.01 SCOPE OF WORK

The Work covered by this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with plain and/or reinforced concrete work complete in strict accordance with this section of Specifications, applicable Drawings and subject to the terms and conditions of this Contract.

### 4.02 APPLICABLE STANDARDS

Latest editions of the following Pakistan, British and ASTM ACI Standards are relevant to these specifications wherever applicable.

#### 4.02.1 Pakistan Standards

PS233	Portland Cement (ordinary & rapid hardening)
PS243	Natural aggregates for concrete
PS279	Abrasion of coarse aggregates by the use of Los Angeles machine.
PS280	Determination of aggregates crushing value
PS281	Organic impurities in sand for concrete aggregate.
PS282	Material finer than No. 200 BS test sieve in aggregates, method of test for
PS283	Soundness test for aggregates by the use of sodium sulphate or magnesium sulphate.
PS284	Sampling aggregates for concrete
PS285	Sampling aggregates for concrete
PS286	Sieve or screen analysis of fine and coarse
PS421	Description and classification of mineral aggregates
PS422	Sampling fresh concrete
PS560	Slump test for concrete
	Making and curing concrete compression test specimen in the field.
	Sulphate-resistant Portland cement type 'A' and sampling fresh concrete in the laboratory.
PS612	Mixing
PS716	Mixing
PS717	Compacting factor test for concrete
PS746	Definitions and terminology of cements
PS849	Making and curing concrete compression test cubes.

#### 4.02.2 ASTM (American Society for Testing and Materials)

C33	Standard Test Method for Fine and coarse aggregates
	Organic impurities in sand for concrete.
C39	Standard Test Method for Compressive Strength of Cylindrical Concrete
C40	Specimens
C87	Effect of organic impurities in fine aggregates on strength of mortar.
	Soundness of aggregates.
C88	Ready mixed Concrete.
C91	Cement Standards and Concrete Standards
C94	Compressive strength of hydraulic cement mortars
C 109	Material finer than No. 200 (0.075mm) sieve
C 117	Light weight pieces in aggregates.
C 123	Concrete and concrete aggregates.
C 125	Specific gravity and absorption of coarse aggregate.
C 127	Specific gravity and absorption of fine aggregate.
C 128	Resistance to abrasion of small size coarse aggregate.

C 131	Sieve or screen analysis of fine and coarse aggregate.
C 136	Clay lumps and friable particles in aggregates.
C 142	Slump of Portland Cement Concrete
C 143	
C150	Standard Specification for Portland Cement
C156	Water retention by concrete curing material
C171	Sheet material for curing concrete.
C185	Air content or hydraulic cement mortar.
C188	Density of hydraulic cement.
C191	Time of setting of hydraulic cement by vicat needle
C260	Air entraining admixture for concrete.
C289	Potential reactivity of aggregate.
C309	Liquid membrane forming compounds for curing concrete.
C387	Chemical admixtures for concrete.
C494	Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
C535	
C75	Resistance to abrasion of large size coarse aggregates.
C994	Aggregate sampling.
C1190	Preformed expansion joint filler for concrete.
C1715	Concrete joint sealer (hot poured elastic type). Preformed expansion joint filler for concrete paving and structural concrete.
D1850	
E11	Concrete joint sealer (cold application type).
E96	Wire cloth sleeves for testing purposes.
E154	Water vapor transmission of materials in sheet form.
E337	Materials for use as vapor barrier under concrete slabs. Relative humidity by wet and dry bulk psychrometer.

#### 4.02.3 ACI (American Concrete Institute)

211	Recommended practice for selecting proportions for normal and heavy weight concrete.
214	Quality control charts
301	Specifications for structural concrete for building.
304	Recommended practice for measuring, mixing, transporting and placing concrete.
305	Hot weather concreting.
308	Recommended practice for curing concrete.
309	Recommended practice for consolidation of concrete
315	Manual of standard practice of detailing reinforcement concrete structure.
318	
347	Building code requirement of reinforced concrete. Recommended practice for concrete formwork.

#### 4.02.4 British Standards

BS 12	Specifications for Portland cement, ordinary and rapid hardening
BS 410	Specifications for Test Sieve
BS 812	Specification for aggregates from natural sources for concrete Method of testing concrete
BS 822	Test for water making concrete
BS 1881	Method for determination of Compressive Strength of Concrete Cubes
BS 1348	Rigid expanded polyvinyl chloride for thermal insulation.
BS 3837	Sulphate-resisting Portland cement
BS 4027	Specification for Sulfate-Resisting Portland Cement
CP 8110	

CP 114 BS 4550 BS 8500	Specifications for Design and Construction of Reinforced and Pre-stressed Concrete The Structural Use of Reinforced Concrete in Buildings Methods of Testing Cement Concrete – Complementary British Standard
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In addition, the latest editions of other Pakistan and British Standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other Standards as may be specified by the Engineer for special Materials and Construction are also relevant.

#### 4.03 **GENERAL**

- 4.03.1 Until and unless specified or directed otherwise by the Engineer, all materials and workmanship shall be based on the latest versions of applicable ASTM Standards in force at the time of inviting tenders.
- 4.03.2 Any defective work in the opinion of the Engineer shall be removed and reconstructed without undue delay to the approval of the Engineer and the Contractor shall bear all additional costs incurred.
- 4.03.3 Any previous checks by the Engineer shall not in any way relieve the Contractor of his responsibility in respect of quality and accuracy of Work.
- 4.03.4 Full care shall be taken to install embedded items. Embedded items shall be inspected and checks for reinforcements and other materials and items shall be completed and approved before concrete is placed.
- 4.03.5 The Contractor shall get the bar bending schedules of reinforcement checked and approved from the Engineer prior to the cutting of reinforcement.
- 4.03.6 The Contractor shall maintain an accurate record of ambient temperature of Site. Ambient temperature shall be measured using mercury thermometers or other thermometers acceptable to the Engineer.
- 4.03.7 Throughout the concrete work, the Contractor shall employ full time on the Works suitable number of qualified and experienced Engineers whose sole duties shall be as follows:
- Design of concrete mixes
  - Quality control of concrete
  - Supervision of mixing, transporting, placing, compacting, finishing, curing and protecting concrete.
  - Supervision of sampling and testing.
  - Preparation and submission of test certificates and reports.
  - Completion and keeping of record.
  - Such other duties as the Engineer may direct.
- 4.03.8 All concrete work including reinforcement etc. shall be carried out in accordance with the applicable requirements of ACI/ASTM/BSS Standards and to the instructions of the Engineer.

#### 4.04 **MATERIALS**

##### 4.04.1 **Cement**

- a) Ordinary Portland cement shall be grey normal setting cement of approved make and source and of the specified gravity, fineness and chemical composition fully conforming to British Standard Specifications BS-12 and shall be capable of satisfying all tests such as the tensile strength tests contained therein.
- b) Sulphate resistant cement where required shall be sulphate resistant Portland cement of the approved make fully conforming to BS-4027 and satisfying the requirements for fineness, chemical composition, strength, setting time and soundness, etc.
- c) For all types of cement described in sub-clauses 4.03.1 (a) & (b) above, the cement shall have a tricalcium aluminate (C<sub>3</sub>A) content by weight not less than 5% and not more than 8%.

- d) For all types of cement described in sub-clauses 4.03.1 (a) & (b) above. The initial setting time shall not be less than 45 minutes and final setting time not more than 10 hours.
- e) The supply of cement must be so programmed by the Contractor that at no time the quantity of cement stock shall be less than that required for an average consumption of four weeks. Lorry or truck or other means of transportation for the conveyance of cement to the Site of Work shall be clean, dry, metal-lined and covered from top with water proof sheets, so that cement is sufficiently protected from any deterioration during transit.
- f) Cement shall be delivered in sealed bags and be stored in moisture-protected and well-ventilated sheds and each cement supply shall be stored separately.
- g) The Contractor shall provide at his own cost on the Site all necessary sheds which shall be perfectly dry, waterproof and adequately protected against ingress of water for the storing of cement to be delivered to the Work, to ensure adequate supplies being available for the Work.
- h) Cement, which is damp or contains lumps which cannot be broken to original fineness by finger pressure will be condemned irrespective of age and must be removed from the Site.
- i) If any time the Engineer considers that any batch of cement may have deteriorated on Site during storage for any reason, he will direct that tests shall be made and the batch of cement on the Site which may be in question shall not be used until it has been shown by test to be of satisfactory quality at a laboratory approved or appointed by the Engineer. The Contractor shall bear all costs of such testing. The Contractor without delay shall remove any rejected cement from the Site. Cement reclaimed from cleaning bags or leaking containers shall not be used in the Works and immediately be removed from the Site.
- j) Cement shall be consumed in the sequence of its arrival at Site unless otherwise directed by the Engineer.

**4.04.2 Aggregates**

- a) All fine and coarse aggregates to be used shall be supplied from approved sources, which shall not be changed without permission in writing from the Engineer. Aggregates shall conform to the requirements of applicable ASTM C33-82.
- b) Fine aggregates, shall be from an approved source of supply of a uniform quality conforming to ASTM C-33-82 and shall be clean and sharp and free from clay, earth, vegetable and organic matters, alkaline or acid reactions or other deleterious salts or such harmful matters and impurities.
- c) Fine aggregates shall conform to the requirements of the relevant ASTM C- 33-82 Specifications, and shall be graded as follows;

<u>Sieve Number/Size</u>	<u>Percentage (by weight) passing</u>
9.5 mm (3/8")	100
4.75 mm (No. 4)	95 - 100
2.36 mm (No. 8)	80 – 100
1.18 mm (No. 16)	50 – 85
0.6 mm (No. 30)	25 – 60
0.3 mm (No. 50)	10 – 30

- d) Coarse aggregate shall also conform to the requirements of Table 2 of ASTM C-33 and shall be graded as follows:-

For Reinforced Concrete (Nominal Size of Graded Aggregates 20.0 mm to 2.36 mm)

<u>Sieve Number/Size</u>	<u>Percentage (by weight) passing</u>
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25.0 mm	100
20.0 mm	90 – 100
9.5 mm	20 – 55
4.75 mm (No. 4)	0 – 10
2.36 mm (No .8)	0 – 5

- e) All aggregates shall be stored on properly constructed paving and in bins and there shall be a physical partition between the stockpiles of coarse and fine aggregates. No mixed up aggregates shall be used in any concrete. Under no circumstances aggregates shall be allowed to be in contact with ground.
- f) If required, aggregates shall be washed and screened to the sequence of receipt of supplies unless otherwise directed by the Engineer.
- g) All aggregates shall be subjected to the approval of the Engineer. Any aggregates not found to be of the required standard shall be rejected by the Engineer and shall have to be removed from Site without delay. Concrete structures executed with rejected aggregates shall be dismantled and rebuilt at the Contractor's expense.
- h) Special fine gravel of 9 mm. size shall be used if called for in the Drawings or as directed by the Engineer.
- i) Physical properties of aggregates shall be in accordance with Table 3 of ASTM C33.

**4.04.3 Water**

Water to be used in the Work shall be potable water and shall be free from all impurities whether suspended or dissolved. Further, the water shall not contain any chemical impurities, salts etc. of any kind. Water shall be tested for its fitness in Works in accordance with AASHTO Method T26-51.

**4.04.4 Admixtures**

- a) Suitable admixtures from BCR, Sika, Fosroc, Betocrete C-16 or Master Builders or other approved manufacturers may be used in concrete mixes with the prior approval of the Engineer. The amount of admixtures added to each batch of concrete requires careful control and shall be added in the doses as recommended by the manufacturers and approved by the Engineer. The cost of the admixtures shall be deemed to be included in the rates.
- b) For use of an admixture, the information required by the Engineer shall be submitted to him for each admixture for his approval.
- c) BASF 700 or approved equivalent concrete retarding agent, may be used if required with the approval of Engineer.

**4.05 CLASSIFICATION OF CONCRETE**

Classification of concrete to be used in various parts of the Works shall be as indicated on the Drawings and mentioned in the Bill of Quantities. Unless noted otherwise, all blinding concrete shall be of Class E. The concrete of various grades shall be proportioned as set out in Table-1 appended hereto.

Table-1 showing minimum required compressive strengths on 6l x 12l long test cylinders and minimum quantity of cement required per m<sup>3</sup> of finished concrete for various mixes and under various conditions is given below:

**TABLE – 1**

Class of Concrete	Minimum Qty. of Cement Kg/m <sup>3</sup>	Work Cylinder Strength		Max. Water-Cement Ratio
		@ 7 days (psi)	@ 28 days (psi)	
D2	540	4200	6000	0.33

D1	400	3500	5000	0.40
D	385	3150	4500	0.42
A3	350	2800	4000	0.45
A2	325	2450	3500	0.47
A1	300	2100	3000	0.50
C	300	1750	2500	0.50
E	275	1400	2000	0.52
F	217	875	1250	0.55
G	159	600	850	-

**Non-structural Concrete**

Non-structural concrete (NS concrete) shall be used only for non-structural purposes where shown on the Drawing. NS concrete shall be compound of ordinary Portland cement and aggregates complying with this Specification.

The weight of cement mixed with 0.3 cubic meters of combined aggregate shall not be less than 50 kg. The mix shall be proportioned by weight or by volume. The maximum aggregate size shall be 40 mm nominal.

The concrete shall be mixed by machine or by hand to a uniform colour and consistency before placing. The quantity of water used shall not exceed that required to produce a concrete with sufficient workability to be placed and compacted where required.

The concrete shall be compacted by hand towels or rammers or by mechanical vibration.

**4.06 PROPORTIONING OF CONCRETE MIXES**

All concrete shall be proportioned by weight for design of concrete mixes, unless specifically agreed by the Engineer to proportion them by volume, which permission shall be given only if the arrangements made at Site are satisfactory. The Contractor shall submit to the Engineer proposed mix designs for concrete to be used, based on preliminary laboratory tests to determine proportion of cement, aggregates and water in the concrete conforming to the quality and strength requirements specified herein. Preliminary test results of at least three different mixes of each class of concrete with varied water-cement ratio shall be submitted. The results of 7 days and 28 days cylinder tests shall be used to establish the ratio between 7 days and 28 days strengths of used concrete. The Engineer may make adjustments in the ratio of fine to coarse aggregates in the mix for a certain work. Preliminary design of mixes and testing shall be the responsibility of the Contractor at his own cost. The proportion of voids in between the coarse aggregate shall be controlled and if it exceeds 0.45%, the Contractor without any charge shall increase sand and consequently the cement. If the proportion is less than 0.45%, sand shall be decreased but not the cement.

The detailed data, calculations and test results shall be compiled in a report and the proposed mix be declared by the Contractor. The report shall be submitted to the Engineer in time before commencing the concrete works and all test results shall be to the Engineer's satisfaction.

Lack of approval by Engineer shall not constitute a reason for an extension of time or additional costs.

**4.06.1 No Fines Concrete**

"No Fines" concrete shall consist of approved aggregate graded between 40mm and 20mm with not more than 5% passing the 20mm sieve.

The mix shall consist of 0.25 cu m of aggregate to 50kg cement. The aggregate is to be damp at the time of mixing and the water/cement ratio is to be strictly controlled to evenly wet the aggregate with grout.

The concrete is to be placed as quickly as possible after mixing and is to be lightly rodded to assist placing. The concrete shall not be vibrated or rammed.

**4.06.2 Maximum Allowable Water Content**

All concrete specimens shall be made, cured and tested in accordance with ASTM Standard. A curve representing the relation between the water content and the average 28 days compressive strength or earlier strength at which the concrete is to receive its full working load shall be established for a range of values including all the compressive strengths shown on the plans. The curve shall be established

by at least four points, each point representing average values for at least four test specimens. The maximum allowable water content for the concrete shall be as determined from this curve and shall correspond to a strength 15% greater than indicated on the plans. However, the water cement ratio shall not exceed the value given in Table-1 above for the class/strength of concrete specified. No substitution shall be made in the materials used in the work without additional tests in accordance herewith to indicate that the quality of the concrete is satisfactory.

**4.06.3 Slump Test**

The slump for concrete, determined in accordance with ASTM C-143 Test for Concrete, shall be minimum of 2l and maximum of 4l provided the requisite strength is obtained. Corrective additions to remedy deficiencies in aggregate gradations shall be used only with the written approval of the Engineer. When such additions are permitted, the material shall be measured separately for each batch of concrete.

**4.07 BATCHING AND MIXING**

Concrete shall be mixed by a mechanical batch type mixing plant with adequate facilities for accurate measurements and control of each material entering the mixer and for changing the proportions to conform to varying conditions of the Work. The mixing plant assembly shall permit ready inspection of operations at all times. The plant and its location shall be subject to approval of the Engineer.

Water shall be measured for every batch with due allowance for water already present in aggregates.

**4.07.1 Batching Units**

Batching units shall be supplied with the following items:-

- a) Weighing unit shall be provided for each type of material to indicate the scale load at convenient stages of the weighing operations. Weighing units shall be checked at times directed by and in the presence of the Engineer and required adjustments shall be made before further use.
- b) Water mechanism shall be tight, with the valves interlocked so that the discharge valve cannot be opened before the filling valve is fully closed and shall be fitted with a graduated gauge.
- c) Discharge gate shall control the mix to produce a ribboning and mixing of cement with aggregates. Delivery of materials from the batching equipment to the mixer shall be accurate within the following limits:-

<b>Materials</b>	<b>Percentage by Weight</b>
Cement	+1%
Water	+1%
Aggregate smaller than 3/4"	+2%
Aggregate larger than 3/4"	+3%

**4.07.2 Mixing Units**

- a) Mixers shall not be charged in excess of rated capacity nor be operated in excess of rated speed. Excessive mixing requiring addition of water to preserve required consistency shall not be permitted. The entire batch shall be discharged and discarded before re-charging.
- b) Mixing time shall be measured from the instant water is introduced into the mixer drum containing all solids. All mixing water shall be introduced before one-fourth of the mixing time has elapsed. Mixing time for mixers of one cubic meter capacity mixers, time shall be increased by 15 seconds for each additional half cubic meter or fraction thereof, which may be varied if the charging and mixing operations fail to result in the required uniformity in composition and consistence within a batch and from batch to batch. If an air-entraining agent is allowed to be used, additional mixing time shall be allowed so as to provide the specified air-content.

- c) Unless waived by the Engineer, device such as discharge-lock to lock the discharge mechanism, until the required mixing time has elapsed, shall be provided on each mixer. Mixing shall continue for at least 40 revolutions of mixer drum.
- d) No hand mixing under any circumstances even with extra cement shall be permitted. If during concreting, the mixing plant fails, the concrete already poured shall be removed, unless directed otherwise by the Engineer. Mixers, which have been out of use for more than 30 minutes shall be thoroughly cleaned before any further concrete is mixed.

The mixing water shall be regularly sampled and tested for salt content and contamination.

#### **4.08 SAMPLES AND TESTING**

##### **4.08.1 General**

Test cylinders of concrete shall be prepared and stored by the Contractor in accordance with the ASTM C-172, as and when directed by the Engineer. Test cylinders and the concrete materials shall be tested in an approved laboratory and the Contractor shall bear all charges for the same, including such other tests as may be determined by and acceptable to the Engineer.

##### **4.08.2 Water**

Water shall be tested in accordance with AASHTO Method of Test T26-51.

##### **4.08.3 Cement**

Cement shall be tested as prescribed in BS-12.

##### **4.08.4 Aggregate**

Aggregates shall be tested as prescribed in ASTM C-33. In addition, fine aggregates shall be tested for organic impurities in conformity with ASTM C-40.

##### **4.08.5 Reinforcement**

Reinforcement bars shall be tested as prescribed in BS 4449, BS-4461 and ASTM A- 615- 82(S1) for deformed steel bars and mild steel plain bars. Refer clause 4.10 of this section for specification requirements of reinforcement works.

##### **4.08.6 Testing of Concrete**

###### **4.08.6.1 Concrete Compressive Strength Test**

- a) Works Test Cylinders shall be made of all structural concrete incorporated into the works. Unless otherwise directed by the Engineer, one set of cylinder of any particular mix shall be taken from either :-
  - Each 350 Cft or part thereof in columns
  - Each 1050 Cft in walls and small foundations
  - Each 1750 Cft in slabs, beams and large foundations, or
  - each day's production Whichever is the more frequent
- b) Each set of the Works Test Cylinders shall comprise six 6|x12| Cylinders made from a single sample of concrete taken from the point of final deposition of the set concrete under the Engineer's supervision.
- c) The sampling, making, curing and testing of Works Test Cylinders shall be carried out in accordance with ASTM C3 & C39. Test results shall be recorded on approved forms and submitted in duplicate to the Engineer immediately following the test.
- d) A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. The number of samples per day and the times which they are taken shall be varied at random (thereafter at least one sample shall be taken each day the concrete of that particular mix is made).

- e) From each sample six Cylinders shall be made, two for test at seven days, and the other four for test at twenty-eight days.
- f) Specimens shall be cured under laboratory conditions except that the Engineer may require curing under field conditions in which case strength of field cured specimens shall not be less than 85% of that of companion laboratory condition cured specimens.
- g) All cylinder moulds shall be steel moulds perfectly true, having all internal and meeting faces machined to a smooth surface.
- h) If the strength tests of the laboratory cured specimens for any portion of the Work falls below the minimum allowable compressive strength at 28 days required for the class of concrete used in that portion, the Engineer shall have the right to order replacement of the affected work.
- i) All test specimens shall bear distinguishing mark showing number, date of casting, quality of concrete and place from where sample was taken. A proper daily record of test specimens made and test results obtained shall be maintained by the Contractor and weekly test results shall be submitted to the Engineer.

4.08.6.2 Testing for Chloride Ion Content

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 0.15% by weight of cement. To determine water soluble chloride ion content, test procedures shall conform to ASTM C 1218.

**4.08.7 Concrete Members not complying with Specifications**

- (i) Where concrete in the Works does not comply with the Specifications, the Engineer may order any or all of the following or any other appropriate action to be taken:
  - (a) The drilling of test cylinders in mass concrete and testing the cylindersto destruction by compression.
  - (b) The carrying out of load tests or other non-destructive tests on concretestructure.
  - (c) The cutting out and replacement of such volume as is considered defective by the Engineer.
  - (d) Strengthening of the structure in accordance with the requirements and as proposed by the Engineer.
- (ii) The Contractor shall carry out all such tests, investigations, rehabilitation or replacement in coordination with and as acceptable to the Engineer at no additional cost to the Employer.

**4.09 TRANSPORTING AND PLACING CONCRETE**

**4.09.1 General**

- a) Concreting shall be conveyed and deposited as quickly as possible after mixing and shall proceed so that, as far as possible, a complete section of the Work is done in one operation. The concrete may be distributed in barrows, skips, and chutes and by any other method such as pumps, conveyor belts etc. all to the approval of the Engineer.
- b) Transportation of concrete shall be in a manner approved by the Engineer and shall be so as to avoid segregation or loss of ingredients of concrete.
- c) All foundations and portions of Work to be concreted shall be approved by the Engineer in writing before concrete is poured.
- d) All forms and reinforcement shall be completed, cleaned, inspected and approved before

pouring of concrete. No concrete is to be deposited till the Engineer has inspected and approved in writing all reinforcement, foundations, forms, details, positioning of all fixtures and materials to be embedded in concrete, control levels and screeds, etc. and is satisfied with the arrangements the Contractor has made to efficiently proceed with the work such as sufficient labour, materials, plants etc. Such an approval will not relieve the Contractor from any of his obligations under this Contract. No concrete shall be deposited without the written permission from the Engineer who shall have no authority to waive off this condition. Any concrete without such written authorization shall be liable to be rejected.

- e) Placing of concrete shall not be permitted when, in the opinion of the Engineer the sun, heat, wind, cold, snow, or limitations or facilities furnished by the Contractor prevent proper placing, finishing and curing of concrete.
- f) All concrete shall be thoroughly compacted and consolidated by means of pneumatic or mechanical immersion type vibrators of suitable size having minimum frequency of 8000 RPM. Care shall be taken to avoid segregation due to excessive vibration. The Contractor shall maintain on Site at all times one or more standby vibrators. Tapping or other external vibration of forms shall not be allowed unless so directed by the Engineer. In that case formwork shall be adequate to withstand vibrations. Compaction shall be done until the whole mass assumes a jelly like appearance and consistency with water just appearing on the surface. Concrete shall be sufficiently tamped and consolidated around the steel bars, care shall be taken that the vibrator does not touch steel or formwork, and is worked into all parts of the moulds in order that no voids or cavities are left. Steel shall not be disturbed during operations of concreting. Concrete shall be brought up in even layers not more than 8" thickness and worked against side of forms to give a smooth and uniform surface. No surplus water shall be allowed to come out and lie on the surface of concrete. The concrete must be of such a consistency that when ramming, consolidating and tamping is completed a thin film of water is just appearing on the surface. In vibrating, care shall be taken to avoid displacing the reinforcement.
- g) Hardened concrete, debris and foreign materials shall be removed from interior of forms and from inner surface of mixing and conveying equipment.
- h) Runways and gangways shall be provided for wheeled concrete handling equipment and workmen, and such equipment shall not be wheeled over reinforcement, nor shall runways be supported on reinforcement.
- i) Concrete shall not be dropped freely from a height of more than 10 ½ ft. in columns and 4 ft. elsewhere. In cases where an excessive drop is inevitable, the Contractor shall provide spouts, down pipes, chutes, or side ports to forms with pockets, which will let concrete stop and flow easily into the form without any risk of segregation. The discharge of the spouts, down pipes or chutes shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 8" thick.
- j) Concrete is to be deposited as quickly as possible after mixing and to proceed continuously. Concrete which has attained its initial set or has contained its mixing water for more than 30 minutes shall not be allowed to be placed in the work.
- l) Fresh concrete shall not be placed on previously laid concrete or on old concrete surfaces until the latter has been cleaned of all dirt, scum and laitence by wire brushes. The clean surface shall then be thoroughly wetted and grouted with cement slurry as approved by the Engineer.
- m) Care shall be taken not to disturb newly placed concrete by vibrator, indirect loading or otherwise. No traffic or loading shall be allowed on the concrete until it has thoroughly set and hardened.
- n) Construction joints in concrete shall only be given at locations indicated on the drawings or as approved by the Engineer. If approved by the Engineer, the concrete at the end of the day's work shall be finished off against a temporary shutter stop, which shall be vertical and securely fixed. Such stops shall be removed within 24 hours of placing of concrete. Construction joints not shown on the Drawings shall be reinforced with steel bars or dowels, if deemed necessary by the Engineer, and shall be furnished by the Contractor without any additional cost.

- o) No concrete shall be placed during rains or inclement weather and all fresh concrete shall be suitably protected from rain fall and excessive heat or cold.
- p) Should any part of the exposed surface present a rough, uneven or imperfect appearance, when the shuttering is removed, it shall be picked out to such depth and refilled and properly re-surfaced and entirely redone as per directions and approval of the Engineer at the cost of the Contractor.
- q) On removal of the forms and before the concrete skin has had time to harden, all faces of the concrete inside and outside to be kept exposed (i.e. unplastered) shall be rubbed over with carborundum stone, and washed with cement to remove all marks, projections, hollows, or any other defect. No extra payment shall be made for this work.
- r) All exposed surfaces and lines of the concrete work are to be true and fair without cracks, bends, windings and distortions of all kinds, without any extra charges by the Contractor. All concrete work to remain exposed and unplastered is to be fairfaced, smooth, pleasing and to the entire satisfaction of the Engineer.
- s) A float or screed is to be worked over the exposed surfaces of all concrete work on the flat or curve, so as to render the surfaces perfectly smooth, clear and to the necessary slopes or falls or as required to receive the floor or roof finishes according to the Drawings and as directed by the Engineer without any extra charge by the Contractor.

#### **4.09.2 Temperature**

No concrete shall be mixed or placed while the temperature is above 35 degrees centigrade (°C) on a rising thermometer or above 40 degrees centigrade (°C) on a falling thermometer.  
The Contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position in the Works.

The Contractor shall plan the day's concrete in such a manner as to ensure that each bay or panel is completed at a proper construction joint before the temperature rises above the permissible limit.

The Contractor shall allow in his rates for any additional expenses incurred by complying with this Clause in order to complete the works within the "Time for Completion".

#### **4.09.3 Hot Weather Concreting**

Hot Weather Concreting Operation should conform to the provisions of ACI Standard 305-72

- Recommended Practice for Hot Weather Concreting. The following precautions should be adopted as necessary to comply with the above limit:-

- a. Shading of aggregate stock piles.
- b. Insulation of water tanks and pipelines and formwork.
- c. Refrigeration of mixing water.
- d. Addition of ice to mix to lower temperature.
- e. Shading of formwork and reinforcement from the sun and drying winds.
- f. Cooling of formwork and reinforcement prior to and ahead of casting of the concrete by mist spraying.
- g. Covering and spraying with water of hardening concrete surfaces.
- h. Concreting during the cooler part of the day.

#### **4.10 PROTECTION AND CURING**

All exposed concrete shall be cured. Curing shall be accomplished by preventing loss of moisture, rapid temperature change and mechanical injury or injury from rain or flowing water for a period of at least seven (7) days. Curing shall be started as soon as the concrete has hardened sufficiently for the surface not to be marked. Curing shall be done either by covering with sand, hessian, canvas or other approved fabric mats, which shall be kept continuously wet. If required and so directed by the Engineer, formed surface with forms

in position shall also be cured by keeping all forms continuously wet. As an alternative, curing of concrete on all exposed surfaces which could not be kept covered, such as sides of the beams, under side of the slabs, may also be done by sealing concrete surface with liquid membrane-forming curing compounds white pigment type conforming to ASTM C-309 or equal so as to arrest loss of moisture from concrete, with the approval of the Engineer. Care shall be taken so as to spray the compound/chemical on all the exposed faces of concrete so that no loss of moisture takes place. The Contractor shall take special care that curing of concrete is satisfactorily carried out and in accordance with methods specified herein and/or as instructed by the Engineer.

Any negligence in this regard may result in total rejection of such concrete works, which in the opinion of the Engineer have not been adequately cured. Period of curing for any concrete shall be 7 days or more as directed by the Engineer. All concrete pours and concrete structures shall be clearly marked with non-washable paints to indicate the date of placing concrete. During hot weather, curing shall be done even at night. It shall be obligatory on the part of the Contractor to obtain a certificate from the Engineer that the curing has been properly done. A suitable format shall be printed and kept on Site to be signed by the Engineer for every part of the Work.

For sections 5 ft. or more thick, the Contractor shall ensure that the temperature differential between the inner and outer surfaces shall not exceed 20°C and shall submit to the Engineer his proposals to control and monitor this.

#### **4.11 CONSTRUCTION JOINTS**

Construction joints shall be located as indicated on the Drawings and/or as approved or directed by the Engineer. Prior to construction of any structure, the Contractor shall submit a proposal showing location of construction joints and sequence of construction to suit his concreting programmed for the approval of the Engineer. Joint in columns shall be made at the underside of the deepest beam framing thereto. Beam stems and slabs shall be poured monolithically unless allowed otherwise by the Engineer in writing. Joints not specified or shown on the Drawings if so required and approved by the Engineer, shall be so located as to least impair the strength and appearance of the Work.

Except and where indicated on the Drawings, no jointing shall be made in footings or foundations without written approval of the Engineer. Construction joints shall be at right angles to the member and shall be formed against firm stop boards. The stop board shall be removed as soon as possible after placing the concrete but without the risk of movement of the concrete and the concrete surface shall be well brushed with a hard brush and washed off with a spray of water, two to four hours after casting, to expose the aggregate and provide key for the next pour.

In all water retaining structures and other substructure pits and trenches, P.V.C. or any other approved water stops shall be provided at the construction joints in the manner shown on the Drawings and/or approved by the Engineer.

Whenever a section of concrete is left unfinished, for any reasons with the approval of the Engineer, leaving surface which will be hard-set before additional concrete can be joined to it, such dovetails, grooves or other bonds shall be provided as may be necessary to ensure a good bond with the new work, at the cost of the Contractor. Before deposition fresh concrete upon or against any concrete which is already set, the surface of the set concrete shall be roughened with a cutting tool, any laitance removed, thoroughly cleaned from all foreign matter, well-watered and covered with approved bonding agent and cement grout, and special care shall be taken to ram the fresh concrete thoroughly up and against the set concrete; and, if deemed necessary by the Engineer, the joints shall be reinforced with steel bars or dowels to be all furnished and done by the Contractor without any additional cost.

#### **4.12 CONCRETE FLOOR SLAB FINISHING**

Concrete slabs shall be finished as described herein. In preparation for finishing, floor slabs shall be struck off to the required level at or below the elevation or grade of the finished floors as shown on the Drawings. Floors shall be leveled with a tolerance of 1 mm in 1m. Where drains occur, the floor surface shall be pitched to the drains as indicated on the Drawings or as directed by the Engineer.

#### **4.13 MONOLITHIC FINISH**

All concrete surfaces in floors, except where other finish is specified, shall be finished by steel floats or straight edges to bring the surface to the required finish level as shown on the Drawings. While the concrete is still green, but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood floated to

a true even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. The concrete shall then be hand trowelled to produce smooth impervious surface free from trowel marks. If necessary, the process shall be repeated so that the final finish shall produce ringing sound from the trowel. No separate payment shall be made for finishing floor slabs in the aforementioned manner.

#### **4.14 CONCRETE TOPPING**

Where indicated on the Drawings, base slab under concrete topping shall receive a screeded finish. After the base slab is thoroughly cured and when directed, concrete topping shall be laid to the thickness as indicated on the Drawings in alternate panels of suitable sizes as directed by the Engineer.

#### **4.15 ANCHOR BOLTS, INSERTS, SLEEVES, CHASSIS, RECESSES, STEEL FRAMES**

The Contractor shall provide chases and openings required for other sections of the Works and will cooperate and coordinate with other trades in placing their pipes, ducts, recesses and other built-in items as the Work proceeds, entirely at his own cost and risk.

The Contractor shall furnish and place in position accurately, as shown on the Drawings, all inserts, sleeves, chases, recesses, etc., supplied by the Contractor, subcontractors or other contractors, as directed. Full cooperation and coordination shall be maintained with other contractors, subcontractors in this regard.

#### **4.16 WATERPROOF CONCRETE**

Waterproof concrete shall consist of structural concrete as specified herein and with the addition of an approved waterproofing additive. This shall be mixed in accordance with the manufacturer's instructions and as detailed in the Bill of Quantities.

Contractor's attention is drawn to the special care required for casting roof framing, ponds, swimming pools and all underground structures including basement floor, retaining walls, sumps, pits, etc. These are all designed to BS 8007, British Standard for water retaining structures. The contractor shall ensure that workmanship and curing is up to the required standard. The crack widths in such structures shall not exceed 0.2mm.

The Contractor shall take full responsibility for ensuring that the resulting construction is completely watertight and free from penetration of moisture.

When in the opinion of the Engineer, damp patches and/or leakage of water in the finished work are due to failure of the Contractor to comply with this specification, the affected work shall be made good at the Contractor's expense.

Water-stoppers shall be provided in all construction joints and the type of Water-stoppers will be as specified or to the approval of the Engineer. All Water-stoppers will be joined by welding strictly in accordance with the manufacturer's recommendations and all multiple joints and special intersections shall be manufactured by the supplier.

Before commencement of work, the Contractor shall obtain the Engineer's approval of the methods to be used to support and maintain the Water-stoppers in the correct location while the concrete is placed and also the layout and form of all additional construction joints other than those shown on the drawings. Unless indicated otherwise on the drawings, all construction joints in waterproof concrete shall be formed incorporating Water-stoppers to Engineer's approval.

All service holes cast in shall incorporate sleeves with puddle flanges and temporary openings for services should incorporate Water-stoppers.

Care shall be taken at all times to ensure that Water-stoppers are not perforated or damaged in any way and the concrete shall be carefully placed and compacted around the Water-stoppers to ensure void free impervious concrete.

All kickers or starter plinths to walls (if used) on the periphery of the watertight construction shall be cast monolithically with the base.

The formwork shall comply with this Specification and in addition any bolt or fastening embedded in or passing through the concrete shall be to the approval of the Engineer and not impair the water tightness of the

structure. The use of through bolts and sleeves is strictly prohibited.

Special attention shall be given to the elimination of shrinkage or thermal cracking. The size of any bay or slab or wall and sequence of pouring shall be such as to minimize cracking.

Slotted inserts or sockets cast into the structural concrete shall be provided for all fixings including services. The cutting of holes in watertight concrete is strictly prohibited.

The Contractor is completely responsible for making all basements and swimming pools absolutely watertight. If any leakages or moist patches occur, the cost of any repairs, etc. to make the basement and swimming pool fully watertight will be borne by him. The Contractor is to give a ten-year guarantee for water tightness, reckoned from the date of completion of roof framing, basement and swimming pool. The form of guarantee is to be to the satisfaction of the Client. Should any leaks or dampness occur during the Guarantee period of ten years, the Contractor shall, at no cost to the Client, immediately re-waterproof the defective area or areas and make good all damages to surface finishes such as plaster, painting, paneling, tiling, etc. electrical or other installations or other property, caused by leaks or dampness or reimburse the Client for making good such damages.

Water tightness of swimming pools shall be inspected and tested in accordance with BS 8007:1987 and/or ACI-350.

#### **4.17 CLEANING AND REMOVAL OF RUBBISH**

On completion of Works herein, the Contractor shall remove all concrete debris, rubbish, shuttering materials, scraps etc., from the vicinity of the structures completed. All areas shall be cleaned to the satisfaction and approval of the Engineer. The rubbish shall be disposed of within or outside the Site premises, free of cost as directed by the Engineer.

#### **4.18 MEASUREMENT AND PAYMENT**

- a) Concrete works shall be measured and paid for as per theoretical volumes calculated on the basis of the Drawings, or as otherwise approved by the Engineer and paid at per cubic foot at the rates entered in the Bill of Quantities.

Recesses (e.g. openings in slabs, break-through and the like) with an individual volume of more than 1 sq. ft. or 2 cft shall be deducted.

- b) The prices for concrete works shall include all cost for the complete work and are not limited to the cost of formwork, its support, anchoring's, chamfers, construction joints etc., the required scaffolding, false work, temporary works, post-treatment and, if necessary, repair of concrete, all preliminary and routine tests, as well as the required static checks and drawings for Temporary Works in connection with the concrete works.
- c) The cost for special finishing of exposed concrete surfaces such as fair-faced finish etc. shall be included in the unit price applicable to the respective structural member and will not be compensated for separately.
- d) The cost of all concrete admixtures and additives shall not be paid for separately and is deemed to be included in the unit rates of respective items of the BOQ.

##### **Joints**

- a) Expansion Joints

Expansion joints will be paid per number, according to the Drawings. The prices shall include all costs for the different materials and performances relative to the laying and sealing of the joints.

- b) Dummy Joints

Dummy joints required by the Contractor with the Engineer's consent for the sound execution of the Works will not be paid for separately, but the costs involved are deemed to be covered by the concrete prices applicable to the respective structural member.

- c) Construction Joints

Construction joints will be measured and paid for as below:

The Contractor is deemed to have covered the costs for all related supplies, laying, formation and performances of construction joints included in the respective concrete prices. However, the cost of PVC water stoppers and or swell bars shall be measured and paid for separately per running foot of accepted lengths.

If the approved pouring sequence has not been followed by the contractor. Any increase in quantity of materials (pvc water stoppers, swell bars, rear guards, sealants, SBR etc.) associated with the construction joints and or additional reinforcement required shall be paid for by the Contractor at his own cost.

**Tamping of Equipment and Grouting of Recesses**

The costs resulting from materials and performances in connection with the tamping of installed items or the grouting of recesses are deemed to be included in the prices for the supply and/or installation of the respective items, and will therefore not be separately compensated for.

**\*\* END OF SECTION\*\***

## **SECTION-5 REINFORCEMENT STEEL**

### **5.01 SCOPE OF WORK**

The work covered by this subsection of the Specifications consists of furnishing all materials, tools, labour and in performing all operations in connection with the providing, straightening, cutting, bending, fixing, binding including binding wire, chairs, pins, spacer blocks complete in strict accordance with this subsection of the Specifications, the applicable Drawings, approved bar bending schedule, and the terms and conditions of the Contract.

### **5.02 GENERAL**

- a) The Contractor shall procure reinforcing steel only from reputable manufacturers / suppliers duly approved by the Engineer.
- b) Verification of the source of supply shall be prepared by the Contractor and submitted to the Engineer along with necessary certificates and test reports.
- c) The Contractor shall prepare detailed bar cutting and bending schedules on the basis of the working Drawings and in consideration of BS-4466 and of any requirement resulting from the applied bar bending process.
- d) The Contractor shall inform the Engineer of the completion of any reinforcement in time, in order to facilitate its inspection and check of conformity with the working Drawings well before the concreting. Relevant formalities shall be agreed upon between the Contractor and the Engineer at the appropriate time.
- e) Reinforcement bar sizes have generally been shown on the Drawings in the form of designated bar numbers.

### **5.03 MATERIAL**

- a) Reinforcement shall be deformed reinforcement, except that plain reinforcement bars are permitted for spirals. Reinforcing steel bars (Plain and deformed) shall be from the new billet stock of mild steel and shall conform to the British Standard Specifications mentioned below and as indicated on the Drawings and Bill of Quantities.
  - i. Hot rolled deformed bars conforming to ASTM A-615 / BS 4449
  - ii. Cold worked deformed bars to conforming to BS 4461 (revised 4449-1988)
  - iii. Plain round steel bars to conforming to BS 4449
- b) For each consignment, the Contractor shall furnish to the Engineer the manufacturer's mill test certificates to guarantee that the steel supplied meets all the requirements of the relevant specifications and further meets the requirements of specified characteristic strength and minimum tensile strength requirements given as under:-

#### **High Yield Deformed Steel Bars:**

- i. Specified Characteristic Strength:

up to 16 mm (5/8I)	460 N/mm <sup>2</sup> (66,700 psi)
over 16 mm (5/8I)	425 N/mm <sup>2</sup> (61,625 psi)
- ii. Tensile Strength:

Minimum Tensile Strength shall be 10% greater than the Specified Characteristic Strength.
- iii. Minimum Elongation

up to 16 mm (5/8I)	12%
over 16 mm (5/8I)	14%

#### **Mild Steel Plain Steel Bars:**

- (i) Specified Characteristic Strength 250 N/mm<sup>2</sup> (36,000 psi)
  - (ii) Tensile Strength:  
Minimum Tensile Strength shall be at least 15% more than the Specified Characteristic Strength.
  - (iii) Minimum Elongation 22%
- a) All the bars shall be capable of being bent cold through 180 degree round a pin without cracking on the outside of the bent portion as per ASTM-A615.
  - b) 18-gauge galvanized wire to BS 4482 shall be used for binding the steel reinforcement.
  - c) Samples shall be tested for above requirements in an approved laboratory before starting the cutting of bars or when so required by the Engineer; and all cost of such tests shall be borne by the Contractor.
  - d) All reinforcing steel bars shall be free from loose mill scale, loose rust, oil, grease, dirt or other harmful substances.

#### **Wire Gauze**

##### General

Unless otherwise specified the wire gauze shall be of best quality approved uniformly, woven wire webbing of 12 x 12 meshes to 645 mm square (one Sq. Inch) made from 22 gauge galvanized iron wire. All panels shall be in one piece and no joints shall be allowed.

##### Fixing

Wire gauze shall be fixed as shown on the drawings or as directed. The gauze shall remain tight to the fill width without any sag.

#### **5.04 STORAGE**

Reinforcement bars shall be stored on platform sufficiently above ground surface and be free from scales, oil, and structural defects prior to placement in Works. Rusted or dirty steel bars shall not be used in the Works unless brushed and cleaned by proper steel wire brushes and after being approved for use by the Engineer.

#### **5.05 REINFORCEMENT CUTTING AND PLACING**

All reinforcement steel shall be cut and bent cold in strict accordance with bar bending schedules prepared by the Contractor and approved by the Engineer. The Contractor shall prepare bar bending schedule from approved structural working Drawings and as per instructions of the Engineer. The bending schedules shall be drawn on approved forms and submitted to the Engineer for checking and approval. The steel reinforcement shall be cut and bent to sizes as per Drawings and approved bending schedules. In case, any bars cut, bent or even fixed in position are found incorrect in dimensions, size and shape and are not according to the requirements of the Drawings or instructions of the Engineer, notwithstanding any previous approval of the Engineer, the Contractor shall replace such steel bars, cut, bent or fixed in position, by correct sizes bars at his own cost and no extra payment shall be made to the Contractor on such account. Suitable spacers, chairs as approved by the Engineer shall be used for the purpose of supporting and spacing of bars. In case, any bars are bent or displaced they shall be straightened or replaced prior to pouring. All reinforcement bars within the limit of a day's pour shall be in place and firmly tied with 18-gauge wires. Bars with kinks or bends not shown on the Drawings shall not be used. Reinforcement bars shall not be used for supporting the workmen and concreting work. Separate supporting system shall be used for this purpose.

Concrete cover to all reinforcement bars shall be provided as shown in the Drawings using steel chairs and concrete spacer blocks.

The concrete spacer blocks shall be cast from cement sand mix in a ratio of 1:2 in suitable required sizes. These shall be well cured and dry before use in the Works. The spacers shall meet the specified requirements of water absorption. All spacers shall be properly fixed in their required positions and as directed by the Engineer.

For any structural member which shall receive fair-faced concrete surfaces, special spacers shall be used while do not impair the specified appearance of concrete surfaces.

#### **5.05.1 Laps and Splices**

No splicing of bars shall be allowed at positions other than shown on the Drawings. All lap lengths shall be of the minimum sizes as indicated on the Drawings and in accordance with ACI 318-95. Splices of adjacent bars shall be staggered, unless approved otherwise by the Engineer. All reinforcing steel fixed in position shall be inspected by the Engineer and no concrete shall be poured until steel placement has been approved in writing by the Engineer. For inspection purposes, the Contractor shall give to the Engineer reasonable notice before the scheduled pouring time. Clear concrete cover to reinforcement steel shall be as specified or indicated on the Drawings.

#### **5.05.2 Mesh Reinforcement**

- a) Where indicated mesh shall be of the sizes as shown on the Drawings and conform to BS 4482 or 4449 with mesh sizes to BS 4483 or ASTM A-185 (Welded Steel Wire Fabric for Concrete Reinforcement). Mesh reinforcement when used in slabs shall be supported at proper elevations by standard accessories. In slabs on ground (porous fill), precast concrete spacer blocks may be substituted for chairs.
- b) Overlaps in fabric reinforcement shall be a minimum of two meshes, except where otherwise shown on the Drawings, correctly aligned and at least 50% of the wire intersections shall be tied with 18 gauge tying wire. Laps shall be staggered in adjacent rows of sheets.

### **5.06 MEASUREMENT AND PAYMENT**

Reinforcing bars will be measured as per Drawings in consideration of the volumetric weight of 7.85 t/m<sup>3</sup>, without additions for rolling tolerances, deformations, waste lengths and binding wires and paid per ton at the unit rate entered in the Bill of Quantities.

The prices shall include all costs involved with the supply, transportation, storage and protection, the cutting, bending and placing, inclusive of concrete spacers, supports, stands, tying into position, etc.

Assembly stands, spacers etc., whether designated in the Drawings or not or otherwise demanded by the Engineer will not be measured and paid for separately.

If installed reinforcement must be dismantled under certain circumstances or where additional reinforcing bars are to be provided on Engineer's instruction, the Contractor is not entitled to any compensation, if such additional supplies and/or performances are required and demanded by the Engineer due to the Contractor's faulty execution of the respective work.

**\*\* END OF SECTION\*\***

## **SECTION - 6 FORMWORK**

### **6.01 GENERAL**

The formwork shall be inclusive of all labour, material, workmanship and alike. All formwork and supports thereto shall be designed by the Contractor and relevant drawings shall be submitted to the Engineer for approval before the Work is put in hand. Such an approval shall not relieve the Contractor from all or any of the obligations of the Contractor or give rise to any claims.

### **6.02 MAKING FORMS**

The formwork for columns, beams, slabs, foundations, pits, lintels, fins, panels, purdees, parapets and all other works whether to be precast or cast-in-situ shall be of steel plates, scaffolding pipes and joints or other approved material and shall be rigidly formed and designed by the Contractor to the shapes and forms as per Drawings in accordance with the best of the existing practices, so as to be able to withstand without displacement, deflection or deformation or movements of any kind, the pressure of the moist concrete and all other loads. No plank timber formwork will be accepted at any location. Only system formwork will be accepted.

### **6.03 FAIR FACED FINISH**

#### **a) Facing Material**

The form facing material shall produce a smooth, hard, uniform texture on the concrete. It shall be M.S. steel sheets, plywood, tempered concrete grade hardboard, metal or plastic, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surface, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface, shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

#### **b) Shop Drawings**

Shop Drawings shall be submitted by the Contractor for Engineer's approval, showing grooves, joints etc. if indicated on the Drawings or instructed by the Engineer before taking up the job of formwork in hand.

#### **c) Repair**

No repair of surfaces designated 'fair faced' shall be allowed. Any concrete failing to achieve the desired finish or with defective surfaces shall be removed and replaced at Contractor's expense. The Engineer may reject any defective concrete surface and order it to be cut out in part or in whole and replaced at the Contractor's expenses.

### **6.04 RIGID WITH ALLOWANCE FOR CAMBER & BULGES**

The formwork shall be fabricated and erected in position, perfect in alignment, levels and true to plumb and shape and securely braced so as to enable it to withstand all weights, dead and live, to be endured during placing of concrete and its subsequent hardening till the formwork is struck. It shall be sufficiently rigid as not to lose its shape and shall be made to compensate for bulging, and deflection to give the finished concrete the required lines, plumb, size and shape.

### **6.05 EXPOSED SURFACES LEFT UN-PLASTERED**

In addition to the provision made elsewhere, for all the concrete work covered in this Contract which are to remain exposed in the finished work and left un-plastered, the formwork shall be smoothly faced by using M.S. steel sheets or lining the shuttering with smooth G.I. sheets or non-absorbent material like Formica sheets or in any manner as approved by the Engineer so as to make a perfectly smooth surface of the finished concrete. Where any surface defects on the exposed concrete surfaces occur and which do not impair the structural performance, being in excess of the designed surfaces and the architectural appearance of the Work in the opinion of the Engineer such defects may be removed by guniting and grinding with carborundum stone or in any other approved manner, at the cost of the Contractor, otherwise the whole or part of the Work shall be removed and made good by the Contractor, at his own cost. For precast concrete members, the forms shall be rigid, exact and smooth.

### **6.06 MATERIALS AND LABOURS**

The Contractor shall supply all materials runners, and labour, necessary for a good and speedy erection of formwork such as steel plates, shuttering planks, struts, bolts, stays, gangways, boards, fillets etc. and shall do all that is essential in executing the job in a workman-like manner to the satisfaction of the Engineer.

**6.07 FORMWORK NOT TO INTERFERE OR INJURE WORK**

The formwork shall be so designed and arranged as to not unduly interfere with concrete during its placing and easy to be removed without injuring the finished concrete. Wedges, clamps, bolts and rods shall be used, when permitted and where practicable, in making the formwork rigid and in holding it to true position.

**6.08 OPENINGS IN FORMWORK**

Wherever concreting is required to be carried out within forms of depth exceeding 6.5 feet, temporary openings in the side of the form shall be provided to facilitate the pouring and consolidation of the concrete. Small temporary openings shall be provided at bottom of the forms to permit the removal of rubbish etc. but the same shall be suitably closed before pouring.

**6.09 OPENING AND OTHER DETAILS**

Provision shall be kept in the formworks such as openings, recesses, holes, pockets, fillets, etc. for housing services and other architectural details in the finished concrete or on its surface and edges as shown on the Drawings or as directed by the Engineer and to fix all necessary inserts, dowels, pipes, holdfasts etc. in concrete as shown on the Drawings or as directed by the Engineer.

**6.10 JOINTS IN FORMWORK**

All joints in the formwork shall be sufficiently closed to prevent leakage of mortar from concrete for concrete surfaces not to be exposed in the finished work. The joints in the finished work shall be close jointed and perfectly smooth so as not to allow any leakage of the mortar from the concrete and show any appearance of leaking mortar on concrete surfaces.

**6.11 TREATMENT AND INSPECTION OF FORMS**

All rubbish particularly chippings, shavings and saw dust shall be removed from the interior of the forms, before placing concrete. Forms shall be coated with approved shuttering oil before reinforcement is placed. Surplus oil on forms and any oil thus applied on reinforcing steel shall be removed. If the forms are not used within 24 hours, a fresh coat of oil shall be given before placing of concrete.

**6.12 STRIPPING SHUTTERING**

Formwork should not be removed until the concrete has developed sufficiently strength to support all loads placed upon it. The time required before formwork removal depends on the structural function of the member and the rate of strength gain of the concrete. The grade of concrete, type of cement, water/cement ratio, temperature during curing etc. influence the rate of strength gain of concrete.

No struts or timbering which serve the purpose of supporting the shuttering or centering shall be struck and removed without permission from the Engineer in writing and the work of striking and removal after the receipt of such permission shall be conducted under the personal supervision of the competent foremen in the employment of the Contractor and the Contractor even after the permission from the Engineer shall hold himself fully responsible for any consequences whatsoever.

In all cases the Engineer will direct and control the minimum period of time for which the forms, shuttering or centering shall remain in place before being struck; but, for the general guidance of the Contractor, the following are to be considered as the minimum periods for the main classes of Work.

Type of Formwork	Normal Weather	Cold Weather
Footing Sides	24 hours	36 hours
Vertical sides of Beams, Walls and Columns (unloaded)	24 hours	36 hours
Slab soffits ( up to 15 ft span)	10 days	14 days
Slab soffits ( > 15 ft span)	14 days	21 days
Beam soffits ( up to 15 ft span)	14 days	21 days
Beam soffits ( > 15 ft span)	21 days	28 days

The Engineer may require, however, that any walings, soldiers, struts or other timbers or supports, the removal of which may cause the transference of load to the finished work, to be kept in place for three weeks after the placing of the concrete.

The formwork parts and connections should be arranged in a way that makes formwork removal easy and simple, prevents damage to concrete and formwork panels so that it can be reused without extensive repair.

The formwork removal procedure should be supervised by the engineer to ensure that quality of hardened concrete in structural member, i.e. it should be free from or has minimum casting defects such as honeycombing, size and shape defects etc. These defects in concrete influence the strength and stability of structure. Thus immediate repair works can be done or the members can be rejected.

The separation of forms should not be done by forcing crowbars against the concrete. It may damage the hardened concrete. This should be achieved by using wooden wedges.

Beam and joist bottoms should remain in place until final removal of all shoring under them are done.

Joist forms should be designed and removed so that the shores may be removed temporarily to permit removal of joist forms but must be replaced at once. The shores and joists will be dismantled beginning from the middle of the member's span, continuing symmetrically up the supports.

The approval from the engineer should be obtained for the sequence and pattern of formwork removal, prior to start of removal.

#### **6.13 INJURY OR DAMAGE**

The Contractor shall be responsible for any injury to the Work and any consequential damages caused by or arising from the removal and striking of forms, centering and supports, due to striking too soon. Any advice, permission or approval given by the Engineer relative to the removal and striking of forms, centering and supports shall not relieve the Contractor from the responsibilities herein defined.

#### **6.14 TREATMENT AFTER REMOVAL OF FORMS**

Any minor surface honey-combing or other irregularities are to be properly made good immediately upon the removal of the formwork and the surface made good to the satisfaction of the Engineer at the Contractor's own expense. Any small voids shall be neatly repaired with cement mortar consisting of one part of cement to two parts of sand and the whole surface rubbed over with carborundum stone and cement wash to bring the whole to a smooth and pleasing finish and uniform colour.

#### **6.15 TOLERANCES**

The structure shall be built to dimensions and levels shown on the Architect's drawings. Deviation from true positions and/or levels will be accepted only if they do not affect the finished dimensions, positions and levels as shown on the Architect's drawings.

Permitted tolerances shall be in accordance with the current issue of BS 5606, Code of Practice for Accuracy in building with up-to-date amendments.

Construction Tolerances of Structural Elements Supporting curtain walls or surfaces affecting curtain wall set out:-

- Maximum deviation vertically from defined position immediately after stripping of formwork  $\pm 12$ mm.
- Maximum deviation laterally from defined position immediately after stripping formwork and prior to any pre-stressing (if used)  $\pm 12$ mm or building height/4000 whichever is greater. This laterally out of position tolerance includes all local deviations in edge of slab or edge beams as well as overall building tolerance.

NOTE: All structural tolerances given above are for curtain walls (if used) and for all external structural faces of building affecting set out of masonry, windows and other cladding/finishes.

**6.16 EXTERNAL EXPOSED CONCRETE SURFACE**

All external exposed concrete surfaces of cast-in-situ or precast units shall be given smooth or pattern finish as shown in the Drawings schedule or as directed by the Engineer.

**6.17 MEASUREMENT AND PAYMENT**

All costs for formwork must be included in the concrete prices and will not be measured and paid for separately.

**\*\* END OF SECTION\*\***

## SECTION - 7 STRUCTURAL STEEL WORKS

### 7.01 **SCOPE OF WORK**

The work covered by this section consist of general requirement of structural steel work, its fabrication, erection and painting methodology, precautions and other general requirement incidental to structural steel work.

### 7.02 **GENERAL**

The applicable requirements of this section as determined by the Engineer shall apply to all structural steel works under this Contract. The work covered by this section consists of supply of necessary material, labor, plant, equipment and appliances including welding, bolts, nuts, washers, anchor bolts, embedded parts, etc., fabrication and erection in accordance with the Specifications and as per drawings and as directed by the Engineer.

### 7.03 **APPLICABLE STANDARDS**

Latest edition of the following standards are relevant to these specifications, wherever applicable:

AISC	Code of standard practice
AISC	Specifications for Architecturally exposed structural steel
ASTM	Specifications for Structural joint using ASTM A325 or A490 bolts.
ASTM	Specifications for Material
AISC	Specifications
SSPC-SP6	Steel structural council-surface preparation specifications AWS
	Specifications for Welding of steel structures
BS 449	Use of structural steel in buildings

### 7.04 **DRAWINGS**

#### 7.04.1 **Design and Working Drawings**

Design and working drawings shall be prepared by the Engineer and shall be supplied to the contractor. These shall contain main dimensions, sizes of members, and typical details of joints. Forces in members may be specified on the drawings to facilitate design/detailing of connections by the Contractor. However if not specified all connections shall be designed to have full strength capacity equal to that of member being connected.

#### 7.04.2 **Shop drawings**

Shop drawings shall be prepared by the Contractor from the working drawings taking into consideration the sizes (sections) of members/parts of the structure shall be standard rolled steel sections according to German/British/American or approved standards. The contractor, before, tendering, shall prepare material requirement list, ensure its availability at the time of actual fabrication and in case certain sections are not available, he will select suitable available alternatives subject to the approval of the Engineer.

Workshop drawings shall be prepared by taking into consideration the points enumerated below:

- i) Fabrication in convenient sub-assemblies and each shop assembly to be given an erection mark.
- ii) Milling (machining of bases of supporting plate) for erection without adjustments.
- iii) Provision of basic elements with erection devices.
- iv) In-keeping with the requirements of computed strength of all connections and joints of structures not foreseen in the design and in the working drawings.
- v) Other requirements having an influence on the methodology of fabrication, transportation and erection of steel structures.
- vi) Uniformity of elements and parts of the steel structures should be maintained for mass fabrication.

#### 7.04.3 **Contents of Shop Drawings**

Shop drawings shall consist of:

a. An erection scheme drawing having the following information:

- Location of erection elements in respect of axes and marks as well as picking points of these elements with respect to each other or with the existing steel or reinforced concrete structures.
- Erection joints showing erection welding thickness and lengths, bolts or rivet diameter and numbers.
- Chart showing list of assembling marks having columns such as mark, description, quantity, weight of each mark, total weight and remarks with grand total in the end.
- Chart showing list of erection bolts, nuts and washers in tabulated form, showing information such as size, quantity weight and notes and the grandtotal.
- The mark for shop assemblies of each erection scheme shall have a different index, for example scheme of trusses, purlins etc. shall have marks A1, A2, A3 onwards and another scheme of columns, beams etc. shall have marks B1, B2, B3 and onwards. While marking on the plans, elevation, sections and details, the index shall be omitted.
- Except in special cases, all scheme drawings shall be made in single fairlythick lines.
- Erection scheme shall contain the following notes;
- Erection shall be done using the erection welding and bolts of normal sizesand accuracy according to the joints of the scheme.
- Quality and type of electrode.
- Measures against unscrewing of bolts.
- Erection shall be carried out according to the standard for fabrication and erection of steel structures.
- Painting instructions.
- References to design and working drawings.

b) The working drawings shall contain the following information:

- Each Shop Assembly (Mark) shall be drawn separately showing necessary lines, elevations, sections with reference to axis, center lines, location of holes, cleats, plates, lugs, etc. fully dimensioned with part numbers.
- Bolts, holes sizes and symbols, holes diameter for metric size bolts shall be 2mmlarger than bolt diameter and for inch size the same shall be 1/16l larger.
- Welding thickness (general)
- Material quality of steel used.
- Type and quality of electrodes to be used.
- Tests for welding, if any.
- Reference to related erection scheme drawings.
- Reference to design and working drawings.
- Material list.

## **7.05 MATERIAL**

Except otherwise stated in the drawings, the material specifications shall conform to the following. Wherever necessary the contractor may use equivalent alternative material subject to approval of the Engineer.

### **7.05.1 Structural Steel**

Structural steel for structures not requiring welding shall conform to the requirement of ASTM A7 (for bridges and buildings) and ASTM A36.

Structural steel shall conform to the requirement of ASTM A36 or equivalent.

### **7.05.2 High Strength low Alloy Steel**

High strength low alloy steel shall conform to the requirements of ASTM A441 or equivalent.

### **7.05.3 Sheet Steel**

Steel sheet for structures where no welding is required shall conform to the requirements of ASTM A336 (for cold rolled carbon steel sheets commercial quality) or ASTM A415 Standard specifications for cold rolled carbon steel sheets, commercial quality). For structures where welding is required sheet steel shall conform to the requirements of ASTM A425.

### **7.05.4 HD Grade Steel**

HD Grade Steel used with vault area reinforcement shall conform to the requirements of ASTM J93005 (ferritic stainless steel)

### **7.05.5 Steel Forging**

Steel forgings shall conform to the requirements of ASTM A235 (Tentative specifications for carbon steel forgings for general industrial use) class of forging shall be indicated on the drawings.

### **7.05.6 Steel Casting**

Steel casting shall conform to the requirements of ASTM A27 standard specifications for Mild to Medium strength carbon steel castings for general applications) and ASTM A148 (Standard specification for high strength steel castings for structural purposes). Grade of casting shall be shown on the drawing.

### **7.05.7 Filler Metal for Welding**

Welding electrodes for manual shielded metal arc welding shall conform to the specifications for mild steel covered Arc-welding electrodes, AWS A5.1 latest edition or the specifications for low-alloy steel covered Arc-welding electrodes, AWS A 5.5 latest edition. Equivalent locally manufactured electrodes may also be used subject to the approval of the Engineer.

Welding electrodes shall be E70xx. All welding shall be carried out by qualified welder only using approved and qualified welding procedures.

### **7.05.8 Bolts, Nuts and Washers**

Unless otherwise specified anchor bolts and nuts shall conform to the requirements of ASTM A307 (Standard specification for low alloy carbon steel) externally and internally threaded standard fasteners). Bolts shall be of grade A for general application.

### **7.05.9 High Strength Bolts**

All shop connections, except as noted herein or on the drawings, shall be made with high strength bolts in slip critical connections, or by welding.

High strength carbon steel bolts including nuts and washers shall conform to the requirements of ASTM A325 (Standard specification for high strength bolts for structural steel joints including nuts and plain hardened washers). The dimensions shall conform to the requirements of USASI B18.2965 (square and hexagon bolts and nuts for regular semi-finished hexagon bolts and heavy semi-finished hexagon nuts).

#### **7.05.10 Cast Iron**

Cast iron shall conform to the requirement of ASTM A48 (standard specifications for gray iron castings).

#### **7.05.11 Connections**

Unless noted otherwise, all connections shall be designed and detailed for forces shown on the drawings or for 100% of the effective capacity of the member. At least two bolts or equivalent welding shall be used for each connection.

### **7.06 ALLOWABLE STRESSES**

Allowable stresses for steel shall be calculated in accordance with AISC specifications for the design, fabrication and erection of structural steel for building.

Allowable stresses for rivets, bolts and threaded parts shall be calculated in accordance with AISC specifications or tabulated allowable loads specified shall be followed.

Allowable stresses for welds shall be calculated in accordance with AISC specification.

### **7.07 FABRICATION**

#### **7.07.1 Straightening Material**

All material, before being worked upon, must be straightened within tolerances by ASTM specifications A6. Straightening necessarily shall be done by mechanical means or by the application of a limited amount of localized heat. Temperature of heated areas, as measured by approved methods, shall not exceed 1100 F for A514 steel or 1200 F for other steels.

#### **7.07.2 Cutting**

As far as possible, cutting must be done by shearing. Oxygen cutting shall be done where shear cutting is not possible and shall preferably be done by machine. All edges shall be free from gauges, notches or burs. If necessary, the same shall be removed by grinding.

#### **7.07.3 Holes Punching Drilling**

Holes may be made by drilling or punching. Holes shall be punched where thickness of the material is not greater than the diameter of bolt + 3mm. where the thickness of the material is greater, the holes shall either be drilled or sub-punched and then reamed to size. The die for all sub-punched holes and the drill of all sub-drilled holes shall be at least 2mm smaller than the nominal diameter of bolt. Holes for A 514 steel plates over 1/2" thick shall be drilled.

#### **7.07.4 Welding**

- a. **General:** The execution and inspection of welding shall be done in accordance with the provisions of the American welding society code/Specifications for welding in building construction, D1.0.
- b. **Automatic Sub-merged Arc Welding:** For all build-up members, i.e. sections fabricated from plates and flat bars or compound rolled sections and plates, where long continuous, welding is to be done, should be executed by Automatic submerged arc welding process in accordance with relevant AWS specifications.
- c. Maximum and minimum size and lengths of fillet welds shall be done in accordance with AISC specifications.
- d. Surface to be weld shall be free from loose scale slag, rust, grease, paint or any other foreign matter except mill scale, which withstands vigorous wire brushing.

#### **7.07.5 Tolerances**

A variation of 1mm is permissible in the overall length of members with both ends finished for contact bearing. The bearing surface is to be prepared to a common plane by milling. Members without end finished for contact bearing, which are to be framed to other steel parts of the structure, shall have a variation from detailed length not greater than 3mm.

#### **7.07.6 Test Assembly**

Fabricated shops assemblies of all components shall be test assembled together after fabrication, prior to painting/galvanizing.

Test assembly work and procedure should be planned during fabrication process. Major fabrication work of locating of gussets etc. marking and drilling of holes for inter connecting joints, spliced connection leveling, placing of bracing, should be done simultaneously with test assembly.

Each test assembly will be inspected by the Engineer's representative and shall be dismantled only after his approval in writing.

### **7.08 SURFACE PREPARATION/PAINTING/GALVANIZING**

#### **7.08.1 Surface Preparation for Painting and Coating:**

- After fabrication and test assembly the surface preparation for painting or coating of all components shall be done conforming to SSPC – SP10 (near white metal) by means of sand blasting.
- The sand used for this purpose shall be free from earth, dirt, clay and moisture.
- The size of sand particles, air pressure and size of the hose nozzle shall be correlated to give a proper and acceptable surface.

#### **7.08.2 Painting**

Painting of all steel, forged or cast components shall be done in 5-coats as under:

- Surface Preparation:
- Near white metal surface according to SSPC SP-10.
- First and Second Coat
- Two pack anti corrosive Epoxy primer of 50 microns dry film thickness for eachcoat.
- Third, Fourth and Fifth; Finishing Coat:
- Two pack Epoxy resin enamel pigmented suitably for resisting highly corrosive and chemical influences and for withstanding abrasion and erosion.
- Each coat shall have 50-micron dry film thickness.
- Paint Selection/application
- Paints of manufacturers of repute shall be selected. The complete 5-coat paint system of any one of the manufacturers shall be used.
- The application of each coat of paint shall be done in accordance with the paint manufacturers recommendations, printed in their authentic printed catalogue.

#### **7.08.3 Engineer's Approval:**

The contractor shall submit 2 or more proposals containing the following for Engineer's approval:

1. Manufacturers name along with authentic painted catalogue.
2. Relevant 5-coat paint system with manufacturer trade names.
3. Any other details of relevance.

#### **7.08.4 Steel Work/Surface not to be Painted**

- i) Steel work to be encased / embedded in concrete or surface in contact with concrete or grout shall not be painted, but shall be given a cement wash after sand blasting.
- ii) Machined finished surfaces shall not be printed but shall be coated with rust preventive compound, approved by the Engineer immediately after finishing. Such surfaces shall be also protected with wooden pads or other suitable means for transportation. Unassembled pins, keys, and bolt threads shall be greased and wrapped with moisture resistant paper.
- iii) Contact surfaces of connections using high strength bolts in friction type connections shall not be painted. Such surfaces of all components after fabricationshall be cleaned free of paint,

grease, burrs slag by means of sand blasting. No coating whatsoever then be applied to such surface.

#### **7.08.5 Zinc Coating (Galvanizing)**

Components shall be galvanized after complete fabrication i.e. welding, drilling etc. The process should consist of removal of rust and mill scale by pickling in hydrochloric acid or sulphuric acid followed by water wash and prefluxing with ammonium chloride. The fluxed components should then be passed through a drying oven prior to immersion in a bath of virtually pure molten zinc.

The zinc coating shall be applied in a manner and of a thickness and quality conforming to the requirements of ASTM A123, standard specification for zinc (hot galvanized) coating on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.

### **7.09 INSPECTION AND TESTS**

Manufacturer's work test certificate for all material used shall be furnished by the Contractor for Engineer's scrutiny and approval.

- a. Rolling tolerance of all shapes and profile shall be in accordance with the provisions of the American Society for Testing and Material Designation A.6. These shall be checked by the contractor before being worked upon and shall be rejected if found not within limits.
- b. The contractor shall arrange for analysis and test of all material rolled locally at a testing laboratory selected by the Engineer.
- c. Nevertheless, neither the fact that the material has been tested nor that the manufacturers work test certificates have been furnished, shall affect the liberty of the Engineer to reject, after delivery, material found not according to these specifications.

### **7.10 ERECTION**

#### **7.10.1 Bracing**

The framing of steel skeleton buildings shall be carried up true and plumb within the limits defined in Section 7(h) of the AISC code of standard practice, and temporary bracing shall be introduced wherever necessary to take care of all loads to which the structure may be subjected including the equipment and the operation of the same. Such bracing shall be left in place as long as required for safety.

#### **7.10.2 Alignment**

No riveting, permanent bolting or welding shall be done at site during erection until as much of the structure as will be stiffened thereby has been properly aligned.

#### **7.10.3 Joints using High Strength Bolts**

All structural joints using high strength bolts shall be executed and inspected in accordance with —AISC specification for structural joints using ASTM A325 or A490 bolts.

### **7.11 MISCELLANEOUS STEEL WORK**

#### **7.11.1 General**

The work covered shall include furnishing, fabricating, painting and installing miscellaneous steel work including the following:

- a. Steel Stairs
- b. Steel Ladders
- c. Steel Pipe handrails
- d. Steel protection angles
- e. Steel doors, windows, gates, ventilators/louvers.
- f. Steel fencing.
- g. Grating and chequered plate covering.
- h. Embedded plate, anchor bolts and other miscellaneous items.

#### **7.11.2 Steel Stairs**

General: Structural steel stairs complete with grating treads or chequered plate treads, landings, supporting structures, handrail, supports etc. shall be furnished and installed in accordance with working drawings. All components shall be galvanized to maximum extent practicable as shown on the drawings.

Material: Except otherwise indicated in the working drawings materials shall conform to the requirements of ASTM A36 (Tentative specifications for structural steel).

**7.11.3 Steel Ladders**  
Steel ladder shall be welded assemblies with or without safety cages fabricated in accordance with the drawings. Material and standard of fabrication shall be the same as specified for stairs.

**7.11.4 Steel Pipe handrails**  
Steel pipe handrails consisting of posts, handrail, knee rails and toe rail shall be fabricated in suitable units having two posts or three posts in one unit with erection joints between handrail and knee rails. Handrail of platforms galleries etc. of considerable length may not be shop fabricated as complete units consisting of posts etc. in case of such handrails the posts may be fabricated of the required height having one end with necessary arrangement for fixing to the platform or floor beams etc. and other end shop prepared to take the top handrail. Top handrail, knee rail and toe rail may be brought at site in stock length. The same may then be cut and welded at site. Locally manufactured pipes, M.S. or G.I may be used for the hand railing. These shall however conform to the requirements of ASTM A53 or shall be of equivalent requirements.

**7.11.5 Steel Protection Angles**  
Steel protection angles required for the protection of concrete work shall be erected true to line and level. Steel angles shall be fixed in position by using anchors.

**7.11.6 Steel door, windows, ventilators, louvers and gate frames:**  
Frames shall be fabricated from locally available hot rolled angle, tee, channel or pipe sections as specified in the drawings. Material shall however conform to ASTM A36.

**Shutters:**

Shall be made of any of the sections noted above with skin plate of at least 18 S.W.G as shown in the drawings.

Accessories such as hinges, anchors, bolts, locks and handles shall conform to the requirements shown on the drawings or as directed by the Engineer.

**7.11.7 Steel Fencing**  
Steel fencing shall be made from wire mesh bolted on the steel angles or channel frame as shown on the drawings or as directed by the Engineer.

Surface Preparation and Painting.

Surface preparation painting and galvanizing of all miscellaneous steel work shall be done in accordance with clause 10 herein.

**7.12 MEASUREMENT AND PAYMENT**

**7.12.1 General**

Except otherwise specified herein or elsewhere in the contract documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- a. Bolts, nuts, washers, screw, rivets, heads, fillets, welds and welding rods.
- b. Galvanizing and painting.
- c. Glass and glazing.
- d. All embedded parts unless otherwise specified in the Bill of Quantities
- e. Painting
- f. Steel grills and fly proof of shutters
- g. Locks, handle, hinges, hold fast, stopper etc.

**7.12.2 Structural Steel Works and Miscellaneous Steel Work Measurement**

Item of work of structural steel for which the unit rates have been quoted on weight basis and for which detailed workshop drawing have not been made shall be measured net as installed at site as per sketches and instruction of the Engineer. After measurement the theoretical weight shall be calculated from standard tables of section and weight in the manner followed in the preparation of shop drawings.

Items of works of structural steel for which the unit rates have been quoted on weight basis and for which the detailed shop drawings have been prepared, measurement shall be made at site to verify whether the items fabricated, supplied and erected in position are in conformity with the shop drawings. If the same is so verified to the satisfaction of the Engineer the weights given in shop drawing shall form basis of payment of bill. Any deviation found during the verification the same shall be checked from design and specifications point of view and shall be incorporated in the shop drawing and consequently the weights shall be revised.

**Payment**

Payment shall be made for acceptable measured quantity of all structural steel works on the basis of unit rate quoted in the Bill of Quantities and shall constitute full compensation for all the recovery related to the item.

**7.12.3 Steel Embedded Part**

**Measurement**

Measurement of acceptable completed works of steel embedded parts will be made on the basis of weight of steel parts provided and embedded in position as shown on the drawings or as directed by the Engineer.

**Payment**

Payment shall be made for acceptable measured quantity of steel embedded parts on the basis of unit rate per metric ton quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the items.

**\*\* END OF SECTION\*\***

## SECTION - 8 CEMENT CONCRETE BLOCK MASONRY WORK

### 8.01 SCOPE OF WORK

The Work covered by this section of the Specifications consists of all work required in connection with construction of block masonry portions of structures and partition walls including but not limited to furnishing of precast solid or hollow cement concrete blocks, cement mortar, all related items and appurtenances including all items supplied by other trades and customarily built-in and installed under masonry work or required to complete masonry work, all labour, plant, tools, scaffolding, hoisting equipment and all other materials, and in performing all operations in connection with block work, i.e., erecting, placing, bedding, building in, curing and protecting all masonry works, complete in accordance with requirements of Drawings, Bill of Quantities, Specifications as stated herein, and to the entire satisfaction of the Engineer and subject to the terms and conditions of this Contract.

### 8.02 MATERIALS

#### 8.02.1 Portland Cement

All Portland cement for concrete block and mortar shall conform to the stipulations and requirements specified in Section 4 – Specifications of Plain and Reinforced Concrete.

#### 8.02.2 Sand and Coarse Aggregates

All sand and coarse aggregates for the cement concrete block and sand for mortar shall be obtained from approved quarries and shall conform to the requirements specified herein below:

##### a. Sand

Sand shall be clean, and shall be of the same quality as the sand obtained from approved quarries for concrete works. It shall be hard, strong, durable, soft and free from flaky particles, injurious amounts of dust, alkali, organic matter or other deleterious substances and shall comply with all the requirements for concrete. The Contractor will be required to screen and wash the sand to remove any foreign matter in it. The sand or fine aggregate shall be graded as specified in the section on concrete or in the manner approved by the Engineer.

##### b. Coarse Aggregate

Coarse aggregate shall be gravel obtained by screening the gravel or hard crushed stone and shall comply with the requirements for aggregates for concrete. The Contractor shall screen the aggregate through 9 mm and 5 mm sieve as many times as may be necessary to obtain such material as shall be retained on the 5 mm sieve. The grading shall be approved by the Engineer and may be modified if required. A representative sample of the aggregate collected by the Contractor from time to time shall be tested by the Engineer and if the sample would not conform with the approved grading as required by the Engineer, the entire gravel collected by the Contractor will be liable to be rejected.

The aggregate shall be free from soft, friable, porous, flaky, elongated or laminated pieces. The aggregate shall also be free from dirt, silt, clay, shale, alkali or organic matter. It shall be sufficiently strong to utilize the full strength of cementing material.

#### 8.02.3 Water

Water used for making concrete blocks, mortar, laying of masonry, or any other operation of constructions shall be potable water free from objectionable quantities of silt, organic matter, alkali, salts and other impurities and shall comply with the requirements of water for mixing and curing of concrete and shall be tested and approved by the Engineer.

#### 8.02.4 Admixtures

a. Mortar plasticizers shall comply with the requirements of BS 4887.

- b. Admixtures used in the manufacture of blocks shall comply with BS5075.

**8.02.5 Mortar**

Pre mixed mortars shall comply with the general requirements for materials and mix proportions shall be as given in this Specification.

**8.02.6 Damp-Proof Course**

Flexible damp-proof course materials shall comply with BS 743 where applicable and shall comprise of the following:

- i) bituminous roofing felt not less than 3 mm thick, or
- ii) polyethylene sheeting not less than 0.5 mm thick or
- iii) any other approved material

The damp-proof membrane shall be laid on an even bed of cement sand mortar (1:1) and lapped 6l at all joints. The damp-proof membrane shall cover the full width of the blocks.

**8.02.7 Bonding Ties**

Bonding Ties shall be expanded metal strips as shown on the Drawings or as directed by the Engineer.

**8.02.8 Wall Ties**

Wall ties shall comply with BS 1243 and shall be hot dip galvanized steel as approved by the Engineer.

**8.03 PROPORTIONING OF INGREDIENTS**

The blocks will be made using a concrete mix of 1:3:6 cement, Sand and aggregate.

**8.04 MAKING OF CONCRETE BLOCKS**

8.04.1 All solid and hollow blocks shall be machine moulded of required sizes as shown on Drawings and approved by the Engineer and shall generally conform to the requirements of British Standard 2028, 1346:1968 —Precast Concrete Blocks unless specified otherwise. The ingredients shall be well worked into the moulds, vibrated, tamped and pressed to ensure that the blocks are dense and free from voids.

8.04.2 In case of the hollow blocks, the cavities shall be true to the shapes and sizes specified and shall have uniform wall thickness on the outside of the cavities. The cavities in hollow blocks shall not be more than 25% of the total volume.

For casting, the moulds shall be placed on a level platform cast from 2l thick 1:3:6 concrete. The finished blocks shall be true to shape i.e. every face shall be perfect rectangle exactly parallel to the opposite face and exactly perpendicular to the adjoining faces. All the blocks shall be free from cracks, spalls, chips, rugged edges or other defects detrimental to their use. Blocks with broken edges or which are skew will not be allowed to be used on the Work and must be removed from the Site of Work within 24 hours of their being rejected.

8.04.3 The blocks must not be lifted from the platform till they have been cured for a period of 2 days in addition to 10 hours required for setting. After 2 days the blocks must be removed and stacked to reasonable height as directed by the Engineer. The block stacks are to be kept wet for a period of 8 days and then shall be allowed to dry in shade for at least twenty (20) days before they are used in the Work. The blocks cast on different dates must be separately stacked. The date of casting and number of blocks in each stack shall be properly marked with non-washable paint.

8.04.4 The average compressive strength of any five solid blocks at random shall be not less than 1000 pounds per sq. inch.

- 8.04.5 The average moisture content of all the concrete masonry units shall not exceed 30% of the total water absorption of units. The shrinkage of cement concrete blocks is much greater at the time it dries for the first time after moulding and subsequent curing. It is, therefore, essential that the Contractor shall take full care to see that blocks are sufficiently and thoroughly dried so that their initial shrinkage is completed before the blocks are laid in the Works. Not only well dried blocks shall be used, but the blocks shall also be laid dry without wetting except with slightly moistened surfaces on which mortar is to be applied to obviate absorption of water from the mortar and even during curing of the mortar joints. The walls shall be slightly moistened and shall not be allowed to be excessively wet till they receive any plaster or render.
- 8.04.6 The blocks shall be stored in such a manner as to avoid any contact with moisture on the Site of Works. The blocks shall be stock piled on platforms or other supports free from contact with the ground. If necessary, cover for protection against wetting shall be provided. The blocks right from casting to curing, drying, stock piling and their subsequent placing in masonry walls shall be handled with care.

## **8.05 MORTAR**

- 8.05.1 All mortar for masonry shall be in proportion of one part of cement to six parts of sand (fine aggregate) or as directed by the Engineer. The ingredients shall be mixed by volume in purpose made gauge boxes. All mortar shall be mixed in a mechanical mixers. Handmixing, when permitted by the Engineer shall be done on clean, hard platform of only such quantities as required for immediate use with just sufficient water to produce mortar of stiffest consistency and sufficient workability.
- 8.05.2 Cement shall be Portland cement as specified under the section - Plain and Reinforced Concrete as per BS 12.
- 8.05.3 Fine aggregate (sand) shall be clean, hard, durable, soft and free from flaky particles as specified herein above shall be subject to the approval of the Engineer. Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of water to the mix shall be rejected. Re-tempering of mortar will not be allowed.
- 8.05.4 The dry materials (cement and sand) shall be dry mixed for approx. two (2) minutes and for three minutes after addition of water making total minimum time of five (5) minutes in a mortar mixer. When hand mixing is permitted, dry mix, rake well, turn over materials for each batch before adding water, until uniform colour of mixed materials indicated through distribution of cementitious material. After dry mixing is complete, add water until the correct consistency is obtained.

The sand shall meet the following B.S. Specifications:

- a. Sand for mortar shall comply with the requirements of BS 1200.
- b. The grading of sand for general purpose mortars shall be within the limits of Table 1 of BS 1200. The grading of sand for reinforced block work mortars shall be within the limits of Table 2 of BS 1200.
- c. The clay/silt content, when determined in accordance with BS 812, shall not exceed 3%.
- d. The Chloride and Sulphate contents shall not exceed the limits given in aggregates for concrete.

## **8.06 LAYING OF BLOCK MASONRY**

- 8.06.1 All block work shall be set out and built to the respective lengths, dimensions, thickness & heights shown on the Drawings.
- 8.06.2 All block work should be true to lines, plumb and level. Chases, grooves, raglet block and raked out joints shall be kept free from mortar and debris.
- 8.06.3 Block work shall be carried up in a uniform manner, no one portion being raised more than 3 ft. above another at one time unless special circumstances render this impracticable. All perpend, quoins etc. shall be kept strictly true and square and the whole properly bonded together. The maximum height which is to be built in one day is 5 ft.
- 8.06.4 All horizontal and vertical joints shall be completely and solidly filled with mortar as and when the

blocks are laid.

The thickness of joints shall generally be  $\frac{1}{2}$ " and at no point more than  $\frac{5}{8}$ ". All crossjoints shall also be filled well.

- 8.06.5 Any mortar which falls on the floor from the joints or removed due to raking of joints shall not be reused and must be cleaned and removed from Work-Site at the end of the day.
- 8.06.6 Where masonry abuts R.C.C. columns or walls, it shall be anchored thereto by means of  $\frac{3}{8}$ " diameter bars at a vertical spacing of 16" and as shown on the Drawings or as instructed by the Engineer.
- 8.06.7 Masonry shall be cured for at least ten (10) days from the day it is laid.
- 8.06.8 Mortar already spread which becomes diluted by rain shall be removed and replaced before continuing with the work.
- 8.06.9 Hollow blocks where used shall be placed in a manner as shown on the Drawings and/or as directed by the Engineer.
- 8.06.10 Block walls shall be built in stretcher bond, accurately special with each breaking joints with the course below. Intersections of block walls shall be properly bonded in alternative courses.
- 8.06.11 Generally, block work where exposed shall be flush jointed as the work proceeds. Joints of those facings which are to receive external or internal plastering shall be raked out  $\frac{3}{4}$ " deep when the mortar is still fresh so as to provide proper bond for the plaster.
- 8.06.12 All hollow blocks shall be filled at sides of openings and intersections with concrete mix having a compressive strength at 28 days of not less than that of the block.
- 8.06.13 A solid or pre-filled course of block work shall be provided at sill level of openings and under bearing of all in situ concrete.
- 8.06.14 Pointing of exposed block work shall be as shown in the Drawings or as directed by the Engineer. Pointing shall be done as the work proceeds.
- 8.06.15 Unless otherwise shown on the Drawings or specified, the spaces around frames and other built-in-items shall be solidly filled with mortar, except the joints that are to be caulked shall be raked out  $\frac{3}{4}$ " deep.
- 8.06.16 Work required to be built in with masonry including anchors, wall plugs and accessories shall be built in, as the work progresses. Wood plugs and blocking shall not be built into masonry.
- 8.06.17 No masonry to be erected when temperature of outside air is below 40°F unless suitable means as approved are provided to heat material protected from cold and frost and ensure that material will harden without freezing.
- 8.06.18 When the masonry is to receive plaster on one side and pointing on the other, the block shall be placed in such a way that the better face shall be on the side of pointing.

## **8.07 COORDINATION**

- 8.07.1 The Contractor shall provide chases and openings in block work required under other sections to sizes and locations as shown in the Drawings.
- 8.07.2 The Contractor shall cooperate with other trades in setting built-in items, take special care in cutting, fitting, setting units so that built-in members are in their true, respective positions.
- 8.07.3 The Contractor shall also coordinate during block work for the items provided in other sections such as door frames, hold fasts, miscellaneous metal work occurring in the masonry and sleeves, anchors, supports, nailing strips, braces, jambs etc. to be built-in the masonry.
- 8.07.4 Special care shall be taken in building walls of door frames. Contractor shall see that frames

are square and in plumb. Check frames before building block work around or against them. The Contractor shall see that electric conduits are not housed into frames so as to prevent extension of frame anchors.

8.07.5 The Contractor shall be responsible for any damage or abortive work due to lack of coordination on his part or due to negligence of his Site supervisory staff in coordination of various sections of Works and no compensation shall be made to the Contractor on such account. The Contractor shall reinstate/make good such affected works at his own cost.

**8.08 PROTECTION AND CLEANING**

8.08.1 Surface of masonry not being worked on shall be properly protected to all times during the construction operations. When rain is expected and the work is discontinued, the top of exposed masonry walls shall be covered with a strong waterproof membrane, well secured in place.

8.08.2 Exposed masonry surfaces shall be cleaned with water and fiber brushes or as directed by the Engineer.

8.08.3 Protect adjacent work during cleaning operations. Make good any damages from neglect of this account.

**8.09 SAMPLES**

Samples of all kind of materials to be used on the job shall be submitted to the Engineer and to be approved by him before quantities are procured for the Works. Source of supply or quality or materials not be changed unless authorized in writing by the Engineer.

**8.10 TESTING**

All the materials and completed masonry work shall be subjected to standard testing and if found below the Specifications and BSS or ASTM standards, shall be rejected. Rejected material shall be removed from the Site immediately at the Contractor's expense. All testing shall be done at the Contractor's cost.

**8.11 CONCRETE LINTEL BEAM**

Unless otherwise indicated, provide concrete lintel over openings in the concrete masonry unit walls and partitions. Lintels shall be of the size and shall be reinforced as indicated. All lintel shall be as-in place and when exposed shall be the same color, surface texture and finish as the adjacent walls or partition. Concrete work shall conform to section 4 of this specification.

**8.12 MEASUREMENT AND PAYMENT**

Masonry Works in accordance with this section of Specifications shall be measured and paid for per square Meter/feet wall of a thickness as specified in the Drawings and Bill of Quantities complete and approved including mortar as specified, preparations, tests etc. but excluding cost of blocks which shall be supplied by the Employer. Openings of more than 0.28 sq.m shall be deducted. Damp-proof course shall be measured and paid for separately.

Steel anchors/wall ties for connection to R.C.C. or steel columns are deemed to be included in the above rates and will not be paid for separately.

Cuttings for conduit/pipe installations, anchors, fixing of other installations, embed items, fittings & fixtures are deemed to be included in the relevant items and will not be paid for separately.

**\*\* END OF SECTION\*\***

## SECTION - 9 PLASTERING AND RENDERING

### 9.01 **SCOPE OF WORK**

The Work covered by this section of the Specifications consists of furnishing all plant, labour, appliances/equipment and materials for performing all operations in connection with lathing, plastering and rendering, complete in all respect; in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract.

### 9.02 **APPLICABLE STANDARDS**

Latest editions of following Pakistan, British & ASTM standards are relevant to these specifications wherever applicable.

#### **Pakistan Standard**

PS 232 Ordinary Portland Cement

#### **ISO (International Organization for Standardization)R**

597 Definitions and terminology of cement.

R 679 Method of testing strength of cements, compressive and flexural strength of plastic mortar (Rilem - Embureau method).

R 680 Chemical analysis of cement& main constituents of Portland cement. R 681

Chemical analysis of cements-mixer Constituents of Portland cement. R 682

Chemical analysis of cements - determination of Sulphur as Sulphide.

#### **ASTM (American Society for Testing and Material) C**

144 Aggregate for Masonry mortar

C 631 Bonding compounds for interior plastering **BSI**

#### **(British Standards Institution)**

812 Methods for sampling and testing of mineral aggregates, sands and fillers.

1199 Sands for external renderings internal plastering with lime and Portland cement and floor screeds.

1369 Metal lathing (steel) for plastering.

5262 External rendered finishes.

5492 Internal plastering.

### 9.03 **GENERAL**

Except as may be otherwise shown or specified, all interior & exterior plaster shall be cement plaster in specified thickness shown on Drawings & BOQ. Plastered ceilings and walls shall include partitions, piers, columns, beams, ceilings, plastered jambs and other returns, reveals, and backs of recesses and alcoves, and joints and heads of windows and doors, unless otherwise specified or shown on the Drawings. Plaster on walls shall be carried down to dado, skirting and projected bases. Plasterwork shall also include all plasterwork on and under concrete surfaces and masonry. Concrete surfaces to be left exposed and concrete not specified to be left fair faced, as indicated on Drawings.

A 3/8" render coat shall be applied to walls with a slightly roughened surface where wall finishes of applied nature, such as ceramic tiles, marble tiles, granite tiles, textured paint etc., are to be installed over wall surfaces.

Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, doors and window frames and all sorts of inserts and embedded items are fixed in position. It shall be the responsibility of the Contractor to make sure that other contractors carry out all such work before starting of plasterwork. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer.

### 9.04 **MATERIALS**

- a. Cement for plaster shall be Ordinary Portland Cement (BS 12 or PS 232) or Sulphate Resisting Cement (BS 4027 or P.S. 612) as specified and shall conform to requirements specified in the section "Plain and Reinforced Concrete".

- b. Sand for plaster shall comply with the requirements of BS 1199, BS 1200, ASTM C-33 and/or the Pakistan Standard "Sand for Plaster" as directed by the Engineer.
- c. Water shall be clean and free from oils, acids, alkalis, salts and organic or other injurious matter and as described in section for "Plain and Reinforced Concrete".
- d. All materials and workmanship for plaster not explained in these Specifications, shall comply with the requirements of relevant BS CP 211 and CP 221 as directed by the Engineer.
- e. External rendered finishes should comply with appropriate clauses of BS 882.
- f. Mortar plasticizer shall comply with BS 4887 and shall be used in accordance with the manufacturer's instructions.
- g. Pigments to be used shall comply with BS 1104.
- h. Galvanized metal angle beads and plaster stops shall be as manufactured by the Expanded Metal Co. Ltd., London or other equal and approved.

#### **9.05 MIXING OF PLASTER**

Measurement of materials by volume shall be by containers of known capacity to maintain consistent proportions. No lumpy or caked material shall be used. Mixing equipment boxes and tools shall be clean. Materials shall be proportioned as specified on the Drawings or as directed by the Engineer. Mixing shall be continuous until all ingredients are evenly distributed and thoroughly mixed. Only limited water shall be added for proper workability and such quantity of mortar shall be prepared which can be consumed in thirty minutes after preparation. Preparation of mortar in bulk quantity for use during the entire day or for any other time more than that stipulated above is expressly prohibited. Re-tempering shall not be permitted and all mortar, which has begun to stiffen, shall be discarded.

Except where hand mixing of small batches is approved by the Engineer, mechanical mixers of an approved type shall be used for the mixing of plaster. Frozen, caked, or lumped materials shall not be used. Mechanical mixers, mixing boxes and tools shall be cleaned after mixing each batch and kept free of plaster from previous mixes. Plaster shall be thoroughly mixed with the proper amount of water until uniform in colour and consistency.

Re-tempering will not be permitted, and all plaster which has begun to stiffen shall be discarded. Plaster ingredients shall be thoroughly mixed either by hand on a clean cement concrete platform or by a mechanical mixer, as directed by the Engineer.

Water Proofing Plaster 3/4 inch. (20mm) thick 1:4 cement sand plaster mixed with approved water proofing agent.

Re-tempering will not be permitted, and all plaster which has begun to stiffen shall be discarded.

#### **9.06 PROPORTIONING OF PLASTER ON INTERNAL AND EXTERNAL WALLS**

All plaster shall be Portland cement plaster, all coats of which shall be mixed in the following proportions by volume:

- One part cement and 4 parts sand or specified otherwise.
- One part cement and 3 parts sand only for RCC roof slab soffits.

All coats of plaster in water retaining structures shall be waterproofed by the addition of an approved waterproofing additive/admixture from BCR, Sika, Fosroc, Betocrete C-16or Master Builders or approved imported equivalent.

External plaster shall be pigmented plaster in the shades/ colors to the approval of the Engineer.

#### **9.07 PREPARATION OF SURFACES OF PLASTER**

- a. Surfaces to receive plastering shall be brushed to remove all loose particles, dust, laitence, efflorescence, etc. and any projecting fins on concrete surfaces shall be hacked off.
- b. Glossy or greasy surfaces shall also be suitably cleaned and chipped off to remove all traces of mould oil.
- c. Where unduly smooth in-situ concrete surfaces are encountered, such surfaces must be hacked properly before applying plaster.

- d. Surfaces shall thoroughly be sprayed with water and all free water allowed to disappear before plaster is applied.
- e. Irregularities in the surfaces to be plastered shall be filled with cement mortar 24 hours before plastering is commenced.
- f. Before plastering is commenced, all junctions between differing materials shall be reinforced. This shall apply where walls join columns and beams particularly where cracks are likely to develop and places directed by the Engineer. The reinforcement of such joints shall consist of a strip of galvanized expanded metal lath/mesh, at least 6l wide, which shall be plugged, nailed or stapled to the surfaces to be plastered at the intervals not exceeding 12l. The joints in mesh shall be lapped minimum 6l.
- g. Metal angle beads shall be fixed with plaster dabs at 24l centers applied to the wall on either side of the arise and the wings of the beads pressed well in.
- h. The Plaster stops shall also be fixed in a similar manner or plugged, nailed or stapled to the surfaces to be plastered to the approval of the Engineer.
- i. Metal angle beads and plaster stops shall be fixed at places shown on the Drawings or as directed by the Engineer.
- j. It shall be responsibility of the Contractor to ensure that all electrical conduits, pipes, concealed or embedded items, ducts, brackets, doors, window and ventilator frames, and all other fixtures on walls, ceilings, columns or required elsewhere have been fixed in position before the plastering is commenced.
- k. Cuttings and chasings in the block work shall be repaired as per the instructions of the Engineer at least twenty-four hours before the plastering is commenced.

#### **9.08 APPLICATION OF PLASTER**

The Contractor shall not start any work till the surfaces are inspected by the Engineer. In case, any plaster work is done without obtaining the consent of the Engineer, the Engineer shall have the right to order removal of all such work and cleaning and preparation of the surfaces to his full satisfaction and the Contractor shall comply with such orders without any delay.

All surfaces to be plastered shall be treated with cement slurry as a base coat for proper bond. Any approved bonding agent may also be used as an alternative to cement slurry.

Plaster to internal and external surfaces shall be applied in the thickness shown on the Drawings or specified elsewhere. In any case, the plaster thickness shall not be less than the specified thickness.

Plaster shall be applied in two (2) coats on masonry and concrete surfaces where thickness is more than 3/4. The thickness of each coat shall not exceed 3/4l.

- a. In case of 2 coats, the first coat or the under coat shall be full and thick and shall be applied with sufficient force to form good keys. The under coat shall be roughened and cross-scratched upon attaining its initial set to provide a proper bond to the next coat and shall be kept damp with a fog spray.
- b. Finish coat shall not be applied until the under coat has seasoned for 2 days. Just before application of the finish coat, the under coat shall again be wetted evenly with a fog spray.
- c. Finish coat shall be smooth finished.
- d. The finish coat shall be kept moist with a fog spray for at least 2 days and thereafter shall be protected against rapid drying until properly and thoroughly cured.

Plastering shall be executed in a neat workmanlike manner and shall be finished off with a wood or steel float, straight and plumb and shall not have wavy surface. The surface shall be of even texture and entirely free from all marks. The edges and corners shall represent a straight line. All the arises shall be rounded to 6 mm radius unless otherwise specified.

Plastering shall neatly be made good around pipes or fittings.

As far as practical, plastering shall not be commenced until all mechanical, electrical and plumbing items, conduits, pipes, fittings and fixtures have been installed in their sequence of operations.

Plaster is to be maintained in moist condition for at least four days after it has developed enough strength not to be damaged by water.

Plaster stops and angle beads of expanded metal shall be used for protection of arises, edges and plaster end as shown on the Drawings and as directed by the Engineer.

Plaster containing cracks, blisters, pits, discoloration or any defects shall not be acceptable. Any such defective plaster rejected by the Engineer shall be removed and replaced in conformity with these Specifications by the Contractor at his own cost to the satisfaction and approval of the Engineer.

**9.09 SAMPLING OF PLASTER**

Samples may be taken by the Engineer at any time from plaster work in place. Areas represented by samples which show over sanding will be rejected.

**9.10 PATCHING**

Plaster containing cracks, blisters, pits, checks, or discoloration will not be acceptable. Such plaster shall be removed and replaced with plaster conforming to this Specification and approved by the Engineer. Patching shall match with existing work in texture and colour.

**9.11 CONCRETE / MASONRY JOINTS**

All joints of concrete and block walls shall be specially treated as described here or as shown on Drawings. A 150 mm wide approved expanded metal shall be fixed at the joints and then plaster shall be applied. The expanded metal shall be with a weight of 3.0 lbs./sq. yd.

**9.12 CLEANING AND PROTECTION**

Rubbish and debris shall be removed as necessary to make way for work of other trades and as directed by the Engineer. As each room or space is completed all! Rubbish, debris, scaffolding and tools should be removed to leave the room clean.

Prior to plastering all aluminum windows, finished metals should be covered by sheet of plastic or tarpaulin to protect it from damage.

Protect finished plaster from injury by any source. Contractor shall also protect walls, floors and work of other trades from plaster materials.

**9.13 TOLERANCES**

The work shall be carried out while maintaining the following tolerances:

- Surfaces of plaster work shall be finished with a true plane to correct line and level unless otherwise specified and with walls and reveals plumb and square.
- Maximum permitted tolerances shall not exceed 1/8 inch. (3mm) in 6ft. (2 meter), but not exceeding 12 mm, maximum over the length of the building.
- Variation from plumb or level in any exposed line or surface and 1/16 inch (1.5 mm)
- Variation between planes of abutting edges or ends 1/16 inch (1.5 mm)
- Maximum permissible Offset at joints is 1.5 mm maximum

**9.14 MEASUREMENT AND PAYMENT**

Plaster shall be measured and paid per square Meter/feet, complete and approved, at the unit rates entered in the Bill of Quantities, including preparations, junction reinforcements, angle beads, plaster stops, framing and metal furring, metal lathe, chamfered edges, rounding off corners etc. and in the thickness as specified in Bill of Quantities.

**\*\* END OF SECTION\*\***

## SECTION - 10 CARPENTRY AND JOINERY

### 10.01 **SCOPE OF WORK**

The work covered under this section of Specifications consists of providing all material, labor, plant, equipment, appliances and performing all operations connected with the fabrication and erection of all woodwork, mill work, construction assembly, surface finish treatment and building in of all cabinet type items, supports etc. of wood or metal and incidentals, associated woodwork appurtenances, procuring and applying preservatives, installation of "Finish Hard Ware" in connection with finish woodwork as per details shown on the Drawings or as directed by the Engineer. The scope of this section is covered with detailed specifications as laid down herein.

### 10.02 **APPLICABLE STANDARDS**

Latest editions of following British and ISO Standards are relevant to these specifications wherever applicable.

#### **ISO (International Organization for Standardization)**

1891 Bolts, screens, nuts and accessories-Terminology and nomenclature. 1097

Plywood - Measurement of dimensions of panels.

1098 Veneer ply wood for general use-General requirements.

2427 Veneer ply wood with rotary cut veneer for general use-Classification by appearance of panels with outer veneer of beech.

2429 Ply wood - Veneer ply wood with rotary cut veneer for general use-Classification by appearance of panels with outer veneers of brand leaved species of tropical Africa.

3804 Ply wood-Determination of dimension of test pieces. 3805

Ply wood-Determination of density.

3806 Ply wood-Determination of moisture content. 6442

Door leaves-Measurement of defects.

6443 Door leaves-Measurement of dimensions and of defects of squareness. 6444

Door leaves-Test of behavior under humidity variations.

#### **BSI (British Standards Institution) 459**

Wooden doors.

1186 Quality of timber and workmanship in joinery.

1127 Hinges

1331 Builder's hardware for housing. 1567 Wood door frames and linings nails. 1202 Nails 1203 Specifications for synthetic resin adhesive for plywood.

1204 Synthetic resin adhesives for wood.

1282 Guide to choice, use and application of wood preservatives

1494 Fixing accessories for building purposes.

1579 Connectors for timber.

3842 Treatment of ply wood with preservatives

### 10.03 METARIALS

#### 1) Timber

Common Timber shall be sub divided into following:-

- **Hardwood 1st Class**
  - Teak Burma
  - Shisham
  
- **Softwood 1st Class**
  - Deodar
  
- **Softwood 2nd Class**
  - Kail
  - Chir
  - Partal
  - Spruce
  - Garjan
  - Loagerstoemia

Wood types to be used shall be taken as per architectural details.

#### 2) General Characteristics

All the timber shall be in accordance with the requirements of BSI No: 1186, Quality and Workmanship in Joinery.

The whole of the timber shall be from the heart of sound and fully grown tree, uniform in substance, straight in fibber, first class quality properly seasoned, free from large or loose dead knots, and open shakes and excessive sapwood. The scantlings of all timbers shall be bright, sound and square edged. The moisture content of timber shall not be more than ten (10) percent.

#### 3) Preservation of Wood

Prior to installation of all finish wood works in their respective positions, preservatives shall be applied to safeguard the woodwork against fungus, termite and bores.

The preservatives shall be of the best available quality of solignam oil (clear) as approved by the Engineer. The method of application shall be strictly in accordance with the manufacturer's instructions. The treatment and application of all the preservatives shall comply with the requirements of BS-CP 98:1964.

#### iv. Adhesive:

The adhesives shall conform to the requirements of BSI No. 745 "Animal Glues for Wood" or as directed and approved by the Engineer.

#### v. Nails and Screws:

All Nails shall comply with BS 1202, screws with BS 1210, bolts with BS 916 and timber connectors with BS 1579.

#### vi. Ply Wood

- a. The plywood shall comply in all respects with BSI No. 1455:1963. All the plywood shall only be obtained from manufacturers approved by the Engineer.
- b. Plywood used for doors, paneling and other similar works shall be to the thickness and size as shown on the Drawings or as directed by the Engineer. The grade shall be first quality and the face and back shall be free from end joints, dead knots, overlaps, patches and other surfaces shall be free, smooth for painting or polishing.

- c. The veneer shall be of the required thickness and quality including base veneer and shall be impregnated with an approved adhesive and machine compressed. Such machine pressed veneered wood shall be fixed on all sides of the inner core wood (softwood of approved quality) after it has been treated with water resistant hot setting glue.
  - d. External quality plywood shall have Grade 2 veneer with WBP bonding and internal quality plywood shall have Grade 2 veneer with MR bonding.
- vii. Manufactured Boards
    - e. Blockboard shall comply with BS 3444 Grade 2.
    - f. Chipboard shall be resin-bonded wood chipboard complying with BS 2604.
    - g. MDF boards shall be —Lasani Boardl complying with BS 1142 -89.
    - h. Gypsum plaster board shall comply with BS 1230.

viii. Decorative Plastic Laminate

Decorative laminated plastic sheeting shall be 0.6 mm thick locally available complying to BS 3794 Class. Color and type shall be to the approval of the Engineer.

ix. Priming Coat

Priming Coat shall comply with BS 2521.

x. Wood Treatment

Prior to fixing in position, all the timber including ceiling frames, joints, purlins, planks, all the door frames, furring strips, blocking, grounds, nailing strips scantlings, boards etc. in contact with concrete or masonry or wood or other materials shall first be treated with clear Termidor insecticide for termite proofing with approved pressure spraying equipment. All spraying will be done within one week of working of the material. Spraying shall once again be done at the site, after delivery and before installation in accordance with manufacturer's instructions and complying with BS 1282.

xi. Ground, Blocking and Nailing Strips

Ground, blocking and nailing strips shall be provided in ceiling and elsewhere as necessary or as shown on Drawings to receive the Work included herein and as required for the Work of other trades.

Except as otherwise shown or specified and approved by the Engineer, ground, blocking and nailing strips shall be secured in place as follows:

- To steel – by means of ½" diameter bolts spaced not over 4 ft.
- To concrete blocks - by the use of steel cut nails spaced not more than 4 ft. apart and driven directly into the block.
- To poured concrete – by means of galvanized screws as per details shown on the Drawings.

xii. Glues

All glues and adhesives used in carpentry, joinery and in the door manufacture shall be synthetic resin adhesives to BS 1204, unaffected by oil, gasoline and solvents, resistant to the growth of fungus and bacteria, immune from insects and such that the cured glue shall not be harmed by paint and lacquer solvents. The Contractor shall furnish a guarantee that the adhesives/glues used in the manufacture of all doors, joinery and paneling work conform to the Specifications stated above. All the samples of gluing materials shall be subject to the approval of the Engineer before use.

**10.04 SAMPLES**

All samples of the material used for the work under this Section of Specification shall be approved by the Engineer and same type of material shall be used throughout the work. If the Engineer desires to get the material tested, this will be done by the Contractor at his own cost from a laboratory approved by the Engineer.

## **10.05 FABRICATIONS**

### **General**

Unwrought' timber shall be used. Sawing shall be done true to the size and dimensions to finally meet the requirements of specified sizes and dimensions of the finished work.

All framing shall be joined as shown on the Drawings or as directed by the Engineer. All joints shall be secured with sufficient number of nails. The Contractor shall perform all necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all operations required for the correct jointing. The Contractor shall also provide all metal plates, screws, nails and other fixing material that may be ordered by the Engineer for the proper execution of the joinery work. Fabrication that develops defects due to bad workmanship or unsound materials not conforming to these specifications and the directions of the Engineer, shall be cut out and replaced at Contractor's own expense before the expiry of the maintenance period.

### **Doors**

Verify design and size of doors required for each opening. Door thickness shall be 40 mm (1 1/2 inch.) unless otherwise indicated.

Fabricate flush wood doors in accordance with the following requirements.

### **Cores**

Edging of doors, cores and shutters shall be of wood as shown on the drawings planed to a smooth uniform thickness.

All doors and shutters shall have wood lapping on all edges as per details shown on the drawing.

### **Face Panels**

- Door facing on each side of door shall consist of plywood have total minimum thickness of 1/8 inch before sanding.
- Door plywood shall be bonded to each other, and to core unit with approved adhesive and machine compressed.

## **10.06 PROTECTION OF MATERIALS**

All materials and assembled units shall be protected from weather and stored in such a way as to prevent decay and attack by fungus and termites.

## **10.07 WOODEN DOORS & DOOR FRAMES**

### **10.07.1 Materials**

- First class Deodar wood as approved by the Engineer shall be used for the doorframes and full/half glazed and paneled shutters.
- The plywood and veneering shall be of selected best quality as approved by the Engineer.

### **10.07.2 Exterior and Interior Door Frames**

All exterior and interior door frames shall be constructed 18 SWG MS sheet or of wood as shown on the drawings.

The door frames shall be secured in place by means of mild steel anchors welded/screwed in place and built into the masonry as it is being constructed. There shall be one such anchor near the top and bottom of each jamb but not over 900mm intervals between the top and bottom anchors.

### **10.07.3 Exterior and Interior Wooden Doors**

The Engineer shall unless otherwise shown or specified, of the paneled type, flush and type as shown on the Drawings or as direct the exterior and interior wooden door.

**All the door shall conform to the following requirements:**

Paneled doors shall be constructed in accordance with the requirements of Part I of British Standard Specification No. 459 with the additional requirements that panels in exterior openings shall be assembled with waterproof glue, glued tacked in place. Flush door shall comply with BSI

459 Part-2 and shall consist of solid core 40mm (1 1/2 inch.) thick shutters as shown on drawings.

**10.07.4 Door Shutters**

The shutters will be fixed to the frames with approved quality hardware schedule.

All doors, shutters shall be fabricated in a workman- manner strictly to the correct sizes and shapes as shown on the Drawings or as directed by the Engineer.

The door shutters shall have solid core as shown on the Drawings. It shall be built in sections, properly jointed and glued together, both sides being covered with plywood of the required thickness and approved quality. The surfaces shall be prepared for painting or polishing.

The arrangements of inner core for solid shutters shall be approved by the Engineer. It shall be so adjusted that circulation of air is free and uninterrupted. Minute holes shall be provided in edges at suitable places to admit and exit air.

Each door shall be constructed so as to permit the installation of hinges, knobs and locks in the position shown on the Drawings.

Completed doors shall be sound, rigid and free from defects and warp. All edges shall have Deodar wood lipping and shall be aligned and smooth, joints shall be close fitting, hard wood doweled or mortised framed and of strength to maintain frame and of strength to maintain the structural properties of the member connected. All adjoining edges and faces shall be flush and smooth. Edges shall be rectangular and solid.

**10.07.5 Fitting, Hanging and trimming**

All the doors shall be fitted, hung and trimmed as hereinafter specified and as indicated on the Drawings.

Doors shall have a clearance of 4 mm at sides and top unless otherwise directed by the Engineer and shall have 5 mm clearance at bottom. Doors shall be hung and trimmed with hardware as specified. All the locks shall be installed at the same height and shall be located at height as directed by the Engineer.

**10.07.6 Hardware**

Hardware shall be of approved quality and first class finished material. The Contractor shall obtain prior approval from the Engineer for quality; shape and pattern of all the hardware materials by providing samples and shall provide and fix only the approved hardware materials.

Hardware shall be carefully and securely fitted. Upon handing over the work, hardware shall be demonstrated to operate freely. Keys shall be placed into respective locks and upon acceptance of the work keys shall be tagged and delivered to the Employer.

**10.07.7 Quality Assurance**

**Tolerances: Doors shall be fabricated to the following**

- Size: Plus or minus 1.6 mm overall dimensions
- Maximum Warp: 3mm
- Squareness: Maximum diagonal difference 3mm (between length of diagonal measured on face of door from upper right corner to lower left corner and length of diagonal measured from upper left corner to lower right corner).

**10.07.8 Submittals**

- a. Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.
- b. Provide certificates stating that doors were constructed timbers of the species specified having moisture content and meeting equilibrium and relative humidity requirements.

- c. Submit samples of face veneers for selection of color and pattern.

**10.07.9 Product Delivery, Storage and Handling**

- a. Keep products dry, stack products off ground on level platforms, fully protected from weather, including direct sunlight.
- b. Identify type, size and location of each door in order to permit installation at correct location.

**10.07.10 Installation**

- a. Install doors at correct openings and assure smooth swing and proper closer with frames.
- b. Install finishes hardware in accordance with manufacturer directions.

**10.08 KITCHEN CABINETS/WOODEN**

**CABINETS/WARDROBES/DRESSERS/SHELVES/SEATS**

All kitchen cabinet/ wardrobes/ dressers/ shelves/ seat/ file cabinets including fittings, fixtures and hardware 's shall be supplied of approved manufacturer and shall be of best quality fabricated by using materials and details as shown on the drawings.

**Installation**

- All installation of cabinets, wardrobes, and shelves is crucial for maintaining a safe and functional wall. The contractor must inspect the cabinets, wardrobes seats, and related parts for damage and ensure proper installation. The wall cabinet must be secured, concealed fasteners are used, and doors and other moving parts fit perfectly. All works must be protected from damage, and any damage or disfigurement must be rectified at the contractor's expense.
- Cabinet work will be coordinated with Employer supplied items (if any) such as cooking range etc.
- Kitchen cabinet work, generally all Framing will be in treated Deodar wood with portions' etc., in best quality commercial plywood. All exposed surfaces will be covered by approved laminates. Exposed edges, if any, will be covered by polished Deodar wood lipping. Where approved counter tops for kitchen will be specified thick selected marble on painted M.S. framing.
- Best quality hinges, metallic drawer guides (with bearing) and handles will be used. Samples and shop drawings to be approved by Engineer.
- Wardrobes (and similar works) will be made of deodar wood. Internal partitions will be as shown on the drawings. Shutters will have a (deodar wood) louvered front backed by laminated plywood. All louvers and exposed deodar wood edges/faces will be polished. Best quality hinges metallic drawer guiders (with bearing) handles locks catches etc., will be used. Shoe rack (inside wardrobe) will consist of 13mm dia (hollow) chrome plated M.S. rods. Samples and shop draw to be approved by the Engineer.

**10.09 FIRE RESISTANT RECORD CABINET CONSTRUCTION OF FIRE-RESISTANT RECORD CABLES**

**Door:** The external door of the cabinet shall be minimum 2 mm thick as per ASTM D-1360-98, further fortified with hard plate for min burglary protection and fire-resistant barrier material to meet required fire protection.

**Bolt work:** The door shall be secured by four way locking mechanism / Bolt work with minimum moving shooting bolts of minimum 20 mm diameter, shall be provided.

**Locking:** Minimum eight lever dual control key locks, made up of Brass (body and levers), as per ASTM D-1360-98, shall be provided.

**Corrosion resistance process:** All steel parts of the safe shall be processed for corrosion resistance, by seven-tank treatment and further primed with epoxy primer. The finishing layer shall be of best quality Nitro Cellulose paint.

**Capacity and storage system:** The storage capacity shall be minimum 640 Liters with minimum usable internal sizes as 1620 (h) x 670 (w) x 590 (d). The cabinet shall be provided with minimum four nos. adjustable shelves.

**Testing:** The FRRC should be tested at CBRI as per ASTM D-1360-98 for Fire Endurance Test for 120 minutes. Certification for the same must be provided.

**Qualifying Criteria:** The tenderers should fulfill the following qualifying criteria. They shall

submit copies of documents to substantiate their qualifications along with the technical and commercial bids failing which their tenders are liable to be rejected.

- Only manufacturers are eligible to submit tenders.
- The Tenderer should have a Registered Office and Distribution set up and should have been dealing with manufacture and supply of FRRCs for the last ten years.
- The Tenderer should have well established and efficient service network at all major cities or near the places where the safes are to be supplied.
- The Tenderer should furnish audited financial statements for the last 3 years giving segment wise turnover details of Safes.
- The Tenderer shall furnish copies of IT assessment orders for the last 3 years.
- The Tenderer shall furnish ST / VAT Registration numbers.
- The Tenderer should be an original equipment manufacturer of locks. The lock making process should be computerized.
- The Tenderer should be a total security solutions provider, with capability of offering Banking Security products such as Safes, Strong Room Doors and Safe Deposit Locker cabinets.

**10.10 WOODEN LOUVERS**

If shown on Drawings, wooden louvers shall be made in first quality seasoned deodar wood. Frame with recesses on sides to receive louvers shall be made as per details shown on the Drawings from first quality seasoned deodar wood planks and louvers shall be securely fixed in the recesses. The frame shall be anchored by means of 11x41 M.S. hold fasts, and shall be perfectly in line and plumb.

**10.11 ARCHITRAVES, MOULDINGS AND TRIMS**

Architraves, Mouldings, Beadings, miscellaneous trim and scribe pieces shall be provided as shown on Drawings and shall be in deodar wood shop milled to type, profiles and machine sanded to a smooth and even finish all to the approval of Engineer. On running trim, all outsidescorners to be mitered and shall be leveled. All flat trim is to be blocked out to prevent warp. Nailing is to be concealed wherever practicable and all nails are to be driven below surface, filled in and polished or painted as specified

**10.12 DEFECTIVE WORK**

In the event of non-conformance to specification and drawings, the wood works shall be rejected by the Engineer and the Contractor shall remove and replace the rejected work by new work of same specifications.

**10.13 SURFACE PREPARATION**

The surfaces of all wood works shall be prepared in the manner as directed by the Engineer for polishing and painting.

**10.14 MOCK-UP SAMPLE**

After approval of shop drawings and tests etc., the contractor shall submit at his own cost one mock-up sample of each type of wood works complete with all fittings/fixtures accessories prior to the actual fabrication of the bulk.

The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

**10.15 MEASUREMENT AND PAYMENT**

Door shutters shall be measured per square Meter/ feet rough opening area, complete and approved, including cost of door frames, hardware as specified in Drawings, architraves/beadings etc. supply, fabrication, fixing, installation, at the unit rates entered in the Bill of Quantities.

No separate payment shall be made for Termite Proofing for carpentry/joinery items and shall be deemed to be included in the rates of relevant items.

All other items shall be paid at the rates entered in the Bill of Quantities.

**\*\*\* END OF SECTION\*\*\***

**SECTION – 11 ALUMINUM WORKS**

**11.01 SCOPE OF WORK**

The work under this section of specification includes furnishing all labor, equipment, appliances and materials and performing all operations in carrying out the work of anodized aluminum doors, windows and ventilators (other than curtain wall type doors and windows) ventilators, louver and fly screen. All related items such as sealants, rubber gasket for glazing, netting, rollers, latches, fastenings, glazing, anchor bolts and all items supplied by other trades and customarily built in and/or installed in strict accordance with this section of the specifications and as shown on the applicable drawings and subject to the terms and conditions of the Contract.

**11.02 APPLICABLE STANDARDS**

Latest editions of following ISO and British Standards are relevant to these Specifications wherever applicable.

**a. ISO (International Organization for Standardization)**

1804 Doors	- Terminology
6442 Door Leaves	- Measurement of defects of general flatness,
6443 Door Leaves	- Measurement of dimensions and defects of squareness.
6444 Door Leaves	- Test of behavior under humidity variations (successive uniform climates)
6612 Windows & Doors	Wind resistance tests
6613 Windows & Door	- Air permeability test.

**b. BSI (British Standard Institution)**

1227	- Hinges
4873	- Aluminum alloy windows

**11.03 GENERAL**

- a. Aluminum doors and windows shall be of profile, pattern and design shown on drawings and manufactured by reputable manufacturer approved by the Engineer. The contractor shall provide manufacture literature completely describing the product, instructions for installation and maintenance.
- b. All the sections used for doors, windows, ventilators & fly screens shall be of best quality aluminum products such as equal and unequal angles, channels, tubes, corrugated strips, moldings etc., in accordance with International standards conforming to ASTM B308 & B221.
- c. All doors windows & ventilators shall be of type and size indicated on drawings and shall conform to the requirements shown and specified herein.
- d. Contractor shall arrange tests and analysis if directed by the Engineer of scaled models of each window type at the maker's works or any laboratory specified by the Engineer for the material supplied by him to be tested in the presence of the Engineer's Inspector, to whom test certificates, proof sheets, etc. shall be furnished. The models shall be submitted to the Engineer for approval prior to testing. Nevertheless, neither the fact that the materials have been tested in the presence of the inspector nor that the Engineer may have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer to reject, after delivery of materials found not in accordance with these specifications.
- e. The contractor shall submit shop drawings, which shall show full construction details, quantities and locations, fastenings and attachment to adjacent construction and materials. Shop drawings shall be submitted at the proper time to allow for checking, revisions, and agreement and to permit manufacturer's product delivery and start of site work to suit the building program. The Contractor shall submit representative samples of finished windows, anchoring mechanism, embedded parts, fastenings, glass panes, accessories and other materials for the Engineer's approval.
- f. After approval of shop drawings and tests etc., the contractor shall submit at his own cost one mock-up sample of each type of aluminum works complete with glazing, all component assembly method and required fittings and accessories prior to the actual fabrication of the bulk. The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.
- g. Fabricate and assemble all work in the shop of the approved manufacturer to reduce field fabrication to a minimum unless otherwise directed by the Engineer.

- h. The glass shall conform to specification laid down under section 'Glazing' and shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in door and window members. All the glass shall be best quality of approved manufacture.
- i. The structural shape of the Aluminum members shall be of uniform quality, color and temper, clean, round, commercially straight and free from injurious defects.
- j. All doors, windows and ventilators shall be fabricated as a complete unit, fully airtight and watertight, including rubber gasket for glazing, rollers, latch, anodized in specified color, inclusive of glass sheet, necessary holes for fixing, door locks, door closures and window locking requirements, all as approved by the Engineer.
- k. Contractor shall, on request, get certificate signed by the manufacturer stating that each lot has been sampled, tested and inspected and has met the requirements in accordance with these specifications, and the same shall be furnished to the Engineer.

#### **11.04 MATERIAL**

##### **11.04.1 Aluminum**

- a. All aluminum extruded sections shall comply with BS 1470 to BS 1474 and shall be manufactured by Pakistan Cables or approved equivalent. Certificates of origin shall be supplied in all cases.
- b. All aluminum shall be anodized to comply with BS 3987 and 1615 with an anodic film thickness of not less than 25 microns. All surfaces are to be anodized.
- c. Aluminum shall be supplied in natural matt anodized finish to the approval of the Engineer.
- d. The Contractor/manufacturer shall provide 25 years guarantee of 25-micron anodized aluminum extruded sections against corrosion to the satisfaction of the Employer.

##### **11.04.2 Other Components**

- a. All glazing gaskets are to be vinyl glazing channel gaskets (extruded Neoprene or Hypalon). Gaskets shall conform to commercial standard CS-230-60.
- b. All draught seals are to be either in Neoprene as above, or in approved nylon pile, of density and configuration suitable for the designed condition.
- c. All fly screens are to be approved pattern aluminum screens.
- d. Hardware shall be manufacturer's standard match door and windows finish.
- e. Joint sealant shall be approved elastomer.
- f. The finish shall be in approved color in accordance with the standards of Aluminum Association.
- g. Minimum coating should not be less than 23-25 micron.

##### **11.04.3 Fixings**

All fixings shall be in aluminum, non-ferrous metal or stainless steel, selected to prevent galvanic action with the components fastened. In no circumstances shall untreated or painted steel fixings be employed on any part of any door or window component.

##### **11.04.4 Glass and Glazing**

Glazing shall be provided as shown in Drawings and Bill of Quantities and shall meet the Specification requirements as described in —Section 12 – Glass & Glazingl.

##### **11.04.5 Frames/Shutters**

The frames/shutters of anodized aluminum doors, windows, ventilator and louvers shall be formed from rolled, strip or extruded aluminum and be as per drawing. Fastening bolts and screws shall be made from hardened aluminum.

#### **11.05 WORKMANSHIP DESIGN AND FABRICATION**

The Contractor shall be responsible for the protection and installation of all items furnished. All items shall be installed plumb and square and shall be solidly anchored in a good workman like manner in accordance with the manufacturer's instruction and as specified herein. The Contractor shall be responsible for the protection of installed items from damage by other trades. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, etc. The Contractor shall be responsible for final cleaning before the final acceptance.

The glass panes shall firmly be secured in the rebates with the rubber gasket. Ensure that the beads and

grooves are clean, dry and unobstructed at the time of glazing. The complete unit shall be airtight and watertight on completion. No doors windows ventilator louvers shall be considered complete until and unless the fingerprints and other stains and marks have been removed from the surface of glass and aluminum.

**11.06 PRODUCT DELIVERY AND STORAGE**

- 11.06.01 Deliver doors, windows, ventilator and louvers in a manner preventing damage to units. Store materials off the ground under cover in a manner preventing deterioration or damage.
- 11.06.02 All embedded parts and anchor bolts shall be delivered to the site carefully and keeping the fabricated shape and configuration. All these parts shall be suitably marked for identification.

**11.07 FIXING AND ERECTION**

- 11.07.01 All aluminum doors, windows & ventilators shall be fixed in strict accordance with the manufacturer's detailed requirements and recommendations, using only fixing components specified by them, by operative experience in this work. All windows & ventilators shall be solidly and rigidly fixed, square, level, plumb and without distortion; all opening lights and hardware are to be eased, oiled and otherwise left operating smoothly.
- 11.07.02 All aluminum protection is to be left in place until all surrounding wet trades have been completed and cured; then removed by approved means.
- 11.07.03 Raw plugs and anchoring bolts shall be embedded into the concrete or block masonry for holding the doors, windows, ventilators and louvers in their correct positions.
- 11.07.04 Care shall be taken to install the doors and windows, ventilators and louvers in line and plumb & solidly anchored in a good workman like manner in accordance with the drawings. Should any scale or scratch appear on the surface of doors, windows, ventilators the contractor shall at his own expense and louvers the contractor shall at his own expenses and at the Engineers direction have all exposed surfaces cleaned to bare bright specified color.
- 11.07.05 All works shall be installed in strict accordance with the manufacturer's instructions.

**11.08 PROTECTION AND CLEANING**

- 11.08.01 Temporary protection shall be achieved by applying water-soluble protective coating capable of withstanding the action of lime mortar.
- 11.08.02 Apply coating in the manufacturer's plant to the exposed surfaces of all components.
- 11.08.03 Before application of coating, remove all fabrication compounds, moisture and dirt accumulations.
- 11.08.04 All the aluminum doors, windows & ventilators and other items shall be protected throughout the Contract period.
- 11.08.05 Any damage occurring to any of the member of the windows & ventilators before the Contract completion from whatever cause shall be rectified or replaced at Contractor's cost, all to the satisfaction of the Engineer.

**11.09 DEFECTIVE WORK**

In the event of non-conformance to specifications and drawings the aluminum work shall be rejected by the Engineer and the Contractor shall remove and replace the rejected works by new work of same specifications.

**11.10 GUARANTEE**

The manufacturer shall furnish his standard written guarantee against leakage of rain, excessive infiltration of dust and air and all defects in materials and workmanship covering all work under this section. Such guarantee shall be in addition to and not in lieu of all other liabilities, which manufacturers and the Contractor may have by law or by other provisions of the Contract Documents.

**11.11 MEASUREMENT AND PAYMENT**

Aluminum doors, windows & ventilators shall be measured per Square Meter/feet and paid for at the unit rates entered in the Bill of Quantities and as per the terms and Conditions of this Contract. The unit rates shall include the cost of all glazing, aluminum sections, hardware, fly screens, fixing accessories, gaskets, sealants etc., fixing and installation, complete in all respect.

\*\*\* END OF SECTION\*\*\*

## SECTION – 12 GLAZING

### 12.01 SCOPE OF WORK

The work under this section of the Specifications consists of furnishing all labor, equipment, tools, appliances, scaffoldings and providing glass gaskets, sealants, compound and other materials required for performing all operations in connection with the installation and setting of all types of glass, glazing and glass blocks complete in every respect in accordance with the Drawings or as directed by the Engineer. The scope of this section of Specifications is covered with detailed Specifications as laid down herein.

### 12.02 APPLICABLE STANDARDS

Latest editions of following British Standards are relevant to these specifications wherever applicable.

#### BSI (British Standards Institution)

952	Glass for glazing
5051	Security glazing Part I&I)
CP.152	Glazing

### 12.03 GENERAL

- a. Glazing sealant shall be as recommended by the manufacturer for the particular application.
- b. Spacer shims (distance pieces) shall be elasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on drawings between glass and rebates, bead or cleat. Depth shall give not less than inch cover of glazing sealant.
- c. Contractor shall submit samples for each type of glass, minimum 4 ft. x 4 ft. in size with protective edges. Samples of glazing sealant minimum 0.1 liter of specified types shall be submitted. Samples of minimum of three glass blocks shall also be submitted.
- d. Contractor shall submit 1 feet long sample of each type of glazing gasket.
- e. Contractor shall also submit printed materials manufacturer's installation instructions for specified glazing gaskets, compounds sealants and accessories including description of required equipment and procedures and precautions to be observed.

### 12.04 DELIVERY STORAGE AND HANDLING

- a. Contractor shall deliver materials in manufacturer's original, unopened containers clearly labeled with manufacturer's name and address, material, brand, type, class and rating as applicable.
- b. Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements which may damage glass.
- c. Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces.

### 12.05 MATERIALS

#### 12.05.1 General

Glass shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to fit the rebates so as to have a uniform clearance of 1.6 mm round the panes between the edges of glass and the rebates. All glass shall be best quality from reputable manufacturer (USA/Sweden) as approved by the Engineer.

#### 12.05.2 Glass

Glass for windows, and ventilators and louvers shall be of specified thickness and of approved quality.

#### Clear and Tinted Plate Glass

Clear plate glass shall be imported glass complying with BS 952 Part I M Table 2, Ordinary Glazing Quality.

The single glazing shall comprise of 5 mm thick clear/ tinted plate glass.

The double glazing shall comprise of an assembly of two glass panels of clear plate glass each 6 mm thick, with a 12 mm separator between them and hermetically sealed

#### **Clear Laminated Glass**

Clear Laminated glass shall comply with BS 952, ASTM C1036 or C1048. The thickness shall be 11 mm.

#### **Glass Bricks**

Glass bricks/ blocks shall be best quality imported glass bricks/ blocks, to the approval of the Engineer and shall comply with BS 1207.

#### **12.05.3 Glazing Sealants and Compounds**

Contractor shall provide material colored to match frame in which glass is installed. Provide only compounds known to be fully compatible with surfaces, which they will contact as follows:

- Two component polysulfide glazing sealants.
- One component acrylic glazing
- Acrylic-latex glazing sealant consisting of modified latex rubber and acrylic emulsion, non-hardening, non- staining and non-bleeding.
- Cleaners, Primers and sealer as recommended by the sealant manufacturer.

#### **12.05.4 Accessories**

All sealants, neoprene gaskets, tapes, cords, bedding materials, etc. shall be those recommended by the manufacturer for application to aluminum or other window frame materials to suit the environmental conditions.

#### **Glazing Sealant**

It shall be tape or ribbon of polymerized butyl or mixture of butyl 1 and polyisobutylene compounded with inert fillers and pigments, solvent based, 95 percent solids thread or fabric reinforced, paintable, non- staining.

#### **Setting Blocks**

It shall be chloroprene (Neoprene) 70 to 90 durometer hardness, compatible with sealant used, channel shaped and of the necessary height for proper perimeter clearance.

#### **Channels, Gaskets, and spacer's**

It shall be chloroprene (Neoprene), 40 to 50 durometer hardness compatible with sealant used.

#### **12.06 INSTALLATION OF GLAZING**

- a. Glass is to be handled with care, and placed into openings without distortion, set on such spacers, sprigs or other components as recommended.
- b. Glazing shall comply with the recommendations of glass and glazing materials manufacturers.
- c. Examine each piece of glass and discard and replace glass with edge damage or face imperfection. All glazing shall be wind tight and fully water tight on completion.
- d. All rebates, grooves, etc. for glazing shall be prepared by thoroughly cleaning of all dirt, dust, oil, grease and other foreign matter. Clean glazing channels and other framing members indicated to receive glass. Remove coatings, which are not firmly bonded to the substrate.
- e. Remove lacquer from metal surfaces wherever elastomeric sealants are to be used. Apply primer and sealer to joint surfaces wherever recommended by the sealant manufacturer and as shown on the drawings.
- f. All glass shall be cut to suit each opening, perfectly square, and with due allowance for glazing tolerances, thermal expansion as recommended by the manufacturer.
- g. Trim and clean excess glazing materials from surrounding surfaces immediately after installation and eliminate stains and discolorations.
- h. Cure glazing sealants and compounds in compliance with manufacturer's instructions to obtain high early bond strength internal cohesive strength and surface durability.

- i. All glazing secured by neoprene gaskets is to be held in place by full enclosure of gaskets, applied with approved tools, corners continuously gasketed not mitred.
- j. While glazing operation is in progress care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be refixed at Contractor's expense.
- k. No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass and checked by the Engineer for water tightness.
- l. All glazing, by whatever method employed, shall be completely watertight and sound, and generally be in accordance with B.S.C.P. 152 Section 4/404.
- m. All glass shall thoroughly be cleaned on completion

**12.07 PROTECTION AND CLEANING OF GLAZING**

Glass shall be protected against damage. Any damaged or broken glass shall be removed and replaced by the Contractor at his own cost to the approval of the Engineer.

**12.08 ACCEPTANCE**

Labels showing glass manufacturer's identity, type of glass, thickness and quality will be required on each piece of glass. Labels must remain on glass until it has been set and inspected.

**12.09 CLEANING**

Remove all smears, labels and excess glazing sealant, leave clean inside and outside free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with new glass at no additional expense to the Employer.

All glass surfaces shall be washed clean both inside and outside within two weeks prior to final acceptance by the Employer.

Any labels, smears, stains, marks, spots and dirt etc. shall be removed from the glass and the glass shall be washed clean on both sides taking care not to scratch or damage the glass.

Plaster, mortar, paint, excess sealant, putty etc. or any other material shall be removed immediately after contact with the glass and shall not be permitted to remain on the glass surface.

**GUARANTEE**

Contractor shall provide a guarantee that all glazing joints in exterior openings shall remain water tight for a period of at least ten years after the acceptance of the building. The Contractor shall also guarantee that during the above period, glazing gaskets & sealants shall not crack, dry out, crumble or fall away from smash on glass.

**12.10 SAMPLES**

Samples of all kinds of materials to be used on the job shall be submitted to the Engineer for approval. Approved samples shall be retained by the Engineer to form standards against which all deliveries will be judged.

**12.11 TESTING**

All materials shall be subject to standard testing and specifications such as ASTM, British Standard or equivalent. If any item found below the specified standard, shall be rejected and removed from the Site immediately and replaced by the Contractor at his own cost.

**12.12 MEASUREMENT AND PAYMENT**

No separate payment shall be made for the supply, installation and fixing of glass/ glazing as per the requirements of this section of Specifications but is deemed to be included in the unit rates of the relevant items of aluminum doors, windows, ventilators, glazed screens/walls etc. entered in the Bill of Quantities.

Glass bricks/ blocks shall, however, be paid separately per square meter/feet for the supply, installation and fixing as per the requirement of this section of Specifications at the unit rates entered in the Bill of Quantities and as per the terms of the Conditions of this Contract.

\*\*\* END OF SECTION \*\*\*

## SECTION - 13 ROOFWATER PROOFING

### 13.01 SCOPE OF WORK

The works under this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in any floor and at any height in connection with installation of insulation, water-proofing and built-up roofing, including water proof treatment to roof, terraces, balconies and other roofing structures complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

### 13.02 SUBMITTAL

13.02.1 Shop Drawings: Shop drawings showing layout and all the details for construction.

13.02.2 Samples of all materials proposed for use under this section shall be submitted to the Engineer for approval.

### 13.03 MATERIALS

- a. Bitumen 10/20 grades.
- b. Polyethylene buildings film visqueen standard or approved equal. The film shall be 200-500 micron thick, as specified in drawings
- c. Cement and aggregates shall be in accordance with specifications Section for "plain and reinforced concrete".
- d. Mud mortar composed of stiff clay mixed with an equal bulk of chopped ricehusk/bhoosa.
- e. Brick tiles conforming to specifications of relevant section.
- f. Heat insulation tiles
- g. SBR water proofing chemical, to be mixed with 0.5l thick CC slurry, as per manufacturer/ supplier requirements
- h. Water proofing membrane of thickness as specified in drawings

### 13.04 DELIVERY STORAGE AND HANDLING

Materials shall be protected from damage during loading shipment delivery and storage non-staining materials shall be used for blocking and packing.

### 13.05 PREPARATORY WORK

All scuppers and roof drains shall be placed and metal flashing, cant strips flanges etc. shall be provided in time to be installed along with the roofing assembly.

All surfaces, to be treated shall be dust free and dry. Application of roof finishes shall not start unless the preparatory work has been inspected and approved by the Engineer.

### 13.06 APPLICATION

- a. All water proofing treatment shall be done as specified, as indicated on the drawings, as per manufacturer/ supplier instruction and to the approval of Engineer.
- b. Waterproofing shall not be applied during rain or while surfaces are damp, it shall be applied only to surfaces that are clean and dry.
- c. Mopping of surface with bitumen shall be performed so that the surface shall be completely covered. Coats of bitumen shall be as specified in drawings. All bitumen shall be applied with mops except that the hot surfacing application shall be poured from a dipper.
- d. Polyethylene sheet shall be laid in position wherever shown in drawings. Where joint is necessary at the side or end of the sheet, this shall be a double weld folded joint made by placing the edges together and folding over twice continuously taking the top edge prior to plastering or screeding. The contractor shall protect the sheets from damages during laying and subsequent operation and shall replace at his own cost all damaged sheets to the satisfaction of the Engineer.
- e. Mud mortar/concrete screed of specified thickness as indicated on drawing shall be laid in slope.
- f. Brick tiles of specified size laid over prepared base to be grouted and flush pointed with cement sand mortar.

**13.07**    **MEASUREMENT AND PAYMENT**

The waterproofing shall be measured per square meter and paid as per unit rates entered in the Bill of Quantities inclusive of all overlaps, complete in accordance with the terms and Conditions of Contract.

PVC water stop shall be measured per running meter and paid at per unit rates entered in the Bill of Quantities of accepted lengths a complete with accordance with the terms and Conditions of the Contract.

**\*\*\* END OF SECTION\*\*\***

## **SECTION - 14 MARBLE AND GRANITE WORK**

### **14.01 SCOPE OF WORK**

The work under this section of specifications, consists of providing all material, labor, plant, equipment, appliances and performing all operations required for providing and installing marble natural stone slab and tile finishes in floor and special aglow marble stone in floor & skirting, where shown on the drawings, complete in strict accordance with this section of the specification and the applicable Drawings.

### **14.02 SUBMITTALS**

Submit three range samples of size as mentioned in BOQ, of each type of marble, granite used; showing color, grade, finishing and texture for approval.

### **14.03 DELIVERY, STORAGE AND HANDLING**

Materials shall be protected from damage during loading, shipment, delivery and storage. Non-staining materials for blocking and packing shall be used. Stack marble units at site in accordance with manufacturer's recommendations and as required to prevent staining, scratching, etching or breakage.

### **14.04 MATERIALS**

#### **14.04.1 General**

The marble/granite work of all types should be consistent in type, color range and texture.

Provide slabs or tiles of specified sizes in floor and wall areas as shown on drawings.

Provide marble/stone of specified thickness. Saw-cut the back surfaces that are meant to be concealed in finished work.

Provide irregular shaped units, staircase units and skirting base units to the profiles of required, with arises sharp true and matched at joints, polish exposed edges.

#### **14.04.2 Marble/Granite Type**

All marble/granite types are to be selected, as shown in drawings, as written in BOQ and as approved by the Engineer for quality, color and texture as:

- a. Marble of local origin or imported, first class quality and high class finish acceptable to the Engineer.
- b. As approved by the Engineer.
- c. Granite shall be of good quality, 16 ± 2mm thick, having smooth, hard polished surface, regular in shape, size and of uniform thickness, of good appearance, and of sharp and square edges. It shall be free from cracks and other defects. The color and size shall be as per the instruction of the engineer and drawing. Sample of granite stone to be used shall be submitted to the engineer and his approval should be taken before the bulk purchase. All the granite stone supplied shall conform to the approved sample in all respect.

#### **14.04.3 Beds and Backings**

Where applicable, standard cementitious screed and mortar beds and backings, mixed and proportioned by volume shall be as follows:

Grey ordinary Portland cement: 1 part

Sand: 4 parts 2 parts (for granite)

Water: Clean, fresh and free from deleterious substances.

Mortar mixing shall be done as per specification for mortar mixing of block masonry work

#### **14.04.4 Adhesives Grouts and Sealants**

Proprietary adhesives, joint grouts and sealants of approved type as required and recommended by the manufacturer for specific application shall be used. The color of the joint grout and the sealants shall match with the color of stone/marble.

#### **14.04.5 Marble, Granite Counter Tops**

Marble/ Granite slabs to kitchen counters, toilet counters or others shall be provided to sizes and profiles as indicated on the Drawings. The marble/ granite tops shall be provided in configurations to suit the built-in cabinets as per approved shop drawings in approved shade and color, delivered to Site polished and finished to the approval of the Engineer. Marble/ Granite tops for toilets shall be recessed to provide wash hand basins, where required.

### **14.05 EXECUTION**

#### **14.05.1 Flooring, Skirting and Stair**

Apply cement slurry coat over surfaces of concrete substrate immediately prior to placing setting bed. Limit area of application to avoid premature drying out. Install setting bed of required thickness and set marble/stone units before initial set occurs. Apply a thin layer of cement paste to bottom of each unit. Set, tamp and level units immediately. Set units in required pattern with uniform joint widths.

Joints as soon as possible after initial set. Force grout into Joints, strike flush and tool slightly concave.

Remove mortar and grout from surfaces while still moist and as the work progresses. Do not permit traffic on finished surface during setting and for a minimum of 24 hours after final pointing of joints.

#### **14.05.2 Dressing**

Each marble/granite stone slab shall be machine cut to required size and shape as specified in the drawings. All angles and edges of the marble/granite slabs shall be true and square and free from chippings and the surface shall be true and plane. The thickness of the stone shall be as specified in the drawings. No tolerance shall be allowed for thickness.

The marble/granite slabs shall be mirror polished. All stones shall be brought pre-polished to the site. The contractor shall prepare samples and obtain approval of the Engineers before proceeding with the work.

The contractor shall ensure that no chisel marks are visible on the surface of the stone before fixing. Stones with chisel marks or broken edges shall be rejected.

#### **14.05.3 Laying**

The base shall be made rough and watered and given a cement wash and then the mortar shall be laid in 19-20 mm. thick layers as per instruction of Engineer. After laying mortar, it should be leveled with wooden floats. Proper slope for draining wash water shall be provided as per instruction of the Engineer. And over this, marble/granite stone should be laid; the joints should not be more than 1.5 mm. The joints should be painted with approved colored cement slurry.

#### **14.05.4 Curing**

After about 2 hours of laying, the surface shall be covered with wet bags and kept wet and left undisturbed for 2 days.

**14.05.5 Repair and Cleaning**

Remove and replace marble/stone units, which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units, which do not match adjoining stonework or are not in line and level as shown on Drawings. Provide new matching units, install and point joints to eliminate evidence of replacement. Repoint defective and unsatisfactory joints to provide neat, uniform appearance.

Clean stonework not less than 6 days after completion of work, using clean water and bristle brushes. Do not use wire brushes, acid or caustic type cleaning agents or other cleaning compounds which may be detrimental to the marble/stone finish or joint grout.

**14.05.6 Protection**

Provide covers, boards, supports and all other necessary materials to protect finished work from collapse, deterioration, discoloration or damage during installation and until contract completion.

**14.05.7 Polishing**

The finished surface shall be provided with two applications of approved wax polish or as approved by Engineer.

**14.05.8 Finish**

Finally, when the surface is absolutely dry, the surface shall be rubbed with wax to give a glazing surface, as per instruction of Engineer. Care shall be taken that the floor is not left slippery and that ordinary wax is not used under any circumstances

**14.06 MEASUREMENT AND PAYMENT**

Measurement shall be in square meter of exact length and breadth of the floor. Rate shall include materials, mixing, laying, curing, finishing and labor etc. all complete.

**\*\*\* END OF SECTION\*\*\***

## SECTION - 15 FLOOR AND WALL FINISHES

### 15.01 **SCOPE OF WORK**

The work under this section of the Specification consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with the laying of cement concrete floors and floor finishes including bases, skirting and dado, complete in strict accordance with this section of the specifications and the applicable drawings and in accordance with the terms and conditions of the Contract.

### 15.02 **APPLICABLE STANDARDS**

Latest editions of following Pakistan, ISO, British & ASTM standards are relevant to these specifications wherever applicable.

#### **Pakistan Standard**

P.S. 232 Ordinary Portland Cement

#### **ISO (International Organization for Standardization)**

R 680 Chemical analysis of cements Main constituents of Portland Cement. R 681

Chemical analysis of cements Minor constituents of Portland cement.

#### **ASTM (American Society for Testing and Materials)**

C 482 Bond strength of ceramic tile to Portland cement. C 648

Breaking strength of ceramic tile.

C 650 Resistance of ceramic tile to chemical substances. C 798

Color permanency of glazed ceramic tile.

E 84 Surface burning characteristics of building materials **BSI**

#### **(British Standards Institutions)**

882 Pt.2 Course and fine aggregates from natural sources.

1199 Sands for external renderings, internal plastering with lime and Portland cement and floor screeds.

1201 Pt.2 Aggregates for granolithic concrete floor finishes.

1281 Glazed ceramic tiles and tile fittings for internal walls.

5442 Classification of adhesives for use in Construction pt-1 Adhesives for use. 203  
Tile flooring

204 In-situ Floor Finishes.

209 Pt.1 Care and Maintenance of floor surface, wooden flooring.

### 15.03 **GENERAL**

#### **15.03.1 Samples and Approval**

- a. All applied floor finishes materials such as terrazzo tiles, marble imported or local, imported Porcelain Tiles and ceramic tiles etc. to be used in the Works shall receive prior approval of the Engineer.
- b. Samples of all the materials to be used shall be submitted to the Engineer for his selection and approval before their use in the Works. The Contractor shall strictly follow the instructions of the manufacturers and the floor finishes shall be laid accordingly.
- c. Floor finishes shall be laid true to the line and level in approved manner satisfactory to the Engineer.
- d. Any work covered under this section of the Specifications not conforming to the requirements of the specified quality and workmanship will not be acceptable and shall be rejected and the Contractor shall be required to remove and replace such work at his own cost as per the instructions of the Engineer.

#### **15.03.2 Floor Screed Beds**

- a. All floor finishes of an integral nature such as cement concrete flooring, waterproof flooring shall be laid direct on to structural or site reinforced concrete slabs. In these cases, the slabs must first have been fully cured, then hacked, chipped or otherwise roughened to provide a good adhesion key, then brushed, hosed and cleaned thoroughly of all loose concrete, dirt, dust, grease, oil and other impurities. The surfaces shall then be thoroughly wetted for a period of at least a day before the application of the floor finish, and given a thin brush applied

cement slurry grout. The floor finishes of integral nature shall then be laid as described in their respective subsections.

- b. All floor finishes of an applied nature such as terrazzo tiling, ceramic/marble tiling, etc. shall be laid on a floor screed as described below at 7.03 or as per the instructions of the Engineer. The floor screed shall be laid to a thickness calculated to be the overall nominal floor thickness less the actual thickness of the applied finish.
- c. Care is to be taken to relate finished floor levels to specified floor levels. The screed is to be completely flat, level and smooth, with no projections, low or high areas, etc., and finished with a wood float. Where required, the screed shall be laid to falls as shown on Drawings or as directed by the Engineer.

#### **15.04 CEMENT SAND SCREED**

##### **15.04.1 Preparation of Base**

- a. The laitance on the base shall be entirely removed by complete chipping, hacking & exposing the clean coarse aggregate. All loose concrete and dirt should be removed by thorough washing or hosing. The Contractor shall not undertake any finishing work until the surfaces are approved by the Engineer.
- b. The base concrete shall be wetted thoroughly for a period of at least a day before the application of floor finishes and any excess water is brushed off before laying the screed.
- c. Just before the screed is to be laid, a neat grout should be brushed into the base. The grout should consist of water and cement mixed to the consistency of a thick fluid. An approved bonding agent may be used as an alternative to the grout. Excess of the grout shall be removed by thorough sweeping just prior to placing the topping material.

##### **15.04.2 Laying of Screed**

- a. Cement sand screed up to a thickness of 40 mm shall be mixed in the proportions of 1:3 by volume with fine aggregate of approved size and gradation. Screeds over 40 mm thick should be mixed in the proportions of 1: 1 1/2:3 (cement: sand: aggregate) to the approval of the Engineer.
- b. Where specified, Aquaguard or an equal approved waterproofing additive shall be mixed in the waterproof cement sand screed in the ratio as per manufacturer's instructions or as directed by the Engineer and shall be finished with a steel float.
- c. Where screeds are to receive terrazzo or marble tiles etc. the screeds shall be finished with a slight rough finish to accept the cement paste and tiles. The mortar bed shall be spread and tamped to an even thickness over an area no greater than that, which can be tiled before the mortar reaches its initial set. However, ceramic tiles shall be bedded over a hard set cement sand floor screed laid earlier and well cured.

#### **15.05 TERRAZZO TILES**

##### **15.05.1 Description**

- a. Terrazzo Tiles shall generally comply with the requirements of BS 4131 and shall be as approved by the Engineer.
- b. Terrazzo tiling shall be locally manufactured, from an approved manufacturer, specialist in terrazzo tile making. Tiles shall be cast with a cement/sand base, and a pigmented terrazzo topping, cast integral, all in heavy metal moulds under pressure, all to the required sizes and thickness shown on Drawings and to Engineer's detailed approval.
- c. Tiles shall be selected by the Engineer from colours and patterns as prepared by the approved manufacturer from samples, the cost of which shall be deemed to be included in the rates. The approved samples shall be retained by the Engineer to form standards against which all deliveries will be judged.

#### **15.05.2 Materials**

- a. Portland cement conforming to BS 12.
- b. White Cement conforming to relevant BS Specification.
- c. Sand and aggregates shall comply with requirements of ASTM C-33.
- d. Water shall be clean potable drinking water, free from oils, acids, alkalis, salts, and organic or other injurious matter.
- e. Marble chips of approved shade, color, size and quality and shall have an abrasive hardness of not less than 16.
- f. Marble powder shall be clean and should be of approved quality.
- g. Pigments to be used shall comply with BS 1014.

#### **15.05.3 Tile Mixes**

- a. Tile mixes shall be as under:
  - Backing shall consist of Portland cement and fine sand in proportions of 1:5; mixed with a minimum of clean potable water.
  - Terrazzo topping shall consist of white Portland cement and granulated marble chips of approved sizes, shade, colour and quality, mixed in proportions dependent on the exact terrazzo selected but average 1:2.
- b. The backings shall be placed first into the moulds, then the toppings to a minimum depth of 10 mm; the tiles cast under pressure and filled, ground and polished before delivery to Site. Bottom faces of tiles shall be cast with an approved incised key pattern.
- c. All the terrazzo tiles shall be cast to the sizes shown on the Drawings or as approved by the Engineer, perfectly square, with sharp square edges, and consistent in color and texture throughout the Contract for the color/ pattern selected and approved.
- d. Curing shall be effected by continuous wetting for a minimum period of 3 days.

#### **15.05.4 Bedding and Finishing**

- a. Terrazzo Tiles shall be bedded on the wet screeding described above at 7.02.2(b) and 7.03 by applying a thin layer of neat cement paste on to the screed bed and the tiles placed in position and tamped down gently with a wooden mallet to be level with other tiles. The tiles shall be laid in the manner so that they align perfectly to the specified lines and levels and are square. The tiles joints shall be as thin as possible but not more than 2 mm wide and shall be regular and perfectly straight, and setting out shall be carried to ensure a minimum of cut tiles. Any tiles requiring to be cut shall be saw-cut by approved tools. Tiles pattern shall be square to the spaces floored, and any patterning by tile jointing, alternating colors, etc. is to be carried out as indicated on the Drawings and as approved by the Engineer.
- b. The surface during laying shall be frequently checked with a straight edge at least 2m long to obtain a true surface with dead level or slope, as directed.
- c. All tile joints shall be grouted up solidly with a grout comprising of white Portland cement and water; all surplus to be cleaned off immediately.
- d. Once bedded, curing shall be carried out by covering in hessian and continuous wetting for a minimum period of 3 days and the floor kept clear of traffic for at least 48 hours.
- e. When cured, the terrazzo tiling shall be machine polished to the approval of the Engineer. Polishing must be evenly and carefully carried out and a perfect smooth surface produced.

### **15.06 MARBLE FLOOR TILES**

#### **15.06.1 Description**

- a. The Work included under this subsection shall comprise of providing and fixing marble tiles in floors at locations shown on the Drawings in approved shades and colours. Unless otherwise specified, all marble work shall be in conformity with the latest British Code of Practice for this Work.
- b. The marble tiles shall be from approved local source, uniform in color, texture, shade and quality.
- c. Generally, marble tiles shall be 12|x12|x 1/2| and 24| x 24| x 3/4" or of size and thickness specified in the Drawings and Bill of Quantities.

### **15.06.2 Materials**

a. Marble

- Marble shall be best quality Boticina marble, compact, dense, metamorphic rock of lime stone origin from quarries in Pakistan or elsewhere. It must be evenly grained with sugar like appearance. The shade and colors shall be to the approval of the Engineer.
- All marble tiles shall be totally free from cracks, defects, fissures etc. and shall have adequate strength to perform as required with good resistance against abrasion and shall have an abrasive strength not less than 20.

- b. Portland cement conforming to BS 12.
- c. White Cement conforming to relevant BS Specification.
- d. Sand and aggregate shall comply with requirements of ASTM Specifications C- 33.
- e. Water shall be clean potable drinking water, free from oils, acids, alkalis, and salts and organic or other injurious matter.
- f. Pigments to be used shall comply with BS 1014.

### **15.06.3 Samples**

- a. The Contractor shall provide samples of marble tiles to be used for this item of Work showing the entire range of variation and colour for the selection and approval of the Engineer. The samples shall be in finished sizes and shape, the cost of which shall be deemed to be included in the rates. The approved samples shall be retained by the Engineer to form standards against which deliveries will be judged.

- b. The samples supplied shall conform to the ASTM standards stated below for the determination of the following:

Weight % Absorption	ASTM C-97-47
Modules of Rupture	ASTM C-99
Compressive Strength	ASTM C-170
Resistance to Abrasion	ASTM C-241-51
Flexural Strength	ASTM C-8880-78

### **15.06.4 Bedding & Finishing**

- a. The Contractor shall employ skilled and trained marble workers for doing this job. The Contractor may be allowed to employ an approved specialist subcontractor for this item of Work. All Work shall be of the highest quality in conformance with the Contract requirements and to the approval of the Engineer. Any substandard work shall be rejected and the Contractor shall remove and replace the same at his own cost.
- b. The surface over which the marble tiles are required to be fixed shall be clean of all dirt and dust and should be properly hacked so that the mortar sticks well to the surface.
- c. The Contractor shall ensure that all the edges of tiles supplied at Site are at right angles to each other, unless other angles are required due to design requirements. The Contractor shall also ensure that all sizes are adequate for the Work as specified.
- d. Damaged tiles or tiles with broken edges shall not be acceptable and in no case shall be used in the Work & shall immediately be removed from the Site.
- e. Marble tiles shall be bedded on the wet screeding described above at 7.02.2 and 7.03 by applying a thin layer of neat cement paste on to the screed bed and the tiles placed in position and tamped down gently with a wooden mallet to be level with other tiles. The tiles shall be laid in the manner so that they align perfectly to the specified lines and levels and are square. The tile joints shall be as thin as possible but not more than 2 mm wide and shall be regular and perfectly straight, and setting out shall be carried to ensure a minimum of cut tiles. Any tiles requiring to be cut shall be saw-cut by approved tools. Tiles pattern shall be square to

the spaces floored, and any patterning by tile jointing, alternating colors, etc. is to be carried out as indicated on the Drawings and as approved by the Engineer.

- f. The surface during laying shall be frequently checked with a straight edge at least 2m long to obtain a true surface with dead level or slope, as directed.
- g. All tile joints shall be grouted up solidly with a grout comprising of white Portland cement and water, all surplus to be cleaned off immediately.
- h. Once bedded, curing shall be carried out by covering in hessian and continuous wetting for a minimum period of 3 days and the floor kept clear of traffic for at least 48 hours.
- i. When cured, the marble tiling shall be polished with chemical polish to the approval of the Engineer. No wax polish shall be allowed. Polishing must be evenly and carefully carried out and a perfect smooth surface produced.
- j. The marble shall be chemical polish finished to a glossy surface that will reflect light to emphasize the color and marking. All finished surfaces shall be of uniform texture, color and appearance.

#### **15.06.5 Dado**

- a. Dado in all marble tiled areas are to be in marble to match the floor tiling to the area concerned, unless specified otherwise. The dado shall be produced in an identical manner as for tiling. The dado shall normally be fixed to the walls up to heights shown in the Drawings with top edges arris-rounded or as shown on the Drawings or as approved by the Engineer.
- b. The dado tiles shall be fixed to walls on a plastered backing having a slightly rough surface with neat cement paste. The back of each tile shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet so that the tile faces are set in one plane. The tiles shall then be grouted and polished with chemical polish as for marble floor tiling.

#### **15.06.6 Marble Tread and Risers**

Stair tread and riser slabs shall be provided in local - Botanical marble or imported marble in approved color and shade and to sizes and profiles as indicated on the Drawings. Treads to be 11 thick in single pieces as shown on Drawings, length to suit stair widths, one long edge arris-rounded and polished, risers shall be 1/2 thick in single pieces of sizes to suit stair widths; ends polished. Treads and risers shall be bedded in screed as for tiling, of thickness as indicated, all level and square or to profiles shown on Drawings, chemical polished and finished.

#### **15.06.7 Marble Counter Tops**

Marble slabs to kitchen counters, toilet counters or others shall be provided to sizes and profiles as indicated on the Drawings. The marble tops shall be provided in configurations to suit the built-in cabinets as per approved shop drawings in approved shade and color, delivered to Site polished and finished to the approval of the Engineer. Marble tops for toilets shall be recessed to provide wash hand basins, where required.

### **15.07 CERAMIC FLOOR TILES**

#### **15.07.1 Description**

The Work included in this sub-section shall comprise of providing and fixing in position locally manufactured ceramic floor tiles in approved sizes, color and pattern at locations shown on the Drawings and mentioned in the Bill of Quantities.

#### **15.07.2 Materials**

- a. Ceramic floor tiles shall be local or imported or equal approved from local source. Ceramic floor tiles for bathrooms shall be non-skid.
- b. The tile shall be bedded with neat cement paste or as recommended by the manufacturer to the approval of the Engineer.
- c. Joint filler shall be white Portland cement grout which shall be non-shrinking, stain resistant,

permanent in colors, and shall not inhabit fungus and bacterial growth. It shall be odorless and non-toxic, of smooth consistency for easy preparation and neat, rapid installation, and shall not contain any metallic material or ingredients. The joint floor grout shall be water resistant and shall not washout underwater.

- d. Portland cement conforming to BS 12.
- e. White Cement conforming to relevant BS standard.
- f. Sand & aggregate shall comply with ASTM C33.
- g. Water shall be clean potable drinking water, free from oils, acids, alkalis, salts and organic or other impurities and injurious matter.
- h. Pigments to be used shall comply with BS 1014.

#### **15.07.3 Samples**

The tile samples for local ceramic floor tiles shall be furnished from various product ranges of different manufacturers in sizes, patterns and colors for the selection and approval of the Engineer. The approved samples shall be retained by the Engineer to form standards against which deliveries will be judged.

#### **15.07.4 Bedding, Laying & Jointing**

- a. Ceramic Tiles shall either be bedded on the hard set floor screeding described above at 7.02.2(b) and 7.03 by applying a thin layer of neat cement paste on to the screed bed and the tiles placed in position and tamped down gently with a rubber mallet to be level with other tiles or directly on top of the M. S. plate with approved tile adhesive. The tiles shall be laid in the manner so that they align perfectly to the specified lines and levels and are square. The tile joints shall be as thin as possible but not more than 2 mm wide if spacer nibs not provided, and shall be regular and perfectly straight, and setting out shall be carried to ensure a minimum of cut tiles. Any tiles requiring to be cut shall be cut by approved tools. Tiles pattern shall be square to the spaces floored, and any patterning by tile jointing, alternating colors, etc. is to be carried out as indicated on the Drawings and as approved by the Engineer.
- b. The surface during laying shall be frequently checked with a straight edge at least 2m long to obtain a true surface with dead level or slope as directed. Tiles that are out of true plane or placed incorrectly shall be removed and reset.
- c. All tile joints shall be straight, level and of even width throughout. The tile joints shall be grouted up solidly in matching color with a grout comprising of white Portland cement or approved tile joint filler, pigment and water; all surplus to be cleaned off immediately.
- d. Once bedded, curing shall be carried out by covering in hessian and continuous wetting for a minimum period of 3 days and the floor kept clear of traffic for at least 48 hours.
- e. When cured, the floor shall be washed and cleaned to the approval of the Engineer.

#### **15.07.5 Skirting**

- a. Skirting in all ceramic floor tiled areas are to be of ceramic tile to match the floor tiling to the area concerned, as specified or shown on Drawings. The skirting shall be provided in an identical manner as for tiling. The skirting shall normally be 4l high with top edges arris-rounded or in the size and shape as shown on the Drawings or as approved by the Engineer.
- b. The skirting shall be fixed to walls on a plastered backing having a slightly rough surface with neat cement paste. The back of each skirting tile shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall over rendered backing with a rubber mallet so that the tile faces are set in one plane. The skirting shall be grouted and finished as for ceramic floor tiles.

#### **15.07.6 Dado**

- a. Dado in all ceramic floor tiled areas is to be in ceramic tiles to match the floor tiling to the area concerned, as specified or shown on Drawings. The dado shall be provided in an

identical manner as for tiling. The dado shall normally be fixed on walls upto the heights shown in the Drawings with top edges arris-rounded or as shown on the Drawings or as approved by the Engineer.

- b. The dado tiles shall be fixed to walls on a plastered backing having a slightly rough surface with neat cement paste. The back of each tile shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall over a rendered backing with a wooden mallet so that the tile faces are set in one plane. The dado shall be grouted and finished as for ceramic floor tiles.

#### **15.08 QUARRY FLOOR TILES**

The non-slip quarry tiles shall be in accordance to B.S. ASTM standard of sizes colors and design as indicated in the Schedule of Finishes. Square tiles shall be laid square with straight joints perfectly horizontal and vertical. Rectangular tiles shall be laid similarly to the square tiles or with broken joints to the tile face.

The preparation, Workmanship and protection are to be as described in the above Specification for Tiling work.

#### **15.09 PORCELAIN FLOOR TILES**

##### **15.09.1 Description**

The Work included in this subsection shall comprise of providing and fixing in position imported porcelain floor tiles of approved size, color and pattern at locations shown on the Drawings and mentioned in the Bill of Quantities.

##### **15.09.2 Materials**

- a. Imported non-skid Porcelain Ceramic Floor Tiles shall be from RAK Ceramics, UAE, or equal approved to the approval of the Engineer in the specified size, color and pattern.
- b. The tiles shall be bedded with neat cement paste or as recommended by the manufacturer and approved by the Engineer.
- c. Joint filler grout shall be from the same manufacture. The grout which shall be non-shrinking, stain resistant, permanent in color, and shall not inhabit fungus and bacterial growth. It shall be odorless and non-toxic, of smooth consistency for easy preparation and neat, rapid installation, and shall not contain any metallic material or ingredients. The joint floor grout shall be water resistant and shall not washout underwater.
- d. Portland cement conforming to BS 12.
- e. White Cement conforming to relevant BS standard.
- f. Sand & aggregate shall comply with ASTM C33.
- g. Water shall be clean potable drinking water, free from oils, acids, alkalis, salts and organic or other impurities and injurious matter.
- h. Pigments to be used shall comply with BS 1014.

##### **15.09.3 Samples**

The tile samples for the imported porcelain floor tiles shall be furnished from various product ranges of different manufacturers in sizes, patterns and colors for the selection and approval of the Engineer. The approved samples shall be retained by the Engineer to form standards against which deliveries will be judged.

##### **15.09.4 Bedding, Laying & Jointing**

- a. Porcelain Tiles shall either be bedded on the hard set floor screeding described above at 7.02.2(b) and 7.03 by applying a thin layer of neat cement paste on the screed bed and the tiles placed in position and tamped down gently with a rubber mallet to be level with other tiles. The tiles shall be laid in the manner so that they align perfectly to the specified lines and levels and are square. The tile joints shall be as thin as possible but not more than 2 mm wide, and shall be regular and perfectly straight, and setting out shall be carried to ensure a

minimum of cut tiles. Any tiles requiring to be cut shall be cut by approved tools. Tiles pattern shall be square to the spaces floored, and any patterning by tile jointing, alternating colors, etc. is to be carried out as indicated on the Drawings and as approved by the Engineer.

- b. The surface during laying shall be frequently checked with a straight edge at least 2m long to obtain a true surface with dead level or slope as directed. Tiles that are out of true plane or placed incorrect shall be removed and reset.
- c. All tile joints shall be straight, level and of even width throughout. The tile joints shall be grouted up solidly in matching color with approved tile joint filler and water; all surpluses to be cleaned off immediately.
- d. Once bedded, curing shall be carried out by covering in hessian and continuous wetting for a minimum period of 3 days and the floor kept clear of traffic for at least 48 hours.
- e. When cured, the floor shall be washed and cleaned to the approval of the Engineer.

#### **15.09.5 Skirting**

- a. Skirting in all porcelain ceramic floor tiled areas are to be of porcelain tiles to match the floor tiling to the area concerned, as specified or shown on Drawings. The skirting shall be provided in an identical manner as for tiling. The skirting shall normally be 4l high with top edges arris-rounded or in the size and shape as shown on the Drawings or as approved by the Engineer.
- b. The skirting shall be fixed to walls on a plastered backing having a slightly rough surface with neat cement paste. The back of each skirting tile shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall over rendered backing with a rubber mallet so that the tile faces are set in one plane. The skirting shall then be grouted and finished as for porcelain tiling.

#### **15.09.6 Protection**

The completed Works or parts thereof shall be protected by the Contractor against any damage. The Works shall be handed over in perfect condition. If any damage is incurred then the Contractor shall remove and/or replace the same at no additional costs. The Contractor shall exercise all care to protect the works executed by other trades and not covered by his Contract. Any damage to these shall be made good and the works restored at no additional cost.

### **15.10 VINYL FLOOR TILES**

#### **15.10.1 Description**

The Work included in this subsection shall comprise of providing and fixing in position imported Vinyl floor tiles of approved size, color and pattern at locations shown on the Drawings and mentioned in the Bill of Quantities.

#### **15.10.2 Materials**

##### **a. Vinyl Floor Tiles**

Imported non-skid Vinyl Floor Tiles shall be from Armstrong/ Marle or equal approved to the approval of the Engineer in the specified size, color and pattern.

- b. The tiles shall be laid with Adhesive or as recommended by the manufacturer and approved by the Engineer.

#### **15.10.3 Samples**

The tile samples for the imported Vinyl floor tiles shall be furnished from various product ranges of

different manufacturers in sizes, patterns and colors for the selection and approval of the Engineer. The approved samples shall be retained by the Engineer to form standards against which deliveries will be judged.

**15.10.4 Bedding, Laying & Jointing**

- a. Vinyl Tiles shall be laid on the hard-set floor screeding described above at 7.02.2(b) and 7.03 by applying a thin layer of Adhesive on to the screed bed and the tiles placed in position and tamped down gently with a rubber mallet to be level with other tiles. The tiles shall be laid in the manner so that they align perfectly to the specified lines and levels and are square. The tile joints shall be as thin as possible and shall be regular and perfectly straight, and setting out shall be carried to ensure a minimum of cut tiles. Any tiles requiring to be cut shall be cut by approved tools. Tiles pattern shall be square to the spaces floored, and any patterning by tile jointing, alternating colors, etc. is to be carried out as indicated on the Drawings and as approved by the Engineer. The surface during laying shall be frequently checked with a straight edge at least 2m long to obtain a true surface with dead level or slope as directed. Tiles that are out of true plane or placed incorrect shall be removed and reset.
- b. All tile joints shall be straight, level and of even width throughout. The tile joints shall be cleaned with approved cleaner tile, all surpluses material to be cleaned off immediately.

**15.10.5 Skirting**

- a. Skirting in all Vinyl floor tiled areas are to be of Vinyl coved skirting to match the floor tiling to the area concerned, as specified or shown on Drawings. The skirting shall be provided in an identical manner as for tiling. The skirting shall normally be 4" high with top edges arris-rounded or in the size and shape as shown on the Drawings or as approved by the Engineer.
- b. The skirting shall be fixed to walls on a plastered backing having a smooth surface with Adhesive.

**15.11 THERMOPORE SHEETS**

The material shall be of approved manufacture and of best quality available in Pakistan. The thermopore shall be of the type used for insulating roof, on sides of and under generator, transformer pads.

The insulation shall conform to the following physical requirements: -

Density (Average) Lbs. per Cft	6 to 8.5
Specific Gravity (Average)	0.12
Flexural Strength (Average Kgm per Sq. Cm.)	3.6 to 4.3
Impact Strength (Cm/Kgm per Sq. Cm.)	0.3 to 0.7
Compressive strength (Cm/Kg per Sq. Cm)	0.17 to 1.44
Deflection (Average)	0.25 to Inches
Thermal conductivity (Average) Maximum BTU at mean temperature 10 Degree F.	0.22

**15.12 MEASUREMENT AND PAYMENT**

Floor tiling works covered by this section of Specifications, complete and approved, will be measured and paid for per square meter, at the individual item rates entered in the Bill of Quantities and generally in accordance with the applicable terms and conditions of the Contract.

Skirting, treads and risers shall be measured and paid for per running meter at the individual item rates entered in the Bill of Quantities, as per terms stated above.

**\*\*\* END OF SECTION\*\*\***

## SECTION – 16 PAINTING

### **16.01 SCOPE OF WORK**

The work under this section of the Specifications consists of furnishing all materials, plant, labor, equipment, appliances and performing all operations in connection with surface preparation, mixing, painting concrete works, gates, grills, frames, walls, ceilings and all such surfaces as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

### **16.02 APPLICABLE STANDARDS**

Latest editions of following British Standards are relevant to these specifications wherever applicable.

#### **BSI (British Standards Institution)**

BS 245 -- Specification for mineral solvents (white spirits and related hydrocarbon solvents)  
for paints and other purposes.

BS 2521 -- Lead-based priming paint for woodwork. BS

2522 -- Lead based priming paint for iron and steel.

BS 2569 -- Sprayed metal coatings. Paint colors for building purposes CP

231 -- Painting of building

CP 3012 -- Cleaning and preparation of metal surfaces.

### **16.03 GENERAL**

- 16.03.1 Except as otherwise specified, all painting shall be applied in conformity with BS CP 231 "Painting of Building" as applicable to the work.
- 16.03.2 The Contractor shall repair at his own/expense all damaged or defective areas of shop- painted metal work and structural steelwork. Metal surfaces against which concrete is to be placed will be furnished shop-painted and shall be cleaned to being embedded in concrete.
- 16.03.3 Except as otherwise specified, all concrete and plastered surfaces are to be painted.
- 16.03.4 The Engineer will furnish a schedule of colors for each area and surface. All colors shall be mixed in accordance with the manufacturer's instructions.
- 16.03.5 Colors of priming coat (and body coat where specified, shall be lighter than those of finish coat. The Engineer shall have unlimited choice of colors.
- 16.03.6 Samples of all colors and finishes shall be prepared in advance of requirement so as notto delay work and shall be submitted to the Engineer for approval before any work is commenced. Any work done without such approval shall be redone to the Engineer's satisfaction, without additional expense to the Employer, samples of each type of paint shall be on separate 1 ft. x 1 ft. x 1/8 inch tempered hard hoard panels. Manufacturer's color chart shall be submitted for color specifications and selection.

### **16.04 MATERIALS AND EQUIPMENTS**

- 16.04.1 All materials shall be acceptable, proven, first grade products and shall meet or exceed the minimum standards of approved manufacturers.
- 16.04.2 Colors shall be pure, non-fading pigments, mildew-proof, sun-proof, finely ground in approved medium. Colors used on plaster and concrete surfaces shall be lime- proof. Allmaterials shall be subject to the Engineer's approval.
- 16.04.3 Approved quality Distemper paint shall be used for painting where specified on the drawings as directed by the Engineer.

16.04.4 The plastic emulsion/weather shield paint or similar as approved by the Engineer shall be used where specified on the drawing as directed by the Engineer.

16.04.5 Other materials/ equipments to be used are;

- Cement primer, Turpentine, Putty, Polish paper, Wood primer, Emery polish paper and Water
- Drop cloth and polythene sheets of suitable size & quality shall be used to protect other materials and surfaces.
- The masking material where-ever necessary shall be used in sufficient quantities to avoid falling of paint on unwanted surfaces.
- Grinding / buffing wheels, wire brush & emery paper.
- Electrical distribution panels switch boards & hand lamps.
- Kerosene, thinners, acetone etc. to remove oil / grease etc.
- Painting brush:
  - Good quality brushes with long and flexible bristles free from any paint residue shall be used.
  - Neat, clean & painted scaffoldings of good quality.
  - Good quality ladders, platforms etc.
  - Safety gears to be used by personnel like respirator, face mask, hand gloves, protective clothing etc.

All material shall be delivered to site in their original unbroken containers or packages and bear the manufacturer's name, label, brand and formula and will be mixed and applied in accordance with his directions.

#### **16.05 DELIVERY STORAGE AND CONTAINER SIZES**

Paints shall be delivered to the site in sealed containers which plainly show the type of paint, color (formula or specifications number) batch number, quantity, and date of manufacture, name of manufacturer and instructions for use. Pigmented paints shall be supplied in containers not larger than 20 liters. All materials shall be stored under cover in a clean storage space which should be accessible at all times to the Engineer. If storage is allowed inside the building, floors shall be kept clean and free from paint spillage.

#### **16.06 SURFACE PREPARATION**

- a. All oil, grease, dirt, dust, loose mill scale and any other foreign substance shall be removed from the surface to be painted, polished and white washed by the use of a solvent and clean wiping material. Following the solvent cleaning, the surfaces shall be cleaned by scrapping, chipping, blasting, wire brushing or other effective means as approved by the Engineer.
- b. All the surfaces to be painted shall be free from dust, dirt, fungus, lichen, algae etc. old paint, varnish and lime wash should always be removed by scraping and washing.
- c. All surfaces shall be made smooth, prior to the application of primer by rubbing with Bathy (silicon carbide rubbing brick) and/ or sand paper, filling the voids putty (Zinc/ Chalk/ Plaster of Paris mixture).
- d. In the event the surfaces become otherwise contaminated in the interval between cleaning and painting, re-cleaning will be done by the Contractor at no additional cost.
- e. No work in this section shall be allowed until all surfaces or conditions have been inspected and approved by the Engineer.

#### **16.07 APPLICATION**

All paint and coating materials shall be in a thoroughly mixed condition at the time of application. All work shall be done in a workman like manner, leaving the finished surface free from drips, ridges, waves, laps, and brush marks. All paints shall be applied under dry and dust free conditions, Unless approved by the Engineer paint shall not be applied when the temperature of the metal or of the surrounding air is below 7 degrees centigrade, Surfaces shall be free from moisture at the time of painting.

All primary paint (Alkali Resistance) shall be applied by brushing. The first coat of paint shall be applied immediately after cleaning. When paint is applied by spraying, suitable measures shall be taken to prevent segregation of the paint in the container during painting operation.

Effective means shall be adopted for removing all free oil and moisture from the air supply lines of the spraying equipment.

A priming coat shall be applied to the cleaned and smooth surfaces first. Unless otherwise specified in the BOQ or approved by the Engineer, all surfaces shall have at least 3 coats of paint in addition to the priming coat.

Each coat of paint shall be allowed to dry or harden thoroughly before the succeeding coat is applied. Surfaces to be painted that will be inaccessible after installation shall be completely painted prior to installation. Only as much material should be mixed as can be used up in one hour. Over-thinning will not be permitted. After the first coat the surfaces will be soaked evenly four or five times and the second coat shall be applied after leaving for at least overnight.

- a. Where shown on Drawings all exterior finishes shall be painted with weather resistant paint in approved colors as per manufacturer's specifications.
- b. For Interior finishes on concrete, masonry, door, windows, cabinets, grills etc. any of the listed types of paints, i.e.; Whitewash, Oil, Plastic or Matte Emulsion, Cement-based, Enamel, Distemper, Textured, Bituminous, Epoxy, Anti-condensation, Luminous (fluorescent), Latex, Lead, Metallic, Rubber, Aluminum, Silicone, Zinc rich, Anti-corrosive, Fungicidal Paint of the approved make and shade shall be applied to surfaces as shown on Drawings or as specified by the Engineer.

Walls, floors & ceiling and adjacent equipment's and piping shall be satisfactorily protected by drop clothes. Other precautionary measures should be taken during spray / brush painting to ensure at surrounding area /equipment is not affected.

The application should be as per manufacturer's instructions / specifications. Before opening the packed drum, it should be rolled on the floor and after opening the drum paints shall be stirred well so that no material/pigments remain settled at the bottom. Suitably of the paint shall be checked as per requirement before opening.

The choice of method of application i.e. by brush or by spray gun will be decided by the Engineer. However, adjacent equipment / structures shall be suitably protected and care shall be taken to prevent intoxication of the surrounding area. The method of paint application depending upon the area shall be jointly discussed and decided with Engineer. Paint thickness (DFT) shall be as per the item scheduled. In case the dry film thickness of finish paint is observe

### **Polishing**

After fine sanding by a skilled operator, one coat of clear polish should be rubbed in by hand using a cloth or pad, be allowed to dry and buffed up with worn fine sand paper or steel wool to remove raised grain. A second coat of clear polish should then be applied less than the specified values, additional coat shall have to be applied free of charge.

## **16.08 JOB CONDITIONS**

- 16.08.1 Observe manufacturer's recommended minimum and maximum temperature but do not apply paint or finish to any surface unless ambient temperature is 10 degree C or above and less than 43 degree C. No painting shall be done above 90% relative humidity.
- 16.08.2 Adequately protect all finished work.
- 16.08.3 Remove and replace all items of finish hardware, device plates, accessories, lighting fixtures or other removable items.
- 16.08.4 In no case shall any finish hardware or other finished item that is already fitted into place be painted, unless otherwise specified.

**16.09 Inspection & Check:**

All the work is subject to the inspection of the Engineer or his authorized representative which shall be carried out in a manner, satisfactory to the Engineer. The contractor shall rectify any short comings pointed out by the said representative. The general inspection requirements areas follows:-

- a. No paint shall be applied until the authorized inspection has ascertained that all prepared surfaces are satisfactorily cleaned and are in a condition to ensure the proper receipt of and adhesion of the coating.
- b. The contractor shall furnish all gauges, instruments and the necessary measuring equipment's required for inspecting the work, test pieces, samples etc. at site and in the shop. The Engineer's authorized representative is intended to ensure that the material and workmanship are in accordance with this specification, but it will not relieve the contractor for any of his responsibilities for the ultimate workmanship and performances.

**16.10 QUALITY ASSURANCE**

All paint for any one surface shall be top quality, of one manufacturer of the specified. Deep tone accent colors shall be used and the unavailability of final coat colors may be the basis for rejecting materials for any one surface.

**16.11 MEASUREMENT AND PAYMENT**

All the painting and finishing on all surfaces, other than timber and steelworks which shall be deemed to be inclusive of painting and finishing in their own items of works, shall be measured per square Meter/ft in accordance with standard method of measurement and paid for at the unit rates entered in the Bill of Quantities and in accordance with the terms and conditions of this Contract.

Where separate quantities are not shown in the Bill of Quantities, these shall be deemed to have been included in the rate of the relevant items to be finished and painted and no separate payment shall be made for painting/finishing works of such items.

**\*\*\* END OF SECTION \*\*\***

## SECTION – 17 MISCELLANEOUS METAL WORK

### 17.01 SCOPE OF WORK

The Work covered in this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the fabrication and installation of miscellaneous metal works, complete in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract.

### 17.02 GENERAL

All metal shall be well formed to shape and size, with sharp lines or angles. Shearing and punching shall be left clean to true lines and surfaces. Shop connections shall be welded or riveted and site connections bolted unless otherwise noted. Use flat headed countersunk rivets where riveted connections are exposed to view in finished work. Bolts shall be turned up tight and threads nicked to prevent loosening. All bolts shall be provided with washers.

For exposed connections with hair line joints which are flush and smooth, concealed fasteners shall be used wherever possible. If exposed fasteners are unavoidable, use countersunk flathead screws or bolts.

All metals shall be free from corrosion, scale, distortion and other damage, and only new material shall be used for fabrication purposes.

### 17.03 MATERIALS

#### 17.03.1 Steel

- a. All steel sections shall comply with BS 4, parts 1 and 2, and BS 4848. Steel shall be mild steel complying with BS 4360, Grades 43A, 43B and 43C as appropriate.
- b. Steel tubes for structural and general engineering purposes shall comply with BS 1775.
- c. Steel tubes and tubulars for balustrades shall comply with BS 1387 designation of either light, medium or heavy and the steel pipe fittings shall comply with BS 1740.
- d. Galvanized MS tube shall comply with BS4 and BS 1387 medium grade.
- e. Stainless steel sections shall be to BS 970, quality En. 58A. stainless steel pipes shall be to BS 3605.
- f. All steel shall be supplied from a specifically approved source, from approved manufacturers, and certificates of origin and mill test certificates shall be supplied in all cases, proof of compliance with the relevant standards shall be a condition of approval.

#### 17.03.2 Nuts, Bolts and Screws

- a. Nuts and bolts etc. shall comply with BS 4190 and BS 1494 and shall have SI metric threads complying with BS 3643.
- b. Stainless steel bolts are to be set bolts and shall comply with BS 4190. The stainless steel for bolts, nuts and washers shall comply with BS 970, quality En 58 A.M.
- c. Self-tapping screws shall comply with BS 4194.

### 17.04 COORDINATION WITH OTHER TRADES

- a. All work under this section shall be coordinated with the work to be done as specified under other sections of the Specifications and as well as with other trades.
- b. The Contractor shall furnish all information and instructions required for work by other trades.
- c. The Contractor shall drill, tap, cut and fit the work included herein as required to accommodate work of other trades in conjunction with it.
- d. The Contractor shall be responsible for obtaining exact site dimensions and accurate execution of all parts of the work specified.
- e. All the works shall be carried out exactly in accordance with the approved shop drawings.

### 17.05 SAMPLES

Samples or materials specified shall be submitted for approval when required by the Engineer.

## **17.06 FABRICATION**

### **17.06.1 General Fabrication**

- a. All steel and other metals are to be cut, drilled, formed, bent, worked and otherwise fabricated to the details, forms and dimensions indicated on the approved shop drawings; setting out joints and fixings are to be such as to produce finished components that are perfectly square, sound and rigid. All members are to be of the sizes specified, and no alterations, additions or omissions in the size or arrangements of members may be made without Engineer's approval. The inclusion of gussets, bracing plates, fixing lugs, spacers, packings, etc. in the interests of rigidity or ease of fixing may be considered, but on a specific approval from the Engineer.
- b. All open-ended members, including hollow sections, shall be capped off with welded plates or caps; no hollow surfaces which cannot be galvanized or maintained are to be left exposed to atmosphere, whether shown so on Drawings or not.
- c. The provision of BS 449 shall apply generally to fabrication workmanship.

### **17.06.2 Joints**

All steel joints specified as welded shall be cleanly and solidly welded, in general accordance with the provisions of BS 5135, using electrodes as specified in BS 639. All welds shall be continuous, solid, with no spot welding, and shall be ground off smooth flush and perfect on completion.

All joints specified as bolted, screwed or otherwise mechanically connected shall be properly set out to provide sufficient but not excessive tolerance, holes drilled accurately, and then soundly and solidly connected. All bolts, screws and connectors shall be either hot-dipped galvanized steel, stainless steel or non-ferrous metal, no untreated steel fixing device is to be used in any circumstances. Fixings shall be selected suitable for the particular purposes, and Engineer's approval obtained.

### **17.06.3 Tolerances**

All metalwork shall be fabricated to overall dimensions so as to provide sufficient but not excessive tolerances between the components and adjoining work, and between adjoining metal components, bearing in mind building materials tolerances, thermal expansion, erection distortions and all other factors.

### **17.06.4 Drawings and Calculations**

Detailed fabrication and shop drawings and, where appropriate, structural calculations shall be prepared by the Contractor for the approval of the Engineer for all the fabricated components. These shall be approved before commencement of work and should indicate all connections, fixing, methods of fabrication, and all other relevant details.

### **17.06.5 Finishes and Protection**

All steel and other metal components specified for painting shall be finished in a smooth workmanlike fashion, free of irregularities of surface, burrs, galvanizing excess, mill marks, oil, grease, dirt, etc. ready for painting.

All metalwork shall be protected during transportation delivery, storage on Site, and after erection, by such measures as shall be agreed with the Engineer, to prevent damage of any type, in particular scratching, denting, distortion, and other mistreatment. Materials so damaged will not be acceptable, and shall have to be replaced.

### **17.06.6 Riveting**

Riveting where exposed shall be flush unless otherwise indicated on Drawings or directed by the Engineer

### **17.06.7 Bolting**

Bolting, where permitted, shall be done with proper size bolts. Nuts shall be drawn tight and thread nicked.

**17.06.8 Steel**

The use of Structural Steel in Buildings shall comply with BS 449 Part 2.

**17.06.9 Welding**

- a. Welding of all steel shall comply with BS 5135. All welded joints which will be exposed shall be ground to a smooth finish. All welding shall be executed by experienced certified welders.
- b. Welding shall be continuous except where tack-welding is specifically permitted. Tack welding will not be permitted on exposed surfaces.
- c. Where galvanized items are to be welded, the weld and joint shall be ground smooth. Only complete welded assemblies may be hot dip galvanized. No cold galvanizing paint permitted cold galvanizing zinc.
- d. No black bolts will be accepted. Only H.D. galvanized bolts shall be allowed.

**17.06.10 Shop Finishing**

- a. Provide a 6-micron thick zinc coating for the items shown or specified to be galvanized using the hot dip process after fabrication.
- b. Shop paint all ferrous metalwork except galvanized work and those portions of items which are to be embedded in concrete or masonry and surfaces and edges which are to be site welded.
- c. Remove scale, rust and other deleterious materials before the shop coat of paint is applied.
- d. Immediately after surface preparation, anticorrosion metal primer paint be applied in accordance with the manufacturer's instructions. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

**17.06.11 Installation**

- a. Provide anchorage devices and fasteners where necessary for securing to finished work including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, rag-bolts, wood screws and other connectors as necessary.
- b. Cut, drill and fit as necessary for installation. Set the work accurately in location, alignment and elevation, plumb, level and true. Provide temporary bracing or anchors in formwork for items which are to be cast or built into concrete, masonry or similar construction. Form right joints with exposed connections accurately fitted together. Do not cut or abrade members with finishes which cannot be completely restored on Site. Where cutting, welding and grinding are required for fitting and jointing of the work, restore finishes to eliminate any evidence of such corrective work.
- c. Carry out all welds and carefully make good on completion.
- d. Immediately after erection, clean all site welds, bolted connections and rough areas of the shop paint and coat all exposed areas with the same material as used for shop painting.
- e. No site welding to galvanized item will be permitted.

**17.06.12 Storage and Handling**

- a. All items described under this Section shall be handled, delivered and stored in a manner that will avoid damage, rust or deformation. Items shall be stored off- ground and shall be entirely covered with weatherproof coverings in storage area.
- b. Items which become rusted or damaged because of non-compliance with these conditions will be subject to rejection, and such items shall be replaced without additional cost to the Employer.

**17.06.13 Protection**

- a. Before arriving on Site, all surfaces of hot-dip galvanized method which are damaged, have rough spots or joints may be permitted to be by the Engineer be touched up, using an approved zinc primer coat. Damaged hot dip galvanized components will however generally be rejected. Primer shall be compatible for finish paint. Hot dip galvanized items shall not receive a shop coat of primer so that there may be a visual inspection on Site of such items by the Engineer.
- b. Thoroughly insulate all non-ferrous items in contact with dissimilar metals, concrete, masonry and mortar with approved zinc-chromate coating or plastic membrane on contact surfaces before installation.

**17.07 MISCELLANEOUS ITEMS**

**17.07.1 Hollow Metal Frames and Doors**

Metal doors shall comprise of M.S. frames and shutters. All shapes and sizes of complete unit as well as components shall be strictly in accordance with details shown on the Drawings, fabricated, painted and fixed to hollow metal frame as per details shown on the Drawings.

**a. Frames**

- i. All hollow metal frames shall be fabricated using 16 gauge M.S. sheets of best quality, free from all defects, and in accordance with the details indicated on the Drawings and Bill of Quantities.
- ii. Frames shall be constructed as full welded units from approved manufacturers as per approved shop drawings.
- iii. All corners mitred and back-welded and any exposed welds at all joints ground and dressed smooth.
- iv. Anchors shall be provided as per approved details, 9l long, three to jambs and welded to frame at shop for embedding in block work.
- v. All frames shall have channel spreaders. Frames cut, reinforced, mortised, drilled and tapped as required for application of all hardware. All frames shall be fabricated as per final approved hardware schedule.
- vi. Rubber/Neoprene bumper or sound absorbers shall be installed 3 per strikejamb.
- vii. All contact edges shall be closed tight.
- viii. Finished work shall be strong and rigid, neat in appearance and free from defects, warps, bulges or buckles. Moulded members shall be clean-cut straight with true edges.
- ix. All cut-outs shall be protected against mortar or plaster with mortar guards of approved gauge.
- x. After the frame is fabricated, all tool marks shall be ground smooth, all exposed surfaces degreased and thoroughly cleaned of rust, oil and other impurities and coated with approved primer to enable the surface of the metal to resist corrosion and promote paint adhesion. The remaining irregularities specially welding shall be dressed smooth.

**a. Doors**

Single or double leaf doors shall be fabricated from 20-gauge M.S. sheets of best quality and free from all defects and in accordance with the details indicated on the Drawings and Bill of Quantities.

The doors shall be manufactured from approved manufacturer as per the approved shop drawings. The door shall be provided with hinges and ready to receive locks etc.

**b. Installation**

- xi. Doors and frames that are fabricated and brought on the Site shall be approved by the Engineer before installation. Any defective or substandard work shall not be acceptable.
- xii. Doors and frames shall be installed in accordance with the manufacturer's drawings and recommendations, all to the satisfaction of the Engineer.

**c. Painting**

- xiii. One coat of anti-corrosion primer paint shall be applied to all exposed surfaces before the door and frame is installed. After this another base coat of enamel paint should be given.
- xiv. After the door and frame has been installed properly, three coats of enamel paint of an approved quality and shade shall be finally applied to all exposed surfaces.

**d. Storage and Handling**

The Contractor shall be responsible for storage, handling and protection of the material on the job. Scratches, holes, dents and nicks and other marring of the paint film will have to be made good and touched up without any extra cost.

**17.07.2 Pipe Handrail**

M.S. pipe hand rail shall be fabricated and installed, as per details indicated on Drawings & Bill of Quantities, by approved manufacturers in accordance with approved shop drawings. The pipe handrail shall be of 2 ½" dia M.S. balusters, M.S. fixing brackets/plates and screws etc., painted and installed.

**17.08 MEASUREMENT AND PAYMENT**

Metal doors shall be measured per square meter and paid for at the unit rates entered in the Bill of Quantities, inclusive of hollow metal frame, anchors, hardware, painting, installation, complete in all respect.

M.S. pipe handrail shall be measured per-running foot and paid for at the unit rate entered in the Bill of Quantities, inclusive of M.S. balusters, M.S. fixing brackets / plates, screws etc., painting and installation, complete in all respect.

M.S. ladder shall be measured and paid for at the unit rate entered in the Bill of Quantities, inclusive of all materials etc., painting and installation, complete in all respect.

**\*\*\* END OF SECTION \*\*\***

## SECTION 18 EMBANKMENTS

### 18.01 General Description

An embankment is constructed for any of the following purposes:

1. Storage of water as in case of dams etc.
2. Flood protections to check erosion and spill, etc.
3. River training on the head-works.
4. Keeping the water in the running channels in the fillings i.e. reaches where the water level in the channels is higher than the ground level.
5. Maintaining uniform slope of rail track and road formation (metaled or un-metaled) in filling i.e., reaches where the proposed formation level is higher than the natural surface level.
6. Bridging depressions or attaining uniform slopes of the link between two or more embankments.
7. Depositing the material obtained from precise or borrow-pit excavations considered unsuitable for any use or rendered surplus.

Embankments can be divided into three main categories depending upon their object. These are: -

- I. Water retaining embankment.
- II. Rail and road embankment.
- III. Spoil bank.

#### 1. Water Retaining Embankment:

It is constructed with selected material on account of its following peculiarities.

1. It has to be watertight as much as possible to resist percolation.
2. It shall be strong enough to withstand the hydrostatic pressure.
3. It shall be impregnated to guard against erosion and wave-wash.
4. It shall have an adequate base friction to eliminate chances of sliding.
5. It shall settle evenly on alternate wetting and drying without cracks or cavities

#### 2. Stabilized Soil:

If the existing soil does not possess the requisite qualities, stabilized soil for embankment can be obtained by blending the following proportions of material: a) Sand (0.02 to 2.0 mm.... 60 to 80% by weight b) Silt (0.002 to 0.02 mm.... 12 to 25% by weight c) Clay (below 0.002 mm.... 08 to 15% by weight.

### 18.02 Construction of Embankment

The following steps are involved in the actual construction of an embankment:

1. The surface area of the ground to be occupied by the embankment is cleared of all rubbish, grass, roots, shrubs, brush, trees, fences, buildings, metaled roads, ruins and such other structures as may either cause hindrance in the execution of work or might decay and form dangerous pockets subsequently.
2. All loose surface or soft soil is removed to about 6 inches depth and the surface roughened by ploughing or digging all over. Small key-trenches are sometimes dug out in the bad to unite the body of the new embankment with the sub-soil. Another way of preparing the soil is by cutting v-shaped benching, at intervals, running parallel to the central line. A key trench is very essential where the ground is porous, sandy or cracked. All soft soil is removed as far as possible, especially soils containing salt.
3. The central line of the embankment is distinctly marked with a dagbel, and pegs are fixed at every chain. The toes of the embankment are clearly lock-spitted and all curves in the alignment properly laid and half breadths carefully set out.
4. A complete profile of the embankments is set up at an interval of 500 feet and at every change of section as

well as at every curve. This profile is 10 feet long of the actual completed embankment, with its correct heights, widths and all slopes dressed to trueform. The correct height of this profile is 5 to 10% greater than the final level of the embankment depending upon whether the embankment is to be compacted up to 95% dry density or it has to guard against shrinkage and settlement. The ends of this profile bank are stepped so that proper locking takes place while constructing the banks adjoining them. Batter boards are employed for checking the slopes of the embankment.

5. The embankment is completed according to the approved profile by spreading earth in uniform horizontal layers of 6 inches to one-foot thickness for the entire width. Each layer is thoroughly compacted before the next one above it is laid.
6. The top of the bank and slopes are carefully dressed and no hollows or humps are allowed to remain.
7. Proper ramps and turning platform are provided for road crossing etc. in the case of ramps a gradient of 1 in 15 with an inner slope of 15 feet radius from the embankment to the ramps usually works well.

### 18.03 **Compaction of Embankment**

The Compaction of the embankment may be required at specified relative density according to ASTM D 1556 at optimum moisture content or otherwise compaction as required. The object of compacting soil is to improve their properties in respect of strength, liability to settlement and resistance to weathering. It involves the following processes:

1. It is desirable to take earth first from the more distant pits, gradually lessening lead as the embankment rises, so that all earth is thrown into the slope and not tipped over.
2. All large clods are broken up in the borrow-pit, and no clod larger than man's fist is brought to the bank.
3. The width of each layer is usually a little more than the width required by the cross-section of the bank. The slopes are then dressed off to final section and not filled in afterwards.
4. Each layer is compacted by rolling or ramming before laying the next one above it.
5. On important embankment each layer is brought to the optimum moisture contents and rolled to produce the maximum density.
6. Longitudinal bunds above 6 to 9 inches high and one foot wide on the top with side slopes of 2 to 1 may be made on the outer edges of the top of embankment. Also, cross bunds of the same dimension at every 25 feet to 50 feet are provided so as impound rain water to expedite consolidation before the monsoon sets in.

#### 1. **Compaction of Embankment (Under Optimum Moisture Conditions)**

The optimum moisture contents for specified density shall be determined by contractor in laboratory in advance of start of construction. Control on compaction in the field shall be exercised through frequent moisture content and density determinations. A systematic record of these shall be maintained. At all times during construction the top of the embankment shall be maintained in a profile to shed water and prevent pounding.

#### **Control Tests on Borrow Material**

Soil suitable for consolidation under O.M.C. conditions should preferably have the following characteristics:

a)	Minimum percentage of clay	10%
b)	Liquid limit	14%
c)	Plasticity index (ASTM D-4318)	4%
d)	Percentage of silt should not exceed	5%
e)	Peat, muck and organic soils are unsuitable	Nil

*Table 5, Characteristics of soil for consolidation*

The Engineer-in-Charge may, however, relax these requirements taking into account availability of materials, cost of transportation and other relevant factors. Various test required to be conducted on the borrow material with their recommended frequency are indicated below. All the test need not be stipulated on every project. Depending upon

site condition etc. only some may be found necessary at a particular project. The frequency of testing indicated refers generally to the minimum number of tests to be conducted. The rate of testing must be stepped up as found necessary depending upon the variability of the materials and compaction methods employed at a project.

- a. Gradation:  
At least one test for each kind of soil. Usual rate of testing shall be 1 to 2 tests per 8000 cum of soil.
- b. Plasticity:  
At least one test for each kind of soil. Usual rate of testing shall be 1 to 2 tests per 8000 cum of soil.
- c. Proctor Tests:  
At the rate of 1 to 2 tests per 8000 cum of soil.
- d. Deleterious Contents:  
As required.
- e. Moisture contents:  
One test for every 250 Cu. M. of soil.

## 2. Rolling

The following are the suitable rollers for rolling purposes.

1. Sheep foot rollers are suitable for compacting dry. Cohesive soils at low moisture contents.
2. Pneumatic tyre rollers are most suitable machines for compacting soils in embankments.
3. Smooth-Wheeled rollers are satisfactory in most cases of sub-grade and base compaction.
4. Vibrating machines are suitably employed for compacting granular soils in confined areas like foundation and abutments.

### 18.04 Precautionary Measures

To safeguard against the failures of earthen embankment owing to percolation, piping, heaving, slipping, leakage, erosion, etc. the following precautions are observed: -

1. **Increase Width of Slopes:** The width may be suitably increased in order to provide additional strength. In the case of embankment over 15 feet high and composed of materials containing high percentage of clay, the side slopes may be increased up to 4 to 1, depending upon the height of the embankments, next slope to which the material will stand without severe sloughing. Alternatively, the berms may be provided 7½ feet wide for every 15 feet height of such embankments.
2. **Cut-Off Trench:** In order to render the foundation of an earthen dam impervious to seepage water, a cut-off trench is made in the bed under the dam up to the depth that will prevent water from percolating underneath it. The trench is made in the center of the dam, over which the core wall is built. Holes may be frilled all along the bed of the trench and thoroughly grouted with cement so as to provide a deep curtain below the bed, which is impervious to water. The trench is filled with puddled clay or concrete which is well bonded into the bottom of the trench by keys or grooves to ensure watertightness. Puddling in the trench is carried out by heeling by feet by workmen. The usual depth of a cut-off trench is 20 to 30 feet (it is not uncommon to have the trench 100 feet below the surface and still deeper walls have been built) and width 6 to 10 feet depending upon the depth.
3. **Core Walls:** The object of a core wall is to provide a barrier to the passage of seepage water from the water side to the rear of the dam and also to the passage of borrowing animals that cause dangerous breaches in embankments. A core wall may be of compact clay puddle, masonry (also called a diaphragm wall), concrete, or planks driven as sheets piling for small or temporary dams, taken down to impervious strata. The core wall may be located either in the centre of the embankment or on the water side of the slope.

Both the methods have their own merits and demerits depending upon the material and other conditions. Although the thickness is increased if the puddle clay is of poor quality. The top of the core wall is kept in foot above the high flood level and 2 to 3 feet below the top of the embankment. It is always preferable to make the whole embankment of one homogeneous watertight material and do away with the core wall which is liable to produce

### 18.05 Embankments Specification

1. Embankment shall be constructed according to the approved profiles. Earth shall be taken from an approved source, borrow-pits or spoils, and shall be free from roots, grass, shrubs or other organic matter liable to decay.

2. Embankment shall be built in horizontal layers, approximately 6 inches thick. These layers shall extend to the full width to the required side slopes and shall not be widened with loose material dumped from the top.
3. All clods and lumps of earth shall be broken up in the borrow-pits to a diameter of not more than 2 inches. Any clods or lumps thrown on to the bank shall be broken up and spread before compaction begins.
4. The top of bank and the slopes shall be carefully dressed according to the approved profiles. No hollows or humps shall be allowed in the slope.

**1) Backfill and Compaction of Embankments (around Structure etc.)**

Embankments and backfill designated as compacted shall be compacted to the lines, grades and slopes shown on the drawings or as directed by the Engineer-in-charge in writing.

- a. The contractor's operations in the excavation of material designated for use in compacted embankment or compacted backfills, shall be carried in a way that results in an acceptable gradation of the materials, when placed. The compacted embankment shall be constructed of the finest and most suitable material for impermeability and stability.
- b. The material in each layer before and during the time it is being placed shall have the optimum moisture content of 2% throughout, required for the purpose of compaction as determined by the Engineer-in-charge. The material shall be brought to the proper moisture content at the site of excavation in so far as it is practicable, but such moisture shall be supplemented by sprinkling water at the site of compaction. If the moisture content is greater than the optimum, the compaction work shall be delayed till the material has dried to the optimum moisture content.
- c. The material to be compacted shall be deposited in horizontal layers, 6 inches thick as compacted. Its distribution shall be so as to ensure that the compacted material is homogenous and free from pockets, lenses, streaks or other imperfections.
- d. When the material has to be conditioned and placed as specified it shall be compacted by ramming or by suitable equipment of proper weight and size duly approved for use by the Engineer-in-charge.
- e. The material in compacted embankments and compacted backfill shall be compacted till the density of the compacted material is not less than 95% of the maximum dry

**2) Borrow-Pits**

- i). All earth for embankment and backfills shall only be obtained from borrow-pits set out (demarcated) by the Engineer-in-charge. The borrow-pits shall be located opposite to or as near as possible to the site of the fill.
- ii). When directed to do so, the contractor shall take earth from old bunds, mounds, key trenches, old borrow-pits, etc., only after they have been measured and measurement has been recorded by the competent authority. No such authorization shall be made unless the measurements mentioned above have been duly recorded.
- iii). The earth taken from any place, not duly authorized by the Engineer-in-charge, shall not be measured and paid for and the contractor shall be responsible for any damage arising from unauthorized pits.
- iv). Borrow-pits, excavated to a depth not exceeding specified depth by 10%, shall be paid for full excavated depths at the discretion of the Engineer-in-charge. However, where the actual excavated depths are more than 10% of specified depths, specified depths alone shall be paid for.
- v). Borrow-pits shall preferably be multiples of 10 feet length, to facilitate recording of measurements.
- vi). As and when directed by the Engineer-in-charge, borrow-pits shall be ploughed by the contractor after final measurement has been duly recorded and checked by the competent authority before the final bill of the contractor is paid.

\*\*\* END OF SECTION \*\*\*

## **SECTION - 19 WALL TILING**

### **19.01 SCOPE OF WORK**

The Work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with providing and laying of wall tiles, complete in strict compliance with this section of Specifications, the applicable Drawings and in accordance with the terms and conditions of the Contract.

### **19.02 GENERAL**

Best quality local or imported wall tiles from approved manufacturers in approved size, color and pattern at locations shown on the Drawings and in the Bill of Quantities shall be supplied and laid dully approved by the Engineer.

### **19.03 MATERIALS**

Tile can be from of any of the types listed below:

Ceramic tiles, Porcelain tiles, Marble tiles, Granite tiles, Cement tiles, Vitrified tiles, Glass Tiles, Mosaic Tiles, Travertine tiles, Slate Tile, Quartzite Tiles etc.

- a. All the tiles shall be perfectly true to shape, flat, free from crazing, walks and other flaws and shall be consistent in color and pattern equal to samples presented to the Engineer for approval. The bedding faces of all tiles shall be keyed to an approved pattern.

Except as otherwise specified, the following British Standards and Code of Practice shall be applicable to materials and fixing methods for ceramic tiles:

- i. British Standard 1281: 1966 —Glazed Ceramic Tiles and Tile Fittings for internal walll.
- ii. British Standard CP 212: for fixing methods and workmanship.
- b. Adhesives for ceramic tiling shall be neat cement paste or as recommended by the tile manufacturer.
- c. Joint Filler shall be white Portland cement grout in matching colour which shall be non- shrinking, stain resistant, permanent in colour, and shall not inhabit fungus and bacterial growth. It shall be odorless and non-toxic, of smooth consistency for easy preparation and neat, rapid installation, and shall not contain any metallic material or ingredients. The joint grout shall be water resistant and shall not wash out under water.
- d. Portland cement conforming to BS 12.
- e. White Cement conforming to relevant BS Specifications.
- f. Sand shall comply with ASTM C-33.
- g. Water shall be clean potable drinking water, free from oils, acids, alkalis, salts and organic or other injurious matter.
- h. Pigments to be used shall comply with BS 1014.

### **19.04 SAMPLES**

All wall tiles materials such as ceramic tiles etc. to be used in the Works shall receive prior approval of the Engineer.

The Contractor shall submit adequate number of samples of tiles from the product ranges of different local manufacturers for the selection and approval of the Engineer. The approved samples shall be kept by the Engineer to form standards against which all deliveries will be judged.

The Contractor shall strictly follow the instructions of the manufacturers and the wall finishes shall be applied accordingly.

Wall tiling to internal and external walls and fascia shall be fixed true to the line level and plumb in approved manner satisfactory to the Engineer. All tiles shall be aligned properly with straight joints in even widths.

Any work covered under this section of the Specifications, not conforming to the requirements of the specified quality and workmanship will not be acceptable and shall be rejected by the Engineer, and the Contractor shall be required to remove and replace such work without any claim at his own cost as per the instructions of the Engineer.

**19.05 BEDDING AND JOINTING**

- a. The tiles shall be fixed to the walls over a rendered backing as described below:  
Rendered Backing  
The tiles to be fixed to walls shall be fixed on a rendered backing. Walls to be tiled are to be prepared exactly as for rendering/plastering. A 10 mm thick cement sand render coat shall then be applied exactly as described for plastering in a ratio of 1:4. The surface to be scratch-keyed as approved and particular attention to be given to curing. The tiles shall be fixed to this rendered backing with a paste of cement.
- b. Surfaces to receive the ceramic tiling shall be clean and free of dirt, dust, oil, grease or other objectionable material.
- c. After having been immersed in clean water for a minimum of 7 hours, until saturated the tiles shall then be bedded in a bedding coat of cement paste, all to the approval and instructions of the Engineer.
- d. Tiles shall be set out carefully and bedded to a true vertical face, square and plumb, aligned in accurate continuous horizontal and vertical courses to an un-bonded pattern so as to give regular joint widths of approx. 2 mm if spacer nibs are not provided.
- e. Tiled areas shall be cured when set by continuous wetting for a minimum period of 3 days.
- f. When cured, tile joints shall be pointed with a liquid neat white Portland cement grout in matching color so as to fill each joint solidly and continuously. When set, joints shall be finger-smoothed off to an even concave profile.
- g. Tiles where required to be cut shall be marked off and cut with approved tools perfectly square and true, with no chipped or cracked edges. Cut tiles shall generally be positioned on the perimeters, and setting-out should be carefully carried out to ensure this. Tiles shall similarly be carefully and cleanly cut around pipes, fixings and other projecting components.

**19.06 PROTECTION**

The completed works or parts thereof shall be protected by the Contractor against any damage. The works shall be handed over in perfect condition. If any damage is incurred then the Contractor shall remove and/or replace the same at no additional costs. The Contractor shall exercise all care to protect the works executed by other trades and not covered by his Contract. Any damage to these shall be made good and the works restored at no additional cost.

**19.07 MEASUREMENT AND PAYMENT**

Wall tiling work covered under this section of Specifications, complete and approved, will be measured and paid for per square meter including preparations, rendered backing, tile adhesive, grouting and pointing etc. at the respective individual item rates entered in the Bill of Quantities and generally in accordance with the applicable terms and Conditions of the Contract.

\*\*\* END OF SECTION \*\*\*

## **SECTION - 20 SUSPENDED CEILING**

### **20.01 SCOPE OF WORK**

The Work under this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with the installation of suspended ceilings at locations shown on the Drawings, complete in strict accordance with this section of the Specifications and applicable Drawings and subject to the terms and conditions of the Contract.

### **20.02 GENERAL**

- a. Suspended ceilings to be provided at the project shall be Gypsum Board Ceiling:
- b. All the suspended ceilings shall be installed in conformance with British Code of Practice: CP 290.
- c. In most cases, ceilings are intended to conceal or contain services. The Contractor shall liaise directly with the mechanical and electrical services specialists and following this shall prepare detailed reflected ceiling plans and shop drawings of each area of ceiling indicating the intended method of framing, tile layout, position of electrical light fittings & smoke detectors etc. for the approval of Engineer. Requirements for removable access panels shall be determined by the services specialists and indicated on the drawings accordingly. Suspended ceilings shall then be installed as per the approved shop drawings.
- d. Suspended ceilings shall be installed by specialist subcontractors as per the recommendations of the manufacturers in conformity with the approved shop drawings and to the approval of the Engineer.

### **20.03 SAMPLES**

- a. The Contractor shall provide samples of gypsum board ceiling tiles, and proposed suspension and framing systems for the selection and approval of the Engineer. The samples shall be in finished sizes and shape, the cost of which shall be deemed to be included in the rates. The approved samples shall be retained by the Engineer to form standards against which deliveries will be judged.
- b. All the materials shall be supplied from the approved manufacturers as per the samples approved by the Engineer.

### **20.04 MATERIALS AND INSTALLATION**

#### **Gypsum Board Ceiling**

Gypsum board ceiling shall comprise of gypsum board tiles, 12 mm thick, fixed to the framing.

Framework to be fabricated from wooden runners or galvanized steel metal frame. Sizes of sections to be appropriate to spans and framing conditions so that a perfectly stable and rigid result is achieved.

Boards are to be fixed to the framework with rustproof self-tapping screws/nails with heads countersunk and filled. Gaps between boards are to be filled with a suitable inert filler and the wholesurface sanded off so as to produce a perfectly plane smooth matching surface.

Removable access panels shall be provided where indicated on the approved reflected ceiling plans. The panels shall be secured by suitable rustproof proprietary fixing devices.

#### **Propriety Acoustic Suspended Ceiling Systems**

The suspended ceiling systems shall be from approved suppliers/ manufacturers all propriety ceilings shall be inclusive of all suspension system steel framing, trims angles exposed or concealed grid system subject to approval of the Engineer.

#### **Approved Manufacturers**

- U.S. Gypsum
- Armstrong
- Or other approved suppliers, manufacturers

#### **Dampa Acoustic Metal Pan Ceiling Systems**

The suspended aluminum ceiling systems shall be from approved suppliers/ manufacturers all

propriety ceilings shall be inclusive of all concealed/ exposed system as recommended by the manufacturers and approved by the Engineer. Various whole sizes and perforation patters in conformation with colored acoustic felt bonded to the reverse side of the tiles shall be used to achieve optimal acoustics. All panels must achieve NRC rating of 0.75 ASTM minimum panel size shall be 600mm x 600mm.

Approved Manufacturers

- Dampa U.K
  - Thermec Engineering (PVT) LTD.
  - Or other approved suppliers, manufacturers
- Other Ceiling Systems
    - Mineral fiber Acoustical Ceiling Tiles.
    - Glass fiber Insulation board adhesive applied to chip board panels
    - False Ceiling comprising of Fur Wood Planks.
    - False Ceiling of Fur Wood planks with deodar wood facia

**20.05** WORKMANSHIP

- a. The installation of suspended ceiling shall be carried out by approved specialist subcontractors with adequate experience in this field.
- b. The Work shall generally by executed in accordance with best practice; members shall be cut, drilled and framed, joints made, fixings positioned and made, and work assembled and fixed generally in accordance with approved shop drawings and manufacturers recommendations.
- c. The workmanship shall generally comply with the standards set out in CP 290.
- d. All suspended ceilings shall be set out and installed in accordance with the details shown on the approved reflected ceiling plans and shop drawings and no modification in form or detail may be made except with the specific approval of the Engineer.
- e. All fixtures shall be fixed as per approved plans.
- f. No suspended ceilings shall be fixed until all wet trades and services above have been completed.

**20.06** PROTECTION

- a. All the suspended ceilings shall be protected throughout the Contract period.
- b. Any damage occurring to the suspended ceiling before the Contract completion from whatever cause shall be made good or replaced at Contractor's cost, all to the approval of the Engineer.

**20.07** MEASUREMENT AND PAYMENT

Suspended ceilings shall be measured per square meter and paid at the unit rates entered in the Bill of Quantities inclusive of all framing, suspension system, accessories, painting, access panels, recesses for lights etc., complete in all respect.

\*\*\* END OF SECTION \*\*\*

## SECTION - 21 EXTERNAL WALL CLADDING

### 21.01 **SCOPE OF WORK**

The Work covered under this subsection of Specifications consists of Supplying, providing and fixing of Sand blasted Thatta Stone, over all external surfaces where shown in drawings. The work will include all labour, tools, scaffolding, hoisting equipment, appliances and materials of every kind and character; and in performing all operations in connection with procurement, transportation and delivery, supply and installation/ fixing of Thatta Stone, complete in all possible respects, in strict accordance with requirements of applicable Drawings and Bill of Quantities as specified herein, and to the entire satisfaction of the Engineer and subject to the terms and conditions of the Contract.

### 21.02 **APPLICABLE STANDARDS**

- ASTM C1063 - Standard Specification for Installation of Lathing and Furring to receive Interior and Exterior Portland Cement-Based Plaster.
- ASTM C1780 - Standard Practice for Installation Methods for Adhered Manufactured Stone Masonry Veneer.
- International Building Code Council, IBC

### 21.03 **MATERIAL**

Thatta Stone Slab Cladding, Jang Shahi Stone or any other approved natural sandstone

### 21.04 **EXECUTION / INSTALLATION**

The installation of Thatta stone shall be carried out by approved specialist subcontractors with adequate experience in this field.

The Work shall generally be executed in accordance with best practice; stones shall be set and layered, joints made, fixings positioned and made, and work done generally in accordance with approved shop drawings and to the approval of the Engineer in charge and architect recommendations.

The subcontractors will prepare a mock-up, for Architect's approval, before start of stone work and will prepare additional mock-ups, if required by Architect, until approved, as described below:

#### **Mock-Up:**

At location directed by Architect, install minimum 48 inch (1219 mm) long by 48 inch (1219 mm) high sample wall panel using specified stone, trim, accessories and substrate construction to show:

- a. Substrate preparation.
- b. Water resistant barriers.
- c. Stone setting method.
- d. Stone pattern, texture, and color range.
- e. Mortar joint size, color, and profile.
- f. Opening details.
- g. Flashing.
- h. Inside and outside corners.
- i. Trim pieces.
- j. Workmanship.

Maintain approved mock-up during construction to establish required standard of workmanship, and basis of comparison for installation of stone work. Do not remove approved mock-up until directed by Architect.

- a. Shape of stone to fit each other approximately. Knock off weak portions to bring stones to even bearing.
- b. The general pattern for sandstone veneer is to be 2 against 1, a few 3 against 1, and some 2 against 2. no 3 against 3 will be permitted.
- c. No continuous horizontal joints to exceed 7 FT in length unless specifically requested
- d. Provide vertical joints at 12 feet intervals. 20% of vertical joints may be angled.
- e. Clip 60% of sandstone units on both ends for an average projection of 1 1/2" from face of wall.

- f. Cut stone at building corners to a straight vertical line from top to bottom of wall.
- g. Grout the void between stone and backup with slush mortar as stone is laid.
- h. Joints: 1/2 IN to 3/4 IN wide.
- i. Provide both vertical and beveled head joints. Work all joints so that all joints are in the same plane.
- j. Provide 4l minimum overlap in coursing.
- k. Completed stone work shall match accepted mock-up panel.
- l. Do not use stone units with chips, voids, stains or other defects which might be visible in the finished work.
- m. Maintain pattern consistency throughout building.

**21.05 BUILT-IN ITEMS:**

- a. **Steel Door Jambs:** Grout steel door jambs set in masonry full of mortar as wall is built.
- b. **Flashings:** Ensure that flashings are in proper place before proceeding with stone work.
- c. **Accessories:** Install weep holes, fabric flashing and other accessories in accordance with
- d. **Control Joints:**
  - Install vertical control joints at approximately 20 FT on center (or other spacing as indicated) and at column lines.
  - Some latitude in spacing increases may be acceptable if approved by Architect and Owner.
  - Relate joints to building design.
  - Saw cut 1/8 IN joints after stone is laid

**21.06 MEASUREMENT & PAYMENT**

All work done under this section shall be measured per square meter and paid at the unit rates entered in the Bill of Quantities. Thickness tolerance will be measured to the nearest 1/2".

\*\*\* END OF SECTION \*\*\*

## **SECTION - 22 WATER RETAINING STRUCTURES**

### **22.01 SCOPE OF WORK**

The Work covered under this subsection of Specifications consists of furnishing all labour, tools, scaffolding, hoisting equipment, appliances and materials of every kind and character; and in performing all operations in connection with procurement, transportation and delivery, supply and installation of special provisions for water retaining structures to ensure water tightness in all possible respects in strict accordance with requirements of Drawings and Bill of Quantities as specified herein, and to the entire satisfaction of the Engineer and subject to the terms and conditions of the Contract.

### **22.02 GENERAL**

- a. Special consideration shall be given to the control of cracking and the provision of dense impervious concrete. Special consideration will also be given to the design of the concrete mix and to the supervision of the placing and compacting in order to provide a dense impermeable concrete. The mix shall be of the stiffest consistency having a workability which will ensure that it can be satisfactorily placed in the formwork and compacted without risk of segregation, honey- combing, sweating or bleeding. Special care shall be given to the method and order of placing the concrete and to the construction of joints in order to achieve full continuity and complete water tightness.
- b. The Contractor shall maintain an accurate record of ambient temperature at Site.
- c. Ambient temperature shall be measured using mercury thermometers or other thermometers acceptable to the Engineer.
- d. Throughout the concrete work, the Contractor shall employ full time on the Works suitable number of qualified and experienced Engineers whose sole duties shall be as follows;
  - Design of concrete mixes
  - Control of quality of concrete
  - Supervision of mixing, transporting, placing, compacting, finishing, curing and protecting concrete including thermal control of concrete pours.
  - Supervision of sampling and testing.
  - Preparation and submission of test certificates and reports.
  - Compilation and keeping of record.
  - Such other duties as the Engineer may direct.

### **22.03 CEMENT CONTENT**

The minimum cement content for all water retaining structures shall be 385 kg/m<sup>3</sup> and the maximum cement content of 500 kg/m<sup>3</sup>. The maximum water-cement ratio shall not exceed 0.42.

### **22.04 ADMIXTURES**

- a. Suitable admixtures from BCR, Sika, Fosroc, Betocrete C-16or Master Builders may be used in concrete mixes with the prior approval of the Engineer. The amount of admixtures added to each batch of concrete requires careful control and shall be added in the doses as recommended by the manufacturers and approved by the Engineer. The cost of the admixtures shall be deemed to be included in the rates. The Contractor shall strictly follow the instructions of the manufacturers and the wall finishes shall be applied accordingly.

Wall tiling to internal and external walls and fascia shall be fixed true to the line level and plumb in approved manner satisfactory to the Engineer. All tiles shall be aligned properly with straight joints in even widths.

Any work covered under this section of the Specifications, not conforming to the requirements of the specified quality and workmanship will not be acceptable and shall be rejected by the Engineer, and the Contractor shall be required to remove and replace such work without any claim at his own cost as per the instructions of the Engineer.

### **BEDDING AND JOINTING**

- a. The tiles shall be fixed to the walls over a rendered backing as described below:  
**Rendered Backing**  
The tiles to be fixed to walls shall be fixed on a rendered backing. Walls to be tiled are to be prepared exactly as for rendering/plastering. A 10 mm thick cement sand render coat shall then be applied exactly as described for plastering in a ratio of 1:4. The surface to be scratch-keyed as approved and particular attention to be given to curing. The tiles shall be fixed to this rendered backing with a paste of cement.
- b. Surfaces to receive the ceramic tiling shall be clean and free of dirt, dust, oil, grease or other objectionable material.
- c. After having been immersed in clean water for a minimum of 7 hours, until saturated the tiles shall then be bedded in a bedding coat of cement paste, all to the approval and instructions of the Engineer.
- d. Tiles shall be set out carefully and bedded to a true vertical face, square and plumb, aligned in accurate continuous horizontal and vertical courses to an un-bonded pattern so as to give regular joint widths of approx. 2 mm if spacer nibs are not provided.
- e. Tiled areas shall be cured when set by continuous wetting for a minimum period of 3 days.
- f. When cured, tile joints shall be pointed with a liquid neat white Portland cement grout in matching color so as to fill each joint solidly and continuously. When set, joints shall be finger-smoothed off to an even concave profile.
- g. Tiles where required to be cut shall be marked off and cut with approved tools perfectly square and true, with no chipped or cracked edges. Cut tiles shall generally be positioned on the perimeters, and setting-out should be carefully carried out to ensure this. Tiles shall similarly be carefully and cleanly cut around pipes, fixings and other projecting components.

### **PROTECTION**

The completed works or parts thereof shall be protected by the Contractor against any damage. The works shall be handed over in perfect condition. If any damage is incurred then the Contractor shall remove and/or replace the same at no additional costs. The Contractor shall exercise all care to protect the works executed by other trades and not covered by his Contract. Any damage to these shall be made good and the works restored at no additional cost.

- b. For use of an admixture, the information required by the Engineer shall be submitted to him for each admixture for his approval.

### **22.05 JUNCTION OF FLOOR AND WALL**

Where the walls are designed to be monolithic with the bottom slab and beam system, a continuous upstand section of the wall shall be cast at the same time integrally with slab. A suitable arrangement of the reinforcement and formwork shall be made to facilitate this. The height of this upstand, which shall not be less than specified shall be sufficient to enable the next lift of formwork to fit tightly and avoid leakage of the cement paste from the newly deposited concrete. Such leakage, where it occurs is liable to cause porosity in the finished concrete and is not acceptable.

### **22.06 PIPES THROUGH WALLS AND FLOOR**

When it is necessary for pipes to pass through a wall or bottom floor, it is preferable to cast the pipes into the panel when it is concreted. If this is not practicable, it will be necessary to box out. In either case, it is desirable that the position of the pipe shall not coincide with a joint. When an opening has been boxed out the sides of the opening shall be treated as construction joint.

All piping and fittings shall be tested as a unit for leaks immediately prior to concreting. The testing pressure above atmospheric pressure shall be fifty (50) percent in excess of the pressure to which the piping and fittings may be subjected but the minimum testing pressure shall be not less than 1.0 N/mm<sup>2</sup> 150 psi above atmospheric pressure. The pressure test shall be held for four hours with no drop in pressure except that which may be caused by air pressure.

No liquid, gas or vapour, except water not exceeding 32°C nor 0.135 N/mm<sup>2</sup> pressure, is to be placed in the pipes until the concrete has thoroughly set.

The concrete cover of the pipes and fittings shall be not less than 1½ inch. The piping and fittings shall be assembled by welding, brazing, solder seating, or other equally satisfactory method. Screw connections shall be prohibited. The piping shall be so fabricated and installed that it will not require any cutting, bending, or displacement of the reinforcement from its proper locations.

Drain pipes and other piping designed for pressure of not more than 1 psi above atmospheric pressure need not be tested.

**22.07 ARRANGEMENT OF REINFORCEMENT**

Particular attention shall be given to the spacing of reinforcement at points so that access to the concrete surface can be provided to enable it to be prepared to receive the following batch of concrete.

The length of lap and anchorage provided shall be in accordance with the requirements of ACI 318- 95.

**22.08 FORMWORK**

Ties used to secure and align the formwork shall not pass completely through any part of the water retaining structure unless effective precaution can be taken to ensure water tightness after their removal. The ends of any embedded ties shall have cover equal to that required for the reinforcement. The gap left from the end of the tie to the face of the concrete shall effectively be sealed. Any steel left in the structure shall be adequately protected against corrosion.

**22.09 CONSTRUCTION**

The degree of success in achieving a watertight structure depends on the quality of workmanship in making and placing concrete, good on-site organization, proper ground water control, clean and dry excavation, careful storage of materials, close-fitting formwork, correctly fixed reinforcement and clean joints.

It is essential that the concrete, when placed, is thoroughly compacted to form a dense uniform mass. The mix shall be of adequate workability and compaction by vibration. Immediately after the removal of formwork, the concrete surface shall be carefully inspected and any defects made good as soon as possible.

**22.10 CURING**

Even after minimum curing period specified in the clause pertaining to curing in the Specifications for Plain and Reinforced Concrete, it may be desirable to prevent drying of the concrete and to restrict the range of temperature changes which it is subjected to.

**22.11 INSPECTION AND MAKING GOOD**

**a. Inspection of Defects**

- (i) Surfaces exposed after stripping shall be inspected by the Concrete Engineer of the Contractor, together with the Engineer. The following standards shall be valid for the assessment of the concrete quality:
- The appearance of the concrete surface must conform to the specified classification of finish, refer to Subsection 3.04.2.
  - The concrete surface must be uniformly smooth, even and free of ridges and other irregularities,
  - The concrete must have a pore-free, dense surface on all sides with no evidence of segregation or inadequate compaction,
  - No reinforcing bars may be exposed or signs be present, which indicate an inadequate concrete cover of the reinforcing bars,

- No hair cracks shall be visible.
- (ii) During the inspection, the Engineer will determine the type and extent of defects to be eliminated and ascertain if cracks are still moving.
- (iii) The Contractor is obligated, if necessary and applicable, undertake the following in accordance with para (iii) below:
  - To expose reinforcing bars, which apparently have an inadequate concrete cover, in the area determined by the Engineer and to bend them inward through suitable measures.
  - To caulk out honeycombs and similar defective spots, which are traceable to segregation of the concrete.
  - To pressure-grout damaged areas, cracks, etc.,
  - To seal all hair cracks of a measured width of more than 0.05 mm, with suitable and recognized epoxy resin material.
  - To seal all holes resulting from the removal of formwork bolts and the like.
  - To demolish and reconstruct such structural concrete members which cannot satisfactorily be repaired or which are otherwise unfit for the Works in the Engineer's opinion.
  - To propose and apply a proven system or measures according to the type and extent of the defect, as set out in para (iii) below in order to achieve a result and appearance acceptable to the Engineer.

**b. Patching & Repair**

- (i) Apply a cementitious repair material approved by the Engineer. The proprietary cementitious repair material, bonding agent and application method shall meet the following criteria:
  - The repair material shall be cementitious and shall possess a similar thermal coefficient to the base concrete.
  - The repair material shall have shrinkage compensating characteristics.
  - The bonding agent shall be compatible with both the existing concrete and the repair material.
  - The system shall exhibit long term durability.

The proprietary cementitious repair material and bonding agent shall be stored, applied and cured in accordance with the manufacturer's requirements and recommendations.

Finish the cementitious repair material to a straight line with the existing surface, to the profile of the original undamaged concrete section.

The Engineer may direct that where the cover to the existing reinforcing is insufficient, the repair may protrude beyond the existing concrete face. The protruding edges of the repair shall then have a 45° chamfer, and shall be horizontal or vertical to provide a pleasing finish.

The Engineer's evaluation of the Contractor's proposed materials and application method shall be based on the above criteria.

The Contractor shall submit full details and specifications of his proposed materials and installation methods to the Engineer for approval prior to commencement of work. This shall include certificates of approval from competent authorities to prove their suitability.

- (ii) Patching work shall begin at the latest 24 hours after stripping, however it shall in no case be undertaken prior to carrying out the joint inspection of the concrete by the Contractor and the Engineer.
- (iii) Patching and repair work shall be executed only through qualified personnel using high quality and recognized materials, e.g., concrete and cement or special mortar. A special bonding agent such as suitable epoxy resin and the like, of first-class quality shall be used where appropriate, to also ensure good bonding and adequate denseness in the joints.
- (iv) All costs for repair and patching work are to be borne by the Contractor.

**c. Sealing of Cracks**

- (i) Cracks detected in concrete members cast by the Contractor, are to be sealed according to the directives of the Engineer, provided cracked structural concrete members are not rejected by the Engineer.
- (ii) All cracks identified by the Engineer as requiring remedial work shall be sealed by injection of epoxy resin to a maximum depth of 4l from the exposed surface. The surface of the cracks must be cleaned. Injection nipples are to be provided at 6l to 12l intervals and the remaining surfaces of the cracks are to be sealed with a thixotropic epoxy resin compound. Prior to the injection, the crack shall be cleaned of dust etc. by blowing oil free and clean compressed air through all the injection nipples. In case of cracks in vertical or sloped walls, the injection must start at the lowest nipple.
- (iii) The epoxy resin shall be Fosroc Nitokit TH System or product of equivalent or better performance and as approved by the Engineer. Epoxy injection shall be in accordance with the manufacturers written instructions. Note that on completion of injection and curing of the epoxy, the nipples are to be removed and the exposed surfaces ground or scraped smooth (following heating with a hot air gun) to provide a smooth, even and tidy finish restoring the original profile).

**22.12 MEASUREMENT & PAYMENT**

All work done under this section shall be paid under relevant respective works; i.e. concrete, reinforcement, formwork, waterproofing etc.

**\*\*\* END OF SECTION \*\*\***

## SECTION – 23 POLYVINYLCHLORIDE (P.V.C) WATER STOPPER AND SWELL BARS

### 23.01 SCOPE OF WORK

The work comprises of providing all labour, tools, equipments, to install, place and fabricate in position and locations rubber water stops together with all jointing and sealing materials as per recommendations, specifications of the Manufacturer and instructions. All embedment in concrete, lapping, turning, sealing shall ensure absolute water tightness subjected to any pressures. The workmanship and operation shall be perfect and guarantee leak proof at places wherever used in the structure.

### 23.02 MATERIAL REQUIREMENTS

Polyvinylchloride water stop shall be extruded from an elastomeric plastic compound, the basic resin of which shall be polyvinylchloride (PVC). The compound shall contain such additional resins plasticizers stabilizers or other materials needed to ensure that when the material is compounded and extruded to the shapes and dimensions shown, it will have physical characteristic when tested by U.S. Corps of Engineers Test Method specified below:

Physical Characteristic	No. of Specimens Tested	Requirement	Test Method
Tensile strength using die III, not less than	5	1750 psi	568
Ultimate elongation using die III, not less than	5	350%	573
Low temperature brittleness, no sign of failure such as cracking or chipping at	3	(-) 35 F	570
Stiffness in flexure, 1/2l span, not less than	3	400 psi	571

**Swell Bar** is a flexible, hydrophilic water stop based on synthetic rubber, with cross-sectional dimensions of 20 mm by 10 mm, applied with the help of adhesive which is used to secure the swell bar to the concrete substrate and around penetrations.

Swell bars of approved make shall satisfy provisions of a Type B (structurally integral) protection as defined in BS 8102: 2009 to waterproof construction joints and penetrations in underground waterproof reinforced concrete structures.

### 23.03 CONSTRUCTION REQUIREMENTS

Splices in the continuity or at the intersections of runs of PVC water stoppers shall be performed by heat sealing the adjacent surfaces in accordance with the Manufacturer's recommendations or as directed.

A thermostatically controlled electric source of heat shall be used to make all splices. The correct temperature at which splices should be made will differ. With the material used but should be sufficient to melt but not char the plastic. After splicing, a remoulding iron with ribs and corrugations to match the pattern of the water stoppers shall be used to reform the ribs at the splice. The continuity of the characteristic components of the cross section of the water stoppers design (ribs, tabular centre axis, protrusions, and the like) shall be maintained across the splice.

The expansion joints wherever indicated on drawings shall have centre bulb rubber water stops or its equivalent as indicated on drawings to be cast integrally with the in-situ-concrete of retaining walls, beams, columns, slabs or at any locations marked on the drawings incorporating junction places or as straight lengths with separate intersection pieces to be jointed at site as per Manufacturer's recommendations and Specifications. The water stops shall be installed so as to hold them securely in their correct position during the placement of concrete. The concrete shall be fully and properly compacted around the water stops to ensure that no voids or porous areas remain. Where reinforcement is present adequate clearance shall be left between water stoppers and the reinforcement to permit proper compaction of concrete. No holes shall be made through any water stops. Hot or cold vulcanising for jointing places of water stoppers at site shall be done with the prior Approval in accordance with the Manufacturer's recommendations and specifications.

**23.04 MEASUREMENT**

Measurement will be made of the number of linear feet/meters of Polyvinylchloride water stoppers of the size and gauge shown on the drawings acceptably placed in the work. In computing the quantities, no allowance will be made for laps.

**23.05 RATE AND PAYMENT**

Payment will be made for the number of Linear feet/meters measured as provided above at the contract unit price per Ft/M. for Furnishing and installing polyvinylchloride water stoppers and shall include full compensation for splicing materials, splicing, sealant and all other work related to the section.

**\*\*\* END OF SECTION \*\*\***

## **SECTION 24 WATERPROOFING OF BASEMENTS, TANKS AND BELOW-GRADE STRUCTURES**

### **24.01 SCOPE OF WORK**

The Work covered in this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in connection with the supply and installation of waterproofing of basements, pools, tanks and below grade structures, complete in strict accordance with this section of the Specifications and the applicable Drawings, Bill of Quantities and subject to the terms and conditions of the Contract.

### **24.02 GENERAL**

The Contractor shall be completely responsible for the supply and proper installation of the specified waterproof membrane system, or its equivalent, to make the basement structure absolutely watertight. All membrane material shall be new and shall comply with the specified material requirements. The Contractor shall produce testing certificates to verify that the membrane meets the specification and is suitable for the end use intended.

The Contractor shall engage a qualified waterproofing specialist as a sub-contractor to supply, install and protect the waterproof membrane system, all in accordance with the membrane manufacturer's recommendations. The waterproofing specialist shall be approved by the Engineer and shall be selected on the basis of past track record, technical reliability, capability and willingness to supply technical assistance, and reputation for standing behind his product and work. The Contractor shall submit the name of his Specialist Contractor at the time of tender.

All basement and below-grade structures (including lift pits, water tanks, fuel tanks, etc) shall be protected by a water proof membrane all round, of the type complying with clause 14.07.

The Contractor shall be responsible for the implementation and maintenance of a temporary dewatering system to keep the Site dry at all times for proper installation of the membrane system. Where relief holes and/or relief panels are required to be left in the basement structure to prevent hydro-static uplift during the construction stage, these shall be cast back with full water proofing treatment following completion of the superstructure and/or when directed by the Engineer.

### **24.03 PERFORMANCE GUARANTEE**

The Contractor shall provide a ten (10) year guarantee for water tightness of the basement, swimming pools, tanks and/or other below-grade structures (including lift pits), effective from the date of completion of the whole Works. The guarantee shall be submitted in the specified format and shall be subject to the approval and acceptance by the Employer.

Should any leak, moist lines, points or patches occur during the guarantee period, the Contractor shall immediately carry out the necessary remedial works, to restore the water tightness of the structure, at no cost to the Employer.

The Contractor shall make good damages to all finishes (such as plaster, paint, panelling, tiling, etc.) electrical or other installations, or other property, caused by water leakage or dampness. Alternatively, he shall reimburse the Employer for making good such damages.

### **24.04 SHOP DRAWINGS**

The Contractor shall provide the Engineer with comprehensive shop drawings showing all details and procedures for the relevant parts of the Works. Reasonable time shall be allowed for checking by the Engineer in programming the production of shop drawings. Delays caused by the late submission of shop drawings or repeated amendments of drawings due to inadequate or inaccurate drawings will not be recognized as a reason for extension to the contract time.

The manufacturer's standard application details shall be used only as a guide for the preparation of shop drawings. The Contractor is deemed to have taken due consideration of the particular requirements of this contract based on the tender documents. Where necessary, the Contractor is expected to improve upon the manufacturer's standard details to suit the project requirements and such amendments shall be shown in shop drawings for approval by the Engineer. The Contractor shall not be entitled to extra contract cost and/or time in this respect.

#### **24.05 CONCRETE CONDITIONING**

The membrane material shall be compatible with the surface of concrete. The use of curing compounds, release coatings on concrete forms, or admixtures in the concrete that interfere with the adhesion of the barrier material to concrete shall not be permitted.

Curing compounds shall not be used on concrete surfaces unless the Contractor can conduct field tests to demonstrate that complete removal of the compound can be achieved before application of the membrane. Alternatively, the Contractor may perform field tests to establish the compatibility of the compound with the membrane materials and the concrete surface.

Release agents such as oil, wax, grease and silicone which transfer to the concrete surface during placement, and contribute to poor adhesion between membrane system and concrete, shall not be used. The use of proprietary paint systems applied to forms and formulated to prevent contamination of the concrete surface, or the use of polyethylene lined forms, may be considered.

Special purpose admixtures, such as water-immiscible chemicals intended to retard evaporation of water during cure, may create adhesion problems and shall not be used.

#### **24.06 CONCRETE SURFACE PREPARATION**

- i. Surface defects, including tie holes, unless otherwise specified in the Contract Documents, shall be repaired immediately after form removal. All honeycombed and defective concrete areas shall be removed down to sound concrete which shall then be cleaned. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. No feather edges shall be permitted.
- ii. Unless specifically recommended by the membrane material manufacturer, normal mix Portland cement-based patching materials shall not be used for the repair of small surface voids and rutted cracks on account of their relatively poor adhesion to cured concrete. Such repair shall be affected with suitable resin-based materials composed of the same resin found in the protective membrane material mixed with inert fillers, but the specific recommendation of the membrane system manufacturer shall be obtained before using such materials for patching. Coarse aggregate shall be omitted.
- iii. Large surface voids and rutted cracks shall be dry packed with graded aggregate and pressure grouted with suitable non-shrink cementitious mortar.
- iv. The quantity of mixing water shall be limited to that necessary for handling and placing. The patching material shall be thoroughly mixed to the extent that it is the stiffest consistency that will permit placing.
- v. The area to be patched and a band at least 150mm wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. After surface water has evaporated from the area to be patched, an approved bonding agent shall be well brushed into the prepared surface. The premixed patching mortar shall be thoroughly consolidated into place, struck off so as to leave the patch slightly higher than the surrounding surface and left undisturbed for at least 1 hour to allow for some initial shrinkage before being finally finished. The patched area shall be kept damp for 7 days.
- vi. Proprietary compounds may be used in lieu of, or in addition to, the foregoing patching procedures. Such compounds must be used strictly in accordance with the manufacturer's recommendations. Specific approval from the membrane manufacturer shall be obtained before proprietary compounds are used for patching. These materials shall be compatible with the membrane system and the concrete, and not interfere with good adhesion between the two.
- vii. Fins, protrusions or similar irregularities projecting from the concrete surface shall be removed back to the surface by chipping, bush-hammering, needle-gunning, or wire brushing. Care shall be exercised to obtain a reasonably planar surface for application of the membrane system. Sharp offsets in the surface, such as those caused by formwork misalignment, shall be mechanically abraded to provide gradual and smooth transitions between the offset surfaces.

- viii. The Contractor shall employ a suitable method of repair to stop any seepage or flow of water into or through the concrete structure prior to application of the membrane system. The method of repair shall depend on the type of defects present in the concrete and the source of water.
- ix. Generally, surfaces shall be dry and must be newly exposed concrete, free of chemical contaminants and loose, weak or unsound materials.

#### **24.07 MATERIAL**

- i. The waterproofing membrane shall be applied in double layers, each layer shall be a self-adhesive 2.0 mm thick water-proofing sheet membrane, Aquafin-Latexl or equivalent, consisting of a non-woven polyester, coated on both sides with an elastomeric bitumen compound. The upper surface of the membrane is covered with polyethylene film with 8 cm strip of siliconized release paper and the lower surface is fully covered with siliconized release paper to protect the adhesive side of the rolls during storage and is removed just prior to application. Joining of seams shall be only by hot air welding without any use of adhesives or solvents. Proper accessories such as preformed corners, outlets, pipe collars and terminations shall be used. The waterproofing membrane shall conform to ASTM Standards D-146, D412 and D751.
- ii. The 2.0mm thick waterproofing membrane shall have high biaxial strength, elongation and puncture resistance. It shall be resistant to most chemicals including all ground chemicals and be root-impenetrable. All joints shall be hot air welded with double seams with a test channel for integrity verification.
- iii. The waterproofing membrane shall be terminated at the top of vertical walls, pile caps, etc. by heat-welding to double anchor strips or mechanical fastening by using an adhesive underlay (Heat-seal or an approved equivalent). The adhesive underlay shall be capable of providing an excellent bond between the waterproofing membrane and substrate. Termination using only liquid-applied sealants is not acceptable.
- iv. The water-proofing membrane for walls shall be covered with cement-sand mortar layer protected by block wall, as shown on the Drawings.
- v. Prior to commencement of waterproofing treatment, the Contractor shall submit shop drawings for each waterproofing detail and endorsed by the manufacturer or his approved representative. These are to be approved by the Engineer. The shop drawing shall be on a CAD-recognizable format and A1 or AO size.

#### **24.08 METHOD OF CONSTRUCTION**

Generally, the application procedures shall be consistent with the Manufacturer's recommendations.

The procedure of work shall be as follows unless otherwise modified by the Engineer to suit the site and project requirements.

- a) At formation level, install proper drainage system including dewatering system, drain channels, sumps and pumps, to ensure dry site conditions. Lay stone soiling and concrete screed as specified. Concrete surface shall be smooth wood float finish.
- b) The concrete surface shall be prepared in accordance with the requirements of the clause headed —Concrete Surface Preparationl in this Specification. The surface shall be free of sharp projections such as nail heads, concrete ribs, etc.
- c) The waterproofing shall be a well-designed system installed by a single Specialist Waterproofing Contractor strictly according to the recommendations of the manufacturer.
- d) The waterproofing membrane shall be identified with the manufacturer's inscriptions on the packaging.
- e) The waterproofing membrane shall be rolled out lengthwise and aligned with an adjoining membrane to form an overlap joint of 50mm. A special hand operated hot-air welding gun or versions of the automatic welding machine shall then be used to fuse the membranes together and weld the overlap.
- f) If required, single anchor strips shall be welded to the waterproofing membrane bi-directionally to provide structural anchoring to the base slab and create watertight compartments at not more than 100 sq.m grid.
- g) The waterproofing membrane may be terminated to pile caps, ground beams using double anchor strips or an adhesive underlay.
- h) If an adhesive underlay is used for termination, the concrete surface shall be primed with an approved primer prior to the installation of the adhesive underlay. The waterproofing membrane shall be terminated by using an adhesive underlay to bond the membrane to the structure and thereafter mechanical fastening it. The minimum widths for the termination using adhesive underlay shall be 250mm at ground beams, pile caps. The membrane shall be terminated using the same termination methods.

- i) The waterproofing membrane shall be terminated at the top of the vertical walls at least a 300mm minimum above ground level by only using double anchor strips.
- j) For horizontal below ground areas, the waterproofing membrane shall be protected with a minimum 25mm thick 1:3 cement and sand screed render prior to the commencement of further construction activities.
- k) For vertical surfaces, the waterproofing membrane shall be covered with the approved protection material prior to backfilling.

#### **24.09 Membrane Flashing**

Flashing shall be provided at the line or joint where the membrane will terminate, particularly at the diaphragm walls and pile foundations. The flashing material used shall be of approved and durable type, and shall be resistant to weathering and mechanical damage. The flashing material shall be compatible with all other material employed in the membrane system and shall not cause chemical reactions when in contact with the latter.

The surface of adjoining building elements that are used to form the terminus of the waterproofing membrane shall meet the same requirements as the surfaces that receive the barrier. A treated timber nailer or equivalent device shall be used to mechanically secure the top edge of the flashing material according to the manufacturer's recommendations. Reglets shall not be used as a substitute for a nailing strip or device.

Flashing materials shall be the same as or compatible with those used in the waterproofing system. Compatibility shall be determined by the membrane manufacturer.

#### **24.10 JOINTS**

The waterproofing specialist shall give careful consideration to the design of membrane details at expansion, contraction and construction joints in the concrete substrate to minimize damage to the membrane due to differential movement.

Where the movement of soil substrate supporting horizontal membrane is likely to occur, the waterproofing specialist in association with the Contractor shall take appropriate measures as necessary to ensure the integrity of the membrane is not compromised.

#### **24.11 MEMBRANE PROTECTION**

Membrane protection shall be applied immediately following the application and testing of the waterproofing membrane. No membrane material shall be left permanently exposed for any period of time after installation.

The Contractor shall take immediate steps to cover up the Works following the application of membrane protection. If for any reason the Works cannot be covered up immediately, the Contractor shall be responsible for taking all necessary and approved measures required either to protect the membrane material from damage or if damage of the material has occurred, to make good all such damage, for the duration of exposure of the Works prior to covering up.

#### **24.12 WATER TESTING**

Water tightness test of below-grade holding structures shall be carried out in full compliance with BS 8007 Section 9, all at the Contractor's expense within contract period. Any leaks found shall be rectified at the Contractor's expense and re-tested to the Engineer's satisfaction.

Where required by the Engineer, water testing shall be carried out to check the performance of horizontal membrane applications. The area to be tested shall be flooded with at least 25mm of water. Drains shall be plugged and kerbings (temporary or permanent) shall be formed to retain the water for a period of at least 24 hours. Any leaks found during this period shall be repaired in accordance with the manufacturer's recommendations and the area shall then be retested. Before repairing the surfaces, they shall be dry.

Where it is impractical to water test an area because the slope of the substrate would produce excessive water depths, the membrane shall be tested by allowing water to run continuously over the area for a period of at least 8 hours. During the 8-hour period, the whole area shall be kept completely immersed.

Where water testing is not possible because of job conditions, location, etc, a thorough inspection shall be carried out to check all laps, terminations and flashings for any evidence of 'fish mouths', incomplete adhesion or other conditions that may be detrimental to the watertight integrity of the membrane.

## **WATERPROOFING TO TANKS AND LIFT PITS**

### **Lift Pits and Non-Potable Water Tanks**

- a) All lift pits (bases and walls up to Ground Floor level) shall be constructed using waterproof concrete. The waterproofing shall be effected by incorporation of an approved waterproofing additive.
- b) The internal faces of lift pits in contact with the ground and of concrete tanks holding non- potable water, including the underside of tank roofs, shall be made watertight with Industries or other approved equivalent.
- c) Preparation of the concrete substrate and the method of application shall be carried out strictly in accordance with the manufacturer's directions. The substrate shall be well saturated with water but the concrete surface is to be kept matt damp and free of ponding before mortar application. The sealing mortar shall be applied in 3 coats of 1.0 - 1.5mm each. The preceding coat shall be allowed to set before applying the next coat but the timelapse between successive coatings shall not be more than 2 days. The total dry coat thickness of Tricolastic sealing mortar or equivalent (3 coats combined) shall not exceed 3mm.

### **Potable Water Tanks**

- a) The waterproofing system provided to internal face of concrete tanks holding potable water for consumption shall be of a type which is non-toxic and approved for such use. Flexible waterproofing coating Flexolastic or approved equivalent shall be used for waterproofing of potable water tanks as per manufacturer's recommendation.
- b) The Contractor shall allow for 9l wide central bulb water-stop for all walls installed in accordance with the earlier requirements of the Concrete Specification.

## **24.13 MEASUREMENT AND PAYMENT**

The waterproofing of basement raft and walls shall be measured per square meter /feet and paid as per unit rates entered in the Bill of Quantities inclusive of all overlaps, complete in accordance with the terms and Conditions of Contract.

PVC water stopper/ swell bars shall be measured per running meter/ feet and paid at per unit rates entered in the Bill of Quantities of accepted lengths a complete with accordance with the terms and Conditions of the Contract.

**\*\*\* END OF SECTION \*\*\***

## SECTION – 25 EXTERNAL PAVING, PARKING AREAS

### 25.01 SCOPE

The work covered under this section consist of providing and making items as per specifications laid down herein under, drawings and Bill of Quantities.

- Washed Terrazzo in Pavings / Walkways
- Concrete Roads / Parking Areas
- Split Tiles work in Pavings / Walkways as dividing Strips/Panels
- Split Tiles on External Steps

### 25.02 MATERIAL REQUIREMENTS

**Cement, Sand, Aggregate:** Shall conform to specifications given in the relevant Section of this specification.

**Concrete Blocks:** Shall conform to specifications given in the relevant Section of this specification.

**Tiles and Special Dry Bond Mortar:** Shall conform to specifications given in relevant Section of this specification.

**Concrete Pavers / Tuff Tiles / Uni-block:** As per manufacturer’s specifications

**Chips:** For washed terrazzo shall conform to specifications given in relevant section of —MaterialsI & washed Terrazzo.

**Strength:** Min 28 days Cylinder Compressive strength for 50 mm thickness shall be 35 Mpa (5000 psi) and for 60 / 80 mm thickness, it shall be 48 MPa (7000 psi).

**Thickness of Sub Base and Pavers:** Recommended thickness of sub base and pavers is shown in Table below:

Application	Thickness of sub-base mm (in.)		Thickness of paver (mm)
	Dry Area	Low Wet Area	
<b>LIGHT DUTY</b> Residential, drive way, walk ways, parking patios etc.	0 to 76 (0 to 3)	100 to 204 (4 to 8)	50
<b>MEDIUM DUTY</b> Residential, Streets, Public Parking, service road, maintenance area, canal lining, storage area, City petrol pumps etc.	100 to 152 (4 to 6)	254 (10)	60
<b>HEAVY DUTY</b> City Streets, Loading deck Industrial floors, Highway petrol pumps etc.	204 (8)	305 (12)	80

**Shapes:** Pavers are available in Uni-Block, I-Section, Rectangle, Half Rectangle, Wavy, Heagon and Delta Shapes

**Quantity and thickness:** Quantity and thickness required per square meter of different shape and size of pavers is shown in Table below:

### Specification for the Paving Stone

S.No	Type	Thickness (mm)	Area per Tile Sq cm (Sq In.)	Nos. of Tiles/Sqm (Tiles/Sq Ft)
1.	Uni-Block	50/60/80	249.74 (38.71)	39.81 (3.70)
2.	I-Section	50/60	270.83 (41.98)	36.90 (3.43)
3.	Rectangle	60/80	196.90 (30.52)	50.67 (4.71)
4.	Half Rectangle	60	128.12 (19.86)	78.01 (7.25)
5.	Wavy	60	275.99 (42.78)	35.83 (3.33)
6.	Hexagon	60	346.64 (53.73)	28.83 (2.68)
7.	Delta	50	245.74 (38.09)	40.67 (3.78)

#### 25.03 CONSTRUCTION REQUIREMENTS

The entire area under external pavings shall be prepared by dressing earth, to a hard or graded surface where necessary, the prepared surface shall be made up to the required levels by filling and consolidating earth in accordance with the specifications for earth filling under floors.

##### a. **Washed Terrazzo**

3/4" Terrazzo in pigmented grey cement 1:2 shall be laid over 1-3/4" Plain Cement Concrete Class- C over 4" thick Plain Cement Concrete Class-E over 4" thick sand over compacted earth for pavings /Footpaths.

After the Terrazzo topping has hardened sufficiently to prevent dislodging of the marble chipping, but before the cement has acquired enough hardness so as to disable removal, the cement shall be washed away moving a wire brush and a steady flow of water from a flexible hose. Terrazzo Surface shall be washed carefully and sponged to expose grains.

##### b. **Split Tile Strips**

Washed Terrazzo in paving / walkway is divided into panels by providing and making strips or width indicated on the drawings with double glazed split tiles as specified hereunder.

The Tiles 9x1/2" x 2-1/4" x 3/8" shall be joint in 3/8" thick dry Bond Mortar and laid over 1-3/8" thick plain cement concrete Class-C over 4" thick Plain Cement Concrete Class-E over compacted earth.

##### c. **Parking Areas / Roads**

Uni-Block tuff pavers or Concrete pavers, as specified in drawings, shall be installed over Parking Areas and Roads, the area under the paves shall be prepared to the required levels by compacting the earth to at least 95% modified AASHO max dry density, the compacted earth shall be tested and approved before the layer of sand is placed. The prepared sub-grade shall then be covered over by 6" of sand cushion compacted over which the specified pavers shall be laid closely packed tamped in place and filled with sand.

##### d. **Finish on External Steps**

Granite Slabs of approved shade and color shall be fixed to the external stair steps of RCC with special Dry bond mortar over 3/4" thick Cement Sand base plaster (1:2).

#### 25.04 CURING

All work involving cement shall be cured thoroughly for at least 3 days.

#### 25.05 MEASUREMENT AND PAYMENT

Measurement for all the items covered under this section shall be made in Sq. ft/m of the actual surfaces completed and approved.

The rate quote from the work items covered in this Section shall constitute full compensation for all materials, labour equipment, plant and all incidentals to complete the works.

\*\*\* END OF SECTION \*\*\*

## SECTION-26 SURFACE COURSES AND PAVEMENT

### 26.01 GENERAL

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

The contractor is responsible for rejecting materials that do not meet specifications and removing them from the site at the contractor's expense. During subgrade/sub base and paving operations, a detour is provided to avoid public inconvenience. The contractor must install road signs, warning lights, flares, barricades, and competent flagmen to expedite traffic flow. The cost of these facilities is included in the work item. If the Engineer deems warning measures insufficient, the contractor remains responsible for public safety.

### 26.02 ASPHALT CEMENT

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

Asphalt Cement shall be classified by penetration and when tested in accordance with the standard methods of tests of the AASHTO, the grades of asphalts shall conform to the requirements set forth in Table 301-3. The grade of asphalt to be used shall be in accordance with these specifications or the Special Provisions or as directed by the Engineer.

### 26.03 ENVIRONMENTAL FACTORS

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

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

**TABLE 26-1 SELECTING ASPHALT GRADE**

Temperature Condition	Asphalt Grade
Cold, mean annual air temperature < 7 oC (45 oF)	AC-10 AR-4000 80 / 100 pen
Warm, mean annual air temperature between 7 oC (45 oF) and 24 oC (75 oF)	AC-20 AR-8000 60 / 70 pen.
Hot, mean annual air temperature > 24 oC (75 oF)	AC-40 AR-16000 40 / 50 pen.

### 26.04 CUT-BACK ASPHALT

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

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

Asphaltic emulsions shall be composed of a bituminous base uniformly emulsified with water and an emulsifying or stabilizing agent. They shall be classified according to use as Rapid Setting, Medium

Setting, Slow Setting, or Quick Setting and shall conform to the requirements specified in Item 313 (Tables 313-1 and 313-2) of this specification.

Emulsified Asphalts can be either of the two types: cationic (ASTM D 2397 or AASHTO M 208) or anionic (ASTM D977 or AASHTO M 140). Selecting one of the two shall depend on the type of aggregate used for better affinity.

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

## 26.05

### **POLYMER MODIFIED ASPHALT**

Polymer Modified Asphalts are asphalts whose properties pertaining to deformation resistance and fatigue characteristics are enhanced by addition of polymers. Polymer Modified Asphalts shall consist of Thermoplastic Elastomers or Thermoplastic Polymers blended with neat Bitumen. Polymer Modified Asphalt corresponding to one of the following types shall be used as specified or directed by the Engineer.

1. Type-I polymer-modified asphalts made with styrene-butadiene or styrene-butadiene-styrene block copolymers, conforming to ASTM D-5976
2. Type-II polymer-modified asphalts made with styrene-butadiene rubber latex or polychloroprene latex, conforming to ASTM D-5840.
3. Type-III polymer-modified asphalts made with ethyl vinyl acetate conforming to ASTM D-5841.

However, any other polymer may be used after approval from the Engineer, that will give the required test results as per one of the above three types, when blended with the desired asphalt.

The blending of the asphalt and polymer modifier to form polymer modified asphalt shall take place through the use of a high speed Sieferr mill. The modifier to be added to bitumen shall have following characteristics:

- It shall resist degradation at asphalt mixing temperatures.
- It shall blend with Bitumen.
- It shall improve resistance to flow at high road temperatures without making the bitumen too viscous at mixing and laying temperatures or too stiff or brittle at low temperatures.

After blending with bitumen the modifier shall have following characteristics:

- It shall maintain its premium properties and shall be stable chemically during storage, application and in service.
- It shall be capable of being processed by conventional equipment.
- It shall achieve a coating or spraying viscosity at normal application temperatures.

#### Compatibility Test:

Polymer Modified Asphalt, when tested according to EN 13399 "Bitumen and bituminous binders - Determination of storage stability of modified bitumen", shall have

a difference in softening point of less than five (5) deg C, between samples taken from top and bottom of the container.

A difference of five (5) deg C or more in softening point shall depict incompatibility of polymer and asphalt, and hence shall be the cause of rejection.

**APPLICATION TEMPERATURES**

**TABLE 26-2 Application Temperature Range, oC**

<b>Asphalt Type</b>	<b>Grade</b>	<b>Mixing Temp</b>	<b>Spraying Temperature Road Mixes</b>
<b>a. Asphalt Cement</b>	All Grades	As required to achieve viscosity of 75-150 seconds Saybolt-Furol. Or as required to achieve a Kinematic Viscosity of 150- 300 centistokes.	160 (Max)
<b>b. Emulsified Asphalts</b>	RS-1	—	20-60
	RS-2	—	50-85
	MS-1	10-70	20-70
	MS-2	10-70	20-70
	MS-2h	10-70	20-70
	HFMS-1	10-70	20-70
	HFMS-2	10-70	20-70
	HFMS-24	10-70	20-70
	SS-1	10-70	20-70
	SS-1h	10-70	20-70
	CRS-1	10-70	50-85
	CRS-2	—	50-85
	CMS-2	—	20-70
	CMS-2h	10-70	20-70
	CSS-1	10-70	20-70
CSS-1h	10-70	20-70	
<b>c. Cutback Asphalts (RC, MC, SC)</b>	30 (MC only)	—	—
	70	—	20 min.
	250	55-80	40 min.
	800	75-100	55 min.
	3000	80-115	—

**TABLE 26-3**  
**REQUIREMENTS FOR ASPHALT CEMENT (AASHTO M-20)**

	Penetration Grade							
	40 - 50		60 - 70		80 - 100		120 - 150	
	Min.	Max.	Min.	Max	Min.	Max.	Min	Max
Penetration at 77° F (25 °C) 100g5 sec.	40	50	60	70	80	100	120	150
Flash point, Cleveland Open Cup, ° F(°C)	450 (232)	-	450 (232)	-	450 (232)	-	425 (218)	-
Ductility at 77 °F (25 °C) 5cmper min, cm.	100	-	100	-	100	-	100	-
Solubility in trichloroethylene percent.	99	-	99	-	99	-	99	-
Thin-film oven test, 1/8 in. (3.2mm), 325 °F (163 °C) 5 hr Loss on heating, percent.	-	0.80	-	0.80	-	1.0	-	1.3
Penetration, of residue, percent of original.	58	-	54	-	50	-	46	-
Ductility of residue at 77 °F (25°C) 5 cm. per min., cm.	-	-	50	-	-	-	100	-

\*\*\* END OF SECTION\*\*\*

## **PLUMBING WORKS**

## **BASIC REQUIREMENTS**

### **1.01 GENERAL:**

This section includes the following basic mechanical requirements, which apply & complement Division 22 sections. The provisions of the contract including Drawings, General & Special Condition of Contract apply to this section.

The Specifications & Drawings make reference to certain Standard Specifications and also to certain manufacturers and equipment model numbers. The object of these references is to ensure that the equipment and materials offered by the Tenderers and supplied by the Contractor are in accordance with the required standard of quality, workmanship and capacities, etc. The object is not to limit the selection of equipment to a particular manufacturer unless specifically mentioned in the tender documents that a particular equipment and/or material is to be supplied.

It is clarified that the equipment and the materials complying with various standards, and of manufacturers other than mentioned in the tender documents shall be acceptable provided they meet the required capacities as specified and meet the intent of the specifications regarding quality and workmanship.

In case there is any deviation between any item or material offered by the Contractor from the tender specifications and drawings, the Contractor shall clearly draw attention to all such deviations and no such item or material shall be supplied by the Contractor without prior written approval of the Engineer Incharge.

These Specifications and accompanying Drawings are to be considered as supplementing each other and as such are intended to serve jointly as the basis upon which the Contractor shall establish a Contract Price, and upon which he shall base the performance of the required work.

It is the intent of these Specifications and Drawings to call for finished work, tested, complete, and ready for operation.

These Drawings and Specifications are presented to the Contractor with the understanding that he is an expert and is competent in the preparation of Contact Bid.

Prices on the basis of information such as is contained in these documents, which do not include assurance as to their complete accuracy and validity, in all details, and which may depend, for proper execution, upon interpretation by the Engineer Incharge and other Authorities, during the course of construction.

For the above reasons, the Contractor shall understand that his submission of an unqualified proposal commits him to perform all work expressed and implied in the Drawings and Specifications without additional compensation. He shall further understand that such submission commits him without extra compensation, and within the scope of the Contract, to the following:

- i. To provide, if required by the Engineer, the items or arrangements of greater quantity, better quality, or higher cost in the event that a disagreement with regard to; such items occur between the drawings and specifications, or within one.
- ii. To provide any small items of work not specifically called for, but required to complete the intended installations.
- iii. To co-ordinate his work or adjust the same so that conflicts in space do not occur with other trades involved at the project.
- iv. To co-ordinate his work or adjust the same to suit site or any other existing conditions.

### **1.02 INTERPRETATION OF THE DRAWINGS & SPECIFICATIONS:**

- a. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instructions to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- b. It shall be understood that the specifications and drawings are complimentary and are to be taken together for a complete interpretation of the work. Exceptions are that notes on the drawings, which refer to an individual element of work, take precedence over the specifications where they conflict with the same.
- c. No exclusions from, or limitation, in the language used in the Drawings or Specifications shall be

interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are omitted.

- d. The necessary Drawings utilise symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed in accordance with the diagrammatic intent expressed on the mechanical drawings, and in conformity with the dimensions indicated on final Architectural and Structural working Drawings and on equipment shop drawings.
- e. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- f. Certain details appear on the Drawings which are specific with regard to the dimensions and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field co-ordination for the indicated work.
- g. Information as to the general construction not evident in these specifications and drawings shall be derived from structural & architectural drawings and specifications.

### **1.03 CODES, PERMITS & INSPECTION:**

- a. All works shall meet or exceed the latest requirements of all authorities exercising jurisdiction over construction work at the project site.
- b. All required permits and inspection certificates shall be obtained, paid for, and made available at the time of completion of the Works.
- c. All work shall be carried out in accordance with the following codes:
  - Gujranwala Development Authority Building Bylaws
  - NFPA Standards
  - Uniform Plumbing Code

### **1.04 SHOP DRAWINGS BY THE CONTRACTOR:**

- a. All shop drawings shall be prepared on computer using current version of AUTOCAD software.
- b. Prior to commencement of works on site and at least 3 weeks in advance of the drawing being required for actual execution, the Contractor shall submit to the Engineer Incharge 3 sets of hard-copy drawings plus soft-copy on AUTOCAD CD showing all major holes, cavities, embedded frames and other parts of the plant to be embedded in the floor, ceiling and walls, channels in the floors, cable trenches, cement pipes or other major conduits, which are needed for the successful and timely completion of the works. The Engineer Incharge after ascertaining the accuracy of these drawings, shall return 1 (one) set of the drawings to the Contractor, within 14 days of the receipt of these drawings.
- c. The Engineer Incharge shall review the drawings & (i) approve the drawing or, (ii) disapprove the drawings with comments or, (iii) disapprove the drawings with comments for rectification/revision. In the event of (iii), the Contractor shall correct/revise the drawing & resubmit 3 hard-copies of the drawings plus soft-copy on AUTOCAD CD to the Engineer Incharge for Approval. On a drawing being approved, the Contractor shall submit 6 hard-copies plus soft-copy on AUTOCAD CD for formal approval and distribution to relevant offices.
- d. All drawings shall show plans and sections with sufficient details to clearly reflect the installation of the plant. All material specifications shall be provided on the drawings. All information required for preparing suitable foundation, for providing suitable access to the plant, for making openings in building structure, for co-ordination with electrical, plumbing, air-conditioning and other designs etc., shall be clearly provided.
- e. Installation shall not be allowed to commence unless approved shop drawings are in possession of the Contractor, for which purpose shop drawings shall be submitted by the Contractor to the Engineer Incharge sufficiently in advance of actual requirements to allow for ample time to the Engineer Incharge in checking and approval and no claim for extension of the Contract time will be considered by reason of the Contractor's failure to submit the drawings on time.

- f. Each shop drawing submitted by the Contractor shall include a certificate by the Contractor that all related conditions on site relevant to the particular installation have been checked and that no conflict exists.
- g. Any expenses resulting from an error mistake or omission in or delay in delivery of the drawings & information mentioned in sub-clause (b) of this clause shall be borne by the Contractor.
- h. Approved Drawings approved shall not be departed from except on the instructions of the Engineer Incharge.
- i. The approval by the Engineer Incharge for any submitted data, working drawings, performance curves, test certificates for any items, arrangements and/or layout shall not relieve the Contractor for many responsibility regarding the performance of the Contract. Such approval shall also not relieve the Contractor from responsibility of any error in the submitted data & workings, brought to light at any time subsequent to any approvals.

#### **1.05 VERIFICATION OF ACTUAL DIMENSIONS ON SITE:**

The Contractor shall be solely responsible for verification of actual site dimensions and building layout. Building layouts shown on Construction drawings shall not be considered to be final with regard to dimensions and layout but shall be subject to actual verification by the Contractor. All working drawings prepared by the Contractor shall incorporate actual measurements taken on site. The Contractor shall ensure that all equipment can be conveniently fitted into the space allocated for this purpose.

If any space allocated for a certain equipment or combination of equipment 's is insufficient or deficient in terms of clearances required for maintenance etc., the Contractor shall forthwith inform the Engineer Incharge of the discrepancy. He shall provide all reasonable assistance to the Engineer Incharge for verification of the same and for taking remedial measures. It is understood that all tenderers during tendering shall have checked that the equipment proposed to be supplied by them fits conveniently into the space allocated for this purpose. In case any such space is insufficient, the tenderer shall so indicate the deficiency in his tender documents and specify the space requirements. Failure on the part of the tenderer to point out any discrepancies existing in this regard shall make him liable, if his tender has been accepted, to bear the full consequences developing out of a certain equipment not fitting into a certain space allocated for the purpose.

If any time during the progress of the Works any error shall appear or arise in the position, levels, dimensions or alignment of any part of the works, the Contractor on being required to do so by the Engineer Incharge shall at his own expense rectify such error to the satisfaction of the Engineer Incharge unless such error is based on incorrect data supplied in writing by the Engineer Incharge, in which case the expense of rectifying the same shall be borne by the Employer.

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

#### **1.06 RESPONSIBILITY FOR ACCURACY OF INFORMATION:**

- a. The Contractor shall be fully responsible for accuracy of all information necessary for successful and timely completion of the works.
- b. The Contractor shall be responsible to make all measurements and set out all the necessary dimensions for their correctness.
- c. The Contractor shall be fully responsible for ascertaining the accuracy of the dimensions and other information given in the tender documents before carrying out the work. The Contractor shall provide the complementary dimensions and communicate the same to the Engineer Incharge.
- d. The Contractor shall consult the drawings and documents which have been prepared for the Civil and other contracts, which can affect his work and which are either kept on site or are available with the Engineer Incharge.
- e. It shall be the responsibility of the Contractor to acquire all necessary information and ascertain its accuracy for co-ordination of the works with the works of other Contractors.

**1.07 APPROVAL FOR MATERIAL & EQUIPMENT:**

- a. General: All equipment and material to be used in the Works shall be subject to approval obtained prior to delivery of the same on site. It is to be specifically noted that any approval given by the Engineer Incharge shall not relieve this Contractor of his obligations under this Contract.
- b. Approval of Imported Equipment: For approval of all equipment, the Contractor shall be required to submit, within two weeks of the signing of the Contract, detailed submittals stating the equipment proposed to be supplied and providing supporting literature/brochures etc., to enable the Engineer Incharge to check conformance to the specifications. Performance curves and charts shall be submitted with the operating points clearly marked. All equipment submittals shall be accompanied with a certificate stating that the equipment proposed to be supplied fits into the space allocated for it with sufficient clearance around it to allow for installation of related ducting, piping, etc., and provides for maintenance clearances as required by the manufacturer of the equipment, and that all special requirements of the equipment have been accounted for.
- c. Any additional information, test reports etc., required by the Engineer Incharge shall be furnished by the Contractor. All work related to the equipment shall only be commenced after receipt of written approval from the Engineer Incharge.
- d. Approval of Locally Manufactured Equipment: The procedure of approval of locally manufactured equipment shall be the same as stipulated above for imported equipment. Additionally all locally manufactured equipment shall be inspected at the manufacturer's premises by the Engineer Incharge, and approval given prior to delivery on site.
- e. Approval of Imported Material: All imported material to be used in the works shall be submitted to the Engineer Incharge and approval obtained. Manufacturer's literature/brochure etc. that provide complete information on the material specifications, to enable the Engineer Incharge to check conformance to specification, shall be submitted. Any additional information, test reports etc., required by the Engineer Incharge shall be supplied by the Contractor.
- f. Approval of Locally Procured Material: All locally procured material shall be submitted to the Engineer Incharge for approval, and approval obtained prior to delivery of the same on site. The procedure for obtaining approval shall generally be the same as given above for imported material, except that where manufacturer's literature is not available, a sample of the material shall be submitted along with type written notes indicating relevant source data and specs on the material. Any other samples, information, test reports etc., required by the Engineer Incharge shall be submitted.

**1.08 STORAGE ARRANGEMENTS:**

- a) The Contractor shall make adequate arrangements for the storage of the materials arranged by him or supplied by the Employer. No payment shall be made to the Contractor for storage arrangements whatsoever. However adequate space for stores shall be provided on site to the Contractor.
- b) The location of the store area shall be within the Site premises and/or selected with the consultation and approval of the Engineer Incharge.

**1.09 MEASURING INSTRUMENTS:**

The Contractor shall acquire and maintain on site various required measuring instruments in perfect working condition to enable the Engineer Incharge to check the quality and standard of all material and performance of equipment's.

**1.10 STANDARDS & TYPICAL DESIGN:**

The specification either cites or implies American, Pakistani or BS Standards where the context so refers. Other comparable United States, European or Japanese standards and typical designs are equally acceptable providing that they in no way detract from the quality, safety, operability or durability of the equipment and material furnished. However, when other standards or typical designs than those cited or implied are offered by the Contractor, he shall set forth in his proposal the alternate standards and/or designs he proposes so that a direct comparison can be made by the Engineer Incharge before the issue of a Letter of Award. Each specific difference from the specifications shall be clearly spelled out by the tenderer. If no alternates are set forth by the Contractor in his proposal, it will be assumed that the equipment and material will be in accordance with the standards and Where differences or contradictions appear between any of the laws, standards, codes, specified herein, the decision of the Engineer Incharge shall be final and binding on the Contractor and he shall not claim any additional charges for carrying out the same.

#### **1.11 OPERATING & MAINTENANCE INSTRUCTIONS:**

- a. Bound Instructions: Five complete sets of operating and maintenance manuals, duly approved by the Engineer Incharge, shall be supplied by the Contractor, prior to handing over of the project to the Employer. Each set shall be permanently bound and shall have a printed hard cover. Each manual shall be inscribed with suitable legend for proper identification and use of the manual. The matter shall be legibly typed and/or shall be clear Photostat copies of the original documents, catalogues, photographs of site and equipment's, etc., including complete set of as installed drawings.
- b. Fly sheets shall be placed before instructions covering each subject. The instruction sheet shall be approximately 8.5" by 11", with large sheets of drawings folded in.
- c. Framed Instructions: Approved piping, wiring and control diagrams showing the complete layout of the entire system, including equipment, piping, valves and control sequence, framed under glass or in approved laminated plastic, shall be posted; where directed. In addition, condensed operating instructions, explaining preventive and procedures of safely starting and stopping the system shall be prepared in typed form, framed as specified above and posted beside the diagrams. Proposed diagrams, instructions and other sheets shall be submitted for approval prior to the posting. The framed instructions shall be posted before acceptance testing of the system.
- d. Field Instructions: During the two months of the operation and maintenance period upon completion of the work the services of one or more project engineers shall be provided by the Contractor to instruct the representative of the Employer in the operation and maintenance of the Works. The field instructions shall cover all the items contained in the bound instructions.

#### **1.12 AS BUILT DRAWINGS:**

The Contractor shall maintain an accurate record of changes as work progresses on a set of Construction Drawings supplied for this purpose, by the Engineer Incharge. He will keep these Drawings at the Site Office, and adopt the following procedure:

- a. Make records in a neat and legibly printed manner with a non-smudging medium.
- b. Identify each As Built Drawing as the —Project Record Copyl, maintain Drawings in good condition, do not use them for construction purposes, and make them readily available to the Engineer Incharge.
- c. Maintain As Built Drawings in a state current to the project. Failure to comply with this requirement may prejudice Progress Payments. The Engineers Incharge visual inspection shall constitute proof that As Built Drawings are current.
- d. The Contractor on the completion of the Contract shall submit to the Employer through the Engineer Incharge one complete set of As Built Drawings (six prints of each drawing and one set of soft-copies of all drawings on AUTOCAD CD) showing Work as actually constructed.

#### **1.13 MECHANICAL INSTALLATIONS:**

Sequence, coordinate, and integrate the various elements of mechanical systems, materials and equipment. Comply with the following requirements:

- a. Coordinate mechanical systems, equipment and materials installation with other building components
- b. Verify all dimensions by field measurements.
- c. Arrange for chases, slots and openings in other building components during progress of construction, to allow for mechanical installations.
- d. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- e. Sequence, coordinate and integrate installations of mechanical, materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing the building.
- f. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.
- g. Coordinate connection of mechanical systems with exterior underground and overhead utilities and

services. Provide required connection for each service.

- h. Install systems, materials and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer Incharge.
- i. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- j. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- k. Install access panel or doors where units are concealed behind finished surfaces.
- l. Install systems, materials and equipment giving right of-way priority to systems required to be installed at a specified slope.
- m. Provide fire stopping materials in all annular spaces surrounding piping, conduits, ducts, etc. that penetrate fire-resistive construction.

#### **1.14 DELIVERY OF EQUIPMENT / MATERIAL ON SITE**

No plant or Contractor's Equipment shall be shipped or delivered to the Site until an intimation in writing has been applied for and obtained by the Contractor from the Engineer Incharge that the items may be delivered. The Contractor shall be responsible for the reception on Site of all Items, plant and Contractor's Equipment delivered for the purpose of the Contract.

Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-and damage and prevent entrance of dirt, debris and moisture.

Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor. Also protect flanges, fittings and piping specialties from moisture and dirt.

#### **1.15 UNLOADING & STORAGE AT SITE**

- a. The Contractor shall unload all owner supplied or otherwise equipment & material at the site from delivery vehicles as the case may be. Items for permanent installation shall be properly stored in areas designated by the Engineer Incharge and shall be protected as required to prevent damage or deterioration of any type. Storage methods shall be such as to cause minimum inconvenience to others and shall be arranged to facilitate inspection.
- b. All equipment and material storage shall be subject to the approval of the Engineer Incharge.
- c. Items stored shall be blocked up at least six (6) inches off the ground.
- d. The ends of all nozzles, pipes, tubes and conduits while in storage at the site shall be covered with a tube cap to save against entrance of rain water, blowing dirt, and other foreign matter. Tubing shall be shipped and stored in neat bundles.
- e. Miscellaneous steel, plate work, pipes, etc. shall be protected by a prime coat of paint and kept painted throughout the storage and erection period to inhibit rusting unless such items are galvanised or have other corrosion proof finish.
- f. All packing boxes, shipping containers, planking, covering, etc., shall become the property of the Employer as soon as the equipment and material which is contained therein arrives at the site. The Employer, on application from the Contractor, may permit the Contractor to use some of the boxes, containers, etc., without charge for equipment and material storage purposes.

#### **1.16 QUALIFICATION OF EQUIPMENT & MATERIAL MANUFACTURER**

- a. All minor equipment and all materials shall be manufactured by companies which have had at least five years previous experience in the design and manufacture of equipment and or material of comparable type, capacity and operating conditions.

- b. Where the requirements of this clause make any material non-obtainable the Employer and/or Engineer Incharge reserves the right to waive any portion or portions of it as required to obtain the intent of the Specifications.
- c. When manufacturer's product is specified by name or equivalent, it shall be the sole judgment of the Engineer Incharge to determine the acceptability of any product which is offered as an equal to that specified.
- d. Proposals shall be based on the equipment and materials specified, and any request to substitute any time shall be so mentioned in the proposal and the amount to be added or deducted shall be given. Any request for substitution after the date of Letter of award shall likewise be accompanied with the difference in price.
- e. If the Contractor in his tender proposal has offered more than one source of equipment or material the selection of the source shall be at the judgment of the Engineer Incharge.

#### **1.17 SAFETY PROGRAM**

- a. The Contractor shall strictly follow at his own cost the Safety Programme outlined below and such additional measures as the Engineer Incharge may determine to be reasonably necessary.
  - i. Prior to commencement of work the successful Contractor shall submit safety programme for discussion with the Employer and the Engineer Incharge.
  - ii. The Contractor shall prepare a plan of the Works Site to assure that storage areas for materials and equipment are located on the project/work site for maximum efficiency. This plan will be subject to the approval of the Engineer Incharge.
  - iii. Activities between different operations and different crafts will be coordinated.
  - iv. The Contractor shall lay out and provide an efficient access system with information and directional signs posted as necessary.
  - v. All employees will be instructed on safe work method.
  - vi. The Contractor shall advise all his supervisory staff of their responsibility for the prevention of injury to persons or damage to property or equipment in their respective areas of supervision.
  - vii. Safety will be included in all job planning. This will include providing safe construction equipment and vehicles, protective equipment necessary for protection of workmen, and establishing methods for safe operation.
  - viii. Good housekeeping will be maintained at all times.
  - ix. Scaffolds, ladders, ramp, runways etc. will be constructed properly and maintained in safe conditions.
  - x. Ample fire protection will be provided and fire hazards guarded, by the Contractor.
  - xi. Adequate lighting, ventilation etc. will be provided as necessary, by the Contractor.
  - xii. Equipment will be properly and regularly inspected and maintained by the Contractor to the satisfaction of the Engineer Incharge.
  - xiii. Contractor to the satisfaction of the Engineer Incharge.
  - xiv. The Contractor will assign to his employees only such duties as are within their physical and mental capabilities.
  - xv. The Contractor will hold monthly meetings with his supervisory staff and the man in charge at the lower level will hold safety meetings of 10 to 15 minutes with his crew each week.
  - xvi. First Aid facilities will be provided at job sites, the services of doctors and hospitals made available, and all supervisors instructed in handling of injured employees.
  - xvii. Adequate toilet facilities will be provided, maintained in a hygienic condition and their use enforced by the Contractor.
- b. Accident reports will be furnished to the Engineer Incharge for onward transmission to the Employer within 2 days of the reported accident.
- c. Copies of the safety programme will be supplied by the Contractor to the Engineer Incharge and will be promptly posted in all offices in use of projects/works under this Contract.
- d. At all construction sites the following instructions shall be followed:
  - i. Availability of safety (hard) hats, which should be worn by anyone visiting or working within the designated work area
  - ii. Controlled entry to the designated work area
  - iii. Proper distribution of temporary electric power (use of RCDs/ELCBs, switch gear, cabling, socket outlets)
  - iv. Proper guarding of shafts, stairs and floor edges up, to a height of 42l.
  - v. Proper access stairs and ladders with handrails

- vi. Properly demarcated passageways, which are kept clear of materials, equipment, and rubbish
- vii. Daily cleaning of debris and rubbish from the site
- viii. Adequate temporary lighting
- ix. Proper housekeeping to reduce slipping and tripping hazards.
- x. Proper protection to pedestrians and adjoining buildings
- xi. Contractor's all-risk Insurance policy to be in place.

#### **1.18 GUARANTEES/WARRANTIES FOR EQUIPMENT/PLANT**

- a. The period of guarantee/warranty on the equipment/plant shall be the period stated in the Conditions of Particular Application.
- b. The Contractor's guarantee does not cover the normal wear & tear.
- c. Manufacturer's equipment warranties if they exceed the Maintenance Period as defined in these Documents, shall be transferred to the Employer at the end of the Maintenance Period.
- d. The Contractor shall guarantee that the material & workmanship incorporated into the plant/equipment are new and the best of their respective kinds for the service intended and that all items will be free from inherent defect in design, workmanship & materials, and that all equipment in its several parts will operate successfully at all capacities up to and including the maximum specified load without undue noise, heating, straining of parts, wear and vibration and that an ample factor of safety is included in every design.
- e. Guarantee/Warranty, shall be furnished by the Contractor upon forms approved by the Engineer Incharge and shall be signed by both the Contractor and the Sub- Contractors whose work is involved. If the equipment/plant manufacturer's standard guarantee/warranty is applicable, the guarantee/warranty form and conditions must be submitted along with the equipment/plant technical submittals'.
- f. The Contractor's liability shall be limited to the replacement of defective parts that may develop in the equipment or material of his own work or manufacture or his Sub- Contractors under proper use and arising solely from faulty design, material, or workmanship provided always that such defective parts are not repairable at the Site, and are not essential in the meantime for commercial use of the equipment, are promptly returned to the Contractor's or Sub-Contractor's factory unless otherwise arranged. The equipment so replaced or repaired shall be in conformity with the specifications.
- g. For indigenous equipment, all replacements shall be made free of cost at the Site by the Contractor.
- h. For imported equipment, all replacement shall be made free of cost ex-Karachi port, and the Employer shall arrange to have then cleared, pay all duties and hand-over the replaced parts to the Contractor.
- i. The return of defective parts to the Contractor's or Sub-Contractor's factory shall be the Contractor's responsibility and shall be made at his expense. The Employer will, however, render such assistance as necessary to expedite the same. In the case of defective parts not repairable at the site but essential in the meantime for the commercial use of the equipment, the Contractor shall, whenever possible, replace free of cost at the site the said defective parts before the defective parts are removed from the site.
- j. If it becomes necessary for the Contractor to replace or renew any defective portions of the Plant under this clause, the provisions of this clause will apply to the portions of the plant so replaced or renewed until the expiration of six months from the date of such replacement or until the end of the guarantee period, whichever shall be later. If any defects are not remedied within a reasonable time, the Employer, after due notice to the Contractor, may proceed with the work at the Contractor's risk and expense without prejudice to any other rights which the Employer may have against the Contractor in respect to such defects.
- k. If the replacements or renewals are of such a character as may affect the efficiency of the plant, the Engineer Incharge shall have the right to give to the Contractor within one month of such replacement or renewal, notice in writing that performance tests be made, in which case tests shall be carried out as provided in these Documents. Should such tests show that the guarantees of the Contract are sustained, the cost of the tests shall be borne by the Employer. Should the guarantees not be sustained, the cost of the test shall be borne by the Contractor.
- l. If during the guarantee period the services of the Contractor's personnel are required for the rectification or replacement of any defective part or work due to defective material, design or workmanship, such services shall be made by the Contractor without charge to the Employer.

#### **1.19 TESTS ON COMPLETION**

- a. The Contractor shall give to the Engineer Incharge in writing 15 day's notice of the date after which he will be ready to make the —Tests on Completion—. Unless otherwise agreed the tests shall take place within 10 days after the said date on such day or days as the Engineer Incharge shall in writing notify the Contractor.
- b. If the Engineer Incharge fails to appoint a time after having been asked to do or to attend at any time or place duly appointed for making the said tests, the Contractor shall be entitled to proceed in his absence and the said tests shall be deemed to have been made in the presence of the Engineer Incharge.
- c. If in the opinion of the Engineer Incharge the tests are being unduly delayed he may, by notice in writing, call upon the Contractor to make such tests within 10 days from the receipt of the said notice, and the Contractor shall make the said tests on such day within the said 10 days as the Contractor may fix and of which he shall give notice to the Engineer Incharge. If the Contractor fails to make such tests within the time aforesaid, the Engineer Incharge may himself proceed to make the tests. All tests so made by the Engineer Incharge shall be at the risk and expense of the Contractor.
- d. The Employer, except where otherwise specified, shall provide free of charge subject to the provisions of Sub-clause (e) of this clause; electricity, fuel and water, as may be reasonably demanded to carry out such tests efficiently.
- e. If any portion of the works fail to pass the tests, tests of the said portion shall, if required by the Engineer Incharge or by the Contractor, be repeated within a reasonable time upon the same terms and conditions, as aforesaid, save that all expenses to which the Employer may be put by the repetition of the tests shall be deducted from the Contract Price.

#### **1.20 INSPECTION OF COMPLETED WORKS**

- a. The Contractor is required to give the Employer/ Engineer Incharge due notification when he expects the work to be completed, a report in triplicate of the measurements carried out with regard to pressure testing of pipes and leak testing of duct work and other specified tests shall be attached to this application. The final inspection should then be carried out, without unnecessary delay, and if possible, within four weeks.
- b. At the request of either party, inspection of such Sections of the work as will not be accessible after completion, or will be difficult to alter, which are to be taken into use by the Employer before the time of the final inspection, may be carried out in advance. (Advance Inspection).
- c. An inspection is to be carried out immediately before the expiry of the guarantee period. (Guarantee Inspection).
- d. Inspection of corrected faults or omissions noted in connection with advance, final, or guarantee inspection is also to be done (Supplementary Inspection).
- e. Inspections are to be carried out by the Engineer Incharge or any other suitable and competent person appointed by the Employer.
- f. The costs of Advance Inspection, Final Inspection & Guarantee Inspection are to be met by the Employer, where the inspection has been carried out by a person appointed by him. The costs of supplementary inspections and re-inspections are to be borne by the Contractor. It is the responsibility of the Contractor to provide & pay for, any help or assistance necessary in connection with the inspection work.
- g. The inspector's decision as to what faults or omissions may have occurred is binding on both sides.
- h. The Contractor is required to carry out, without delay, any improvements, alterations or additions which may be considered necessary as the result of an inspection report.
- i. When the final inspection has taken place, the work is to be handed over to the Employer in so far as been found to be in the state required by the Contract, and can suitably be put into use for this purpose for which it was intended.
- j. The Employer has the right to put into use any Section of the work contracted for and not approved at the time of inspection, provided this can be done without jeopardizing the progress of the work, and he may use it without special compensation even before the faults or omissions have been made good.
- k. Where special dates are specified under the Contract for the completion of different Sections of the work, the provisions of this Clause are to apply to each part separately.
- l. The inspection report required under this Clause is to be delivered in writing, and signed by the inspector, giving the date on which it is to be made available for the parties' inspection. The report should cover the following points:
  - i. State whether the work has been approved or not.

- ii. State the reasons for failing to approve it, if it has not been approved.
- iii. State faults or omissions for which the Contractor is to be held responsible, together with the time within which they are to be made good.
- iv. Include notes on matters which do-not require immediate action, but ought to be finally settled in connection with the guarantee inspection.
- v. The sum to which the Employer is entitled.
- vi. Date on which the insurance taken out by the Contractor lapses.
- vii. If the work has been approved at the final inspection, the date from which the guarantee/maintenance period is to run and the day after which it expires.
- viii. Distribution of costs connected with the inspection.

**1.21 ACCEPTANCE & INTERIM OPERATION**

After the performance tests, if the equipment supplied by the Contractor is found to meet the guarantee and any other specified requirement, and if all other work called for hereunder has been completed, the Employer's acceptance will be forth-coming and final payment will become due as provided for under the terms of payment. This acceptance shall, however, not relieve the Contractor of his responsibility for the first inspection.

Should the equipment furnished by the Contractor fail to operate as required, or in case of failure to meet any of its guarantees, the Employer shall have the right to operate the equipment, using the Contractor's supervisory operating personnel, until such defects have been remedied and guarantees met with. In the event that defects necessitate the rejection of the equipment or any part thereof, the Employer shall have the right to operate the equipment until such time as new equipment is provided to replace the rejected equipment. Such operation shall not be deemed as an acceptance of any equipment.

**\*\*\*END OF SECTION\*\*\***

## PLUMBING WORK

### 1.0 SCOPE

The work under this section consists of providing all material and equipment and performing all the work necessary for the execution and completion including testing and commissioning of all systems of plumbing works as shown on the Drawings and/or as specified herein and/or as directed by the Engineer Incharge, the systems included in plumbing works are as follows:

- i) Cold and Hot Water Supply
- ii) Sanitary Drainage
- iii) Fire Protection
- iv) Roof Drainage

All the above-named systems shall be completed in all respects including extension of these internal systems up to the specified limits outside the building as indicated on the drawings.

### 2.0 GENERAL

All the materials and equipment's shall be of the specifications mentioned herein and the Contractor shall submit the sample, necessary catalogues. Sketches the name of manufacturer and guarantee if necessary, before installation. The system shall be installed after the approval of the Engineer Incharge. All material and equipment shall be new and unused.

Any material or labor which is usually furnished as a part of the specified equipment and which is necessary for its proper completion and best operation shall be furnished as a part of this Contract without any additional cost whether or not shown in detail on the drawings or described in detail, in the specifications.

Misuse of plumbing fixtures to be installed under this Contract is prohibited during the currency of the contract.

All metal fixture trimmings shall be thoroughly covered with non-corrosive grease which shall be maintained until all work is completed. Upon the completion of work, all fixtures and trimmings shall be thoroughly cleaned, polished and left in first class condition.

Before erection, all pipes, valves, fittings, etc. shall be thoroughly cleaned of oil, grease or other material.

All special tools for proper operation and maintenance of the equipment provided under this Contract shall be delivered at no additional cost.

The Contractor shall allow in his bid for cost of all cutting, making holes and subsequent making it good to the desired finish as per approval of the Engineer Incharge. No separate payment shall be made for this item.

The Contractor shall allow in his bid for the cost of providing protective painting or coating as specified in the relevant sections and no claim shall be entertained for this item.

All pipes shall be properly installed as shown on the drawings and/or as directed by the Engineer Incharge, and shall be as straight as possible forming right angles and parallel lines with the walls and other pipelines. The position, gradients, alignment and inverts shall be as shown on the drawings and/or as directed by the Engineer Incharge.

The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings. Special precautions shall be taken for the installation of concealed pipes as shown on the drawings and/or as required. Should it be necessary to correct piping so installed, the Contractor shall be held liable for any injury caused to other works in the correction of piping. The Contractor shall closely coordinate with other works during the entire stage of execution.

A minimum distance between different services shall be maintained as shown on the Drawings and/or as approved by the Engineer Incharge.

Pipes should be installed in such a manner that minimum distance should always be maintained between pipe and wall, beams, columns, etc. Pipes shall be supported on hangers and brackets as shown on the drawings or as directed by the Engineer Incharge.

Waste-water outlet from each fixture shall be individually trapped.

Each vent terminal shall extend to the outer air and be so installed as to minimize the possibilities of clogging and the return of foul air to the building.

When the roughing-in is completed, the plumbing system shall be subjected to test prior to concealing the roughing-in, in order to ascertain that all threads and connections are watertight.

### **3.0 PIPE**

Pipe for the various systems shall conform to the following:

- A. Sanitary Waste, Drain, and Vent Piping:
  - 1. All gravity flow piping inside or below floor to points five (5) feet outside the building, except as otherwise noted - Schedule 40 polyvinyl chloride (PVC) Type DWV per ASTM-D-3965 and conform to the National Sanitation Foundation (NSF) Standard 14.
  - 2. All exterior below grade piping beginning five (5) feet outside the building - SDR35 heavy wall PVC sewer pipe, hub and spigot type, per ASTM D3034.
  - 3. Any size exposed within a finished room or installed in locations not having sufficient space to conceal completely all parts of pipe and fittings or hard drawn copper tubing, shall be heavily chromium plated where exposed to view.
- B. Potable Hot and Cold Water Piping:
  - 1. Domestic underground service lines outside buildings and entering buildings to points one (1) foot above floor slabs on fill grade (limited to domestic service entering the building) – AWWA C900 Class 200 (DR-14) PVC hub and spigot or mechanical joint water pipe.
  - 2. Within building, above ceilings and beneath suspended floors: Type "L" hard drawn copper tubing.
  - 3. Within building, below slabs on grade: Type "L" soft copper tubing, with no below grade joints.
- C. Any size piping exposed within a finished room or installed in locations not having sufficient space to conceal completely all parts of cast iron pipe and fittings or hard drawn copper tubing, shall be heavily chromium plated where exposed to view.

### **3.01 FITTINGS**

Fittings for the various systems shall conform to the following:

- A. Sanitary Waste, Drain, and Vent Piping:
  - 1. With Schedule 40 PVC pipe: Polyvinyl Chloride Type DWV per ASTM D-2661 with solvent weld joints per manufacturer's direction.
  - 2. With SDR heavy-wall sewer pipe - reinforced hub and spigot fittings of same material as pipe, per ASTM D3034.
- B. Potable Hot and Cold Water Piping:
  - 1. With Class 200 PVC Piping - Class 200 AWWA cast iron hub and spigot fittings, OR Class 200 AWWA cast iron mechanical fittings, stuffing box type, with suitable gasket; and with concrete thrust block at each elbow or tee.
  - 2. With copper pipe - wrought copper, pressure type, solder joint fittings, same class as pipe.

### **3.02 FERRULES**

All ferrules shall be of the best quality, extra heavy cast brass not less than 4" long and of weight and size as follows:

I.D.	LENGTH	WEIGHT
2-1/4"	4-1/2"	1# - 4 oz
3-1/4 "	4-1/2"	1# - 14 oz
4-1/4"	4-1/2"	2# - 8 oz

### 3.03 PIPING DEVICES

The specifications for piping devices such as cleanouts, traps and drains, and downspout nozzles, represent the minimum standard of quality required for this project. Equivalent styles and types of devices furnished by the approved manufacturers will be acceptable:

### 3.04 CLEANOUTS

- A. Cleanouts, except at traps and fittings on horizontal branches shall be of same material and of same size as pipe up to 4" and 4" size for all larger pipe.
- B. Cleanouts in steel piping shall consist of a threaded drainage fitting, with an extra heavy cast brass or bronze raised head screw plug. Where concealed behind finished wall surfaces, a cast round flush cleanout access cover with polished top, anchor lugs, and vandal-proof cover securing screws, shall be provided also.
- C. Cleanouts in PVC piping shall be constructed with wye fittings, sweep elbows and screw plugs. Where clearance is limited, or where otherwise permitted by the Architect, such cleanouts may be tapped tee branch type with raised head screwplug.
  1. Cleanouts in PVC piping, not occurring in finished floors or walls, shall have raised head screw plugs. Where cleanouts are tapped tee branch type, screw plugs shall be raised head type with tee and cover for wall.
  2. Cleanouts in PVC piping in finished walls shall be similarly constructed, but provided with raised head screw plug, and stainless steel round flush access cover with polished top, anchor lugs, and cover plate secured to plug by countersunk vandal-proof screw.
  3. Cleanouts in PVC piping in finished floors (except where floor is terrazzo or carpeted) shall be similarly constructed as to piping, but provided with cast round flush cleanout, with flanged rim, anchor lugs, and inside caulk connection.
  4. Cleanouts in PVC piping in terrazzo floors shall be similarly constructed as to piping, ferrule, and plug, but provided with a cast round terrazzo floor access frame and cover, secured with vandal-proof screws.
  5. Cleanouts in PVC piping in carpeted floors shall be similarly constructed as to piping, but provided with caulking ferrule, threaded extra heavy brass or bronze screw plug, adjustable height cover section with heavy-duty scoriated cover and with 1-1/4" diameter carpet marker with vandal-proof screw.
- D. Exterior cleanouts, unless otherwise specifically noted, shall be brought up flush with paving in paved areas, or encased in an 18" x 18" x 6" reinforced concrete pad flush with grade in unpaved areas, and terminated with an extra heavy cast iron caulking ferrule having an extra heavy cast brass or bronzecountersunk head screw plug.

### 3.05 TRAPS AND DRAINS

- A. P-traps shall be placed under all floor drains and at other points indicated on the drawings, or otherwise required. P-traps in PVC piping shall be Schedule 40 ABS PVC with trap primer. Where so noted, traps shall be "deep seal" type, with seal not less than 4" for 2" size or not less than 5" for larger sizes.
- B. Floor drains in mechanical rooms shall (except as otherwise specifically noted) will be cast iron round drain, with double drainage flange, weep holes, inside caulk bottom outlet, flashing clamps, loose set heavy duty nickel-bronze grate, and removable sediment bucket, with trap primer.
- C. All other floor drains and all shower drains shall be cast iron floor drains with double drainage flange, weep holes, inside caulk bottom outlet, and round adjustable nickel- bronze strainer. Strainers shall be provided with vandal-proof screws, with trap primer.
- D. All sanitary floor sinks shall be with acid-resisting interior, double drainage flange, dome strainer, and anti-tilt grate, with trap primer (half grate where noted).

## INSTALLATION

#### 4.0

##### **SANITARY DRAINAGE SYSTEMS**

- A. The Contractor shall furnish and install the various systems of sanitary drainage indicated on the plans. Each shall be complete soil, waste, and vent systems for all closets, lavatories, sinks, urinals, drinking fountains, electric water coolers, floor drains, etc. Waste and vent piping shall be sized as shown on the plans, and arranged to give proper drainage and venting for each fixture. All work shall be done in strict accordance with currently adopted codes (i.e., Uniform or International Plumbing Code, etc.), which shall be followed in case of conflict with the plans.
- B. Soil, waste, drain, and vent piping within the building shall be given a uniform grade of 1/4" per foot wherever possible, but in no case less than 1/8" per foot (limited to 3" and larger). All exterior piping shall be installed to the flow lines indicated on the plans, and laid with 12" earth cover, minimum. Contractor shall verify all levels between the building and main sewer at the beginning of the job, and if the specified grades cannot be maintained, the Architect shall be so informed before proceeding with the work.
- C. All soil, waste, and drain pipes shall be extended full size as vent pipes to above the roof lines as shown. Where so indicated, or elsewhere with the approval of the Architect, two or more vent risers may be connected in roof space and vents extended through roof. Each riser extended through roof shall project at least 15" above roof line and shall be thoroughly flashed with 4 lb. lead flashing turned down inside vent stack, and extended under roofing not less than 12" in all directions from vent pipe. Vent risers smaller than 2" shall be provided with approved brass vent caps in lieu of turning flashing down into pipe.
  1. Contractor shall take care to coordinate vent riser locations through roofs with A/C outside air intakes as required to maintain a minimum separation of at least fifteen feet (15') where possible, and in no case less than ten feet (10'). Necessary offsets of vent lines shall be provided to meet this requirement whether or not indicated on the drawings at no additional cost.
  2. For flat roof areas with parapets, the top discharge of all vent lines through roof shall be set at top of parapet, but in no case less than 15" above the roof line. Taller vent stacks shall be provided with proper supports and flashing as required by the Roofing Contractor.
  3. For hip roof construction, all vent risers through roof shall be located on the back side of the roof ridge where possible.
  4. Upon request by the Employer, Contractor shall be prepared to furnish and install —Sweet Filter III vent filters at designated vent stacks as may be found necessary to eliminate sewer gas odors from re-entering the building. Installation of up to five (5) vent filters shall be included in the Contractor's bid.
- D. The soil, waste, drain, and vent piping shall be provided with cleanouts to make all sections of the system accessible. Cleanouts shall be provided at the ends of change in direction of all drain, soil, and waste pipes and branches thereof, at the foot of each riser, at all offsets, in horizontal runs at approximately 60' intervals and 100' intervals outside the building, and at other points where indicated on the drawings or where required. Two-way cleanouts shall be provided at the discharge of grease traps.
- E. All trenching for soil, waste, or drain lines shall be graded so that the pipe rests on 12" sand base. Sand base shall be tamped to the satisfaction of the Architect. Trenching shall have bell holes at each joint, to allow body of pipe to rest on ground and to provide space for joint makeup. All drain inlets shall be covered and suitably protected from tile slurry, dirt, debris, etc., during construction. Wash down of such materials into building drain inlets is strictly prohibited.

#### 4.01

##### **POTABLE WATER SYSTEMS**

- A. This Contractor shall furnish and install the various potable hot and cold water systems as indicated on the plans. Systems shall be complete from points of connection to mains as indicated through or to the various equipment items furnished by the Employer, or under this or other contracts, and to points of connection with all plumbing fixtures or other outlets requiring same.
- B. All interior piping will be graded for gravity drainage toward main supply risers or to fixture connections, to allow complete drainage of all parts of the system.
- C. Underground piping shall be laid with 36" minimum cover to finished grade.
- D. All connections of water piping to equipment or to piping of dissimilar metals shall be made with dielectric isolating couplings.

#### 4.02

##### **PIPING, HANGERS, SUPPORTS, ETC., GENERALLY**

- A. All piping shall be installed parallel or perpendicular to the lines of the building, unless distinctly shown or noted on plans otherwise. Spacing of lines shall be such as to provide not less than 1" clearance between finished coverings on the various services.
- B. This Contractor shall furnish all foundations, hangers, or supports for the work installed.
  - 1. All suspended drainage piping shall have supports not more than 5' on centers. All horizontal runs of cast iron or PVC waste and vent piping with no-hub couplings or solvent weld joints shall include supports immediately on either side of each joint.
  - 2. All suspended piping shall have supports not more than 5' on centers for sizes under 2", and not more than 10' on centers for sizes 2" and larger.
  - 3. All vertical risers shall be supported at each floor with vertical riser clamps and not more than 10'-0" intervals.
- 4. Supports at special conditions shall be as detailed on the plans.
  - C. All anchors in structural concrete shall be —Code-approved anchors.
  - D. Supports to walls shall be made with molly bolts.
  - E. Perforated strap hangers shall not be used for any work.
  - F. Insulation protection saddles, as specified hereinafter, shall be used at the following locations:
    - 1. At pipe hangers on insulated hot and cold water lines.
    - 2. At trapeze hangers on any insulated piping.
    - 3. At pipe rollers or other framed supports on any insulated piping.
  - G. Hangers for piping shall be adjustable split ring malleable iron or steel clevis type with threaded rod and turnbuckle in rod where hanging height permits. Except as otherwise specified, hangers shall be sized to fit the pipe.
    - 1. Hangers shall be sized to fit the outside diameter of all insulated piping.
  - H. Trapeze hangers may be used for multiple parallel runs where specifically indicated on the plans, or elsewhere with permission of the Engineer Incharge.
  - I. All pipe openings shall be capped during construction. All steel pipe (except pre- insulated), before installation, shall be stood on end and pounded to remove dirt and scale, and all steel pipes shall be properly reamed before joints are made up.
  - J. All piping shall be installed so as to allow for expansion and contraction using offsets, expansion loops, swing joints, etc., as shown or as may be required to prevent undue strain on piping.
  - K. Pipe shall be cut accurately to fit. No bending or springing of pipe will be permitted.
  - L. All water piping shall be arranged for draining through fixtures, equipment, or to floor drains where necessary, by means of 3/4" hose-end drain and ball valve.
  - M. Piping run on roofs shall be supported on corrosion-resistant pipe rollers with mounting curbs secured to the roof, as detailed on the Architectural Drawings.
  - N. All piping supports shall be connected to the top cord of joist or beam. Connection of supports to —X" bracing or cross support structural members is strictly prohibited.

#### **4.03 PIPE JOINTS**

- A. Except as otherwise noted, joints in threaded piping shall be made only with "Jointite" or equal,

applied on the male thread only. The ends of pipes shall be square cut, reamed, and wiped clean before being made up into fittings.

- B. Joints in general-purpose copper piping shall be "sweated", except as otherwise noted. Before making up joints, all copper shall be cleaned to bright metal with emery cloth, and treated with "No-Kerrode" or equal flux. Solder shall be lead-free type, composed of 95.5% tin, 4.0% copper, and 0.5% silver, similar and equal to "Silvabrite 100".
- C. Joints in welded piping shall be made up with factory fabricated welding fittings as specified above which shall include all elbows, tees, laterals, reducers, etc., and shall be "Tube-Turn", "Taylor Forge", "Ladish", or "Crane" full radius type, except that tees may be formed for lines 4" and larger connecting to lines 6" and larger by saddling branch into side and main and connection of lines ----- 1- 1/2" and smaller into lines 2" and larger may be made with "Threadolets". All welding shall be done in accordance with standard practice utilizing only fully qualified welders, in accordance with Section IX of ASME Boiler and Pressure Vessel Code, and ANSI B31.1. All joints shall be smoothly fitted before welding, and welding rod shall be specifically suited to the pipe material. Flanges shall be weld-neck type, class to match valve, except #150 minimum.
- D. Joints in PVC piping shall be U.L. listed solvent welded type with application and use of primer and solvent supplied and recommended by the manufacturer, and conforming to ASTM F-656 and F-493.
- E. Joints in SDR heavy-wall PVC pipe shall be made up with vulcanized natural or synthetic rubber compression gaskets in factory-fabricated joint sections. Pipe and fitting ends shall be properly lubricated with an approved solution, and installed in strict accordance with manufacturer's instructions.

#### **4.04 CLEANING, TESTING, AND ADJUSTING**

- A. It is the intent of this section of the specifications to provide for the thorough cleaning of the interior and exterior of all piping systems, and for all necessary tests during and at completion of the job to insure tight piping and correctly balanced systems. This Contractor shall do any and all work required to accomplish this end.
- B. The various drainage and vent piping systems, and storm drainage systems throughout shall be tested upon completion of the rough work and with fixtures or traps connected. All openings, except at the tops of stacks shall be tightly closed by screw plugs or equivalent devices, and the systems shall be entirely filled with water, applied at minimum 10 feet of head, which shall stand without leak or loss of level for a period of four hours.
- C. All potable hot and cold water piping, prior to being insulated, shall be tested in place to an air or hydrostatic pressure of 125 pounds per square inch at the first floor level for interior piping and the low point of the system for exterior piping, which pressure shall be maintained without pumping for a period of one hour.
- D. Pressure gauges shall be installed to confirm each piping test.
- E. All new strainers and filters shall be cleaned after pressure testing and system cleaning operations, and prior to final filling of systems.
- F. All motors, bearings, etc., on all equipment shall be correctly oiled and/or greased with proper lubricant before the equipment is operated, and again at completion of the job.
- G. The Contractor shall conduct operating tests of all equipment and other apparatus installed by him to demonstrate to the Employer and the Engineer Incharge the satisfactory operation of same and the fulfillment of the specified requirements. He shall make any additional tests that may be required by other authorities.

#### **4.05 STERILIZATION OF POTABLE WATER LINES**

- A. Before being placed in service, all potable hot and cold water piping systems shall be sterilized with a chlorine cleaning solution and shall be completely flushed and rinsed out with cold water, as required by the Punjab Department of Public Health.

- B. Contractor shall provide and pay for a —Service Inspection & Testing Certificate as required by the Engineer Incharge.

## 5.0 PLUMBING FIXTURES

### 5.1 Scope

The work under this section of the specifications consists of providing all material and labor for supply and proper installation of plumbing fixtures of wash basins, kitchen sinks, laboratory sinks, water closets, urinals, etc. along with all their accessories, water inlet connection, waste outlet connection etc. complete in all respect as specified herein or as shown on the Drawings and/or as directed by the Engineer Incharge.

### 5.2 Materials and Installation

#### 5.2.1 General Requirements

Materials shall conform to the latest referenced standard specifications and other provisions stipulated herein and shall be new and unused.

All fixtures shall be of high class quality and finish and shall be of approved manufacture.

Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer Incharge for his approval, a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams; drawings and such other technical data as may be required by the Engineer Incharge to satisfy himself as to the suitability, durability, quality and usefulness of the material to be purchased.

Approval of the schedule shall not be construed as authorizing any deviations from the specifications unless the attention of the Engineer Incharge has been invited to the specific changes. If the material or equipment offered under this provision is, in the opinion of the Engineer Incharge, equal to or better than specified, it will be given consideration.

Plumbing fixtures shall have smooth impervious surfaces, be free from defects and concealed fouling surface. They shall be true to line, angles, curves and color etc. Normally they shall be of local make and of the best quality available, provided.

All taps and cocks to be installed with plumbing fixtures shall be chrome plated (CP) and shall be of appropriate class to work without damage or leakage on the specified pressure of potable water system.

When any fixture is provided with an overflow, the waste shall be so arranged that the standing water in the fixture cannot rise in the over flow when the stopper is closed or remain in the overflow when the fixture is empty.

Plumbing fixtures shall be installed in a manner to afford easy access for cleaning. The space between the fixture and the wall shall be closely fitted and pointed so that there is no chance for dirt or vermin to collect.

When practical, all pipes from fixtures shall be run to the nearest wall.

Where fixture comes in contact with wall and floors, the joint shall be watertight.

Wall hung fixtures shall be rigidly supported by metal supporting members so that no strain is transmitted to the connections. Flush tanks and similar appurtenances shall be secured by approved non-corrosive screws or bolts.

Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet shall be set closer than 1.25 ft. from its center to any side wall. No urinal shall be set closer than 1.0 ft. from its center to any side wall or partition or closer than 24 inch center to center.

The supply lines or fittings for every plumbing fixture shall be so installed as to prevent

back flow.

All cuttings, making holes etc. and making it good shall be included in the work.

5.2.2 Water Closets (Asiatic)

Squatting type water closet including foot rest of Vitreous China shall be of approved color, manufacture and size. It shall be installed as a complete unit including cast iron P-trap, 1/2 inch. CP tee stop cock with wall cups, plastic water inlet connection pipe. Plastic water flush tank with all internal fittings, installed at low level including inter connecting flush piping and sealing material etc. with all other minor accessories or as approved by the Engineer Incharge.

5.2.3 Water Closets (European Type)

European type water closet of vitreous China with close coupled flush tank shall be of approved color, manufacturer & size or as approved by the Engineer Incharge.

Trap shall be cast integral with pan. The seat shall be of smooth non- combustible non-absorbent materials like Bakelite and of the open front type fixed to the pan with hinges.

The fittings shall also include 1/2 inch tee stopcock, with wall cover, plastic water inlet connection pipe nuts bolts etc. required for installation.

Disabled WC Apparatus, European Pattern

Disabled WC Apparatus, European Pattern, complete (coupled set), comprising closet 13 lit flushing cistern glazed, in white colour, seat cover, rails, handle etc complete set (IFO Porta, Marchi pattern or equivalent), fixed to concrete, brick, stone or wood work, best quality as per instruction of Engineer incharge.

Urinal

Urinal, basin/stall pattern best (imported yide or equivalent quality white) or as approved by the Engineer Incharge, including connection to out-going pipe and to flushing pipe complete.

5.2.4 Sinks

Sink shall be stainless steel of approved make single bowl with integral drain board of specified size. It shall be installed as a complete unit with 1/2" dia. cold and hot water C.P mixer, CP brass strainer, CP brass waste outlet and UPVC waste pipe, heavy cast iron brackets with bolts screws etc. Joints, jointing and sealing material, etc., with all other minor accessories or as approved by the Engineer Incharge.

5.2.5 Shower / Mixer

Shower head shall be local best quality chromium plated adjustable type installed on the wall at suitable height, complete with cold and hot water mixer and all accessories such as chromium plated extension pipe, C.P. brass escutcheon etc. It shall be mounted on the wall at a suitable height near the shower head complete with all accessories or as approved by the Engineer Incharge.

5.2.6 Wash Basin

Wash Basin with pedestal, glazed ware, Imported (China) (like Porta design or equivalent) / local in white / Ivory colour or as approved by the Engineer Incharge with one hole, complete with waste pipe coupling, CP chain and plug and pedestal etc (except mixer) best quality, fixed to concrete, brick stone, or wood work or as approved by the Engineer Incharge.

5.2.7 Disabled Bath Wash Basin

Disabled Bath Wash Basin, glazed ware, Imported (like Porta, Marchi design or equivalent) in white / Ivory colour, or as approved by the Engineer Incharge one hole, complete with waste pipe coupling, CP chain and plug, automatic mixer etc best quality, fixed to concrete, brick, stone or wood work as per instruction of Engineer Incharge.

5.2.8 Mirror

Mirror, any shape and pattern, circular, rectangular, oval etc upto 2700 sqcm, 5 mm

thick, Imported (mirror foreign made, but frame Pak made) with plastic frame, any colour, edges ground, or as approved by the Engineer complete, fixed to concrete, brick stone, or wood work.

- 5.2.9 Towel Rail, CP  
Towel Rail, CP, single rod, any pattern, shape and size, imported, or as approved by the Engineer with plugs, screws etc complete, fixed to concrete, bricks, stone or wood work.
- 5.2.10 Toilet Paper Holder  
Toilet Paper Holder, any shape pattern and size, imported, or as approved by the Engineer with plugs, screws etc complete, fixed to concrete, bricks, stone or wood work.
- 5.2.11 Soap / Sponge Tray  
Soap / Sponge Tray any shape pattern and size, imported, or as approved by the Engineer complete with plugs, screws etc complete, fixed to concrete, bricks, stone or wood work.
- 5.2.12 Brush / Tumbler Holder  
Brush / Tumbler Holder any shape pattern and size, Imported / Local complete or approved by the Engineer with plugs, screws etc fixed to concrete, bricks, stone or wood work.
- 5.2.13 Muslim Shower  
Muslim shower with double bib cock & ring pipe etc complete imported quality like Grohe or equivalent) or as approved by the Engineer.
- 5.2.14 Testing and Commissioning  
All fixtures shall be tested for soundness, stability or support and satisfactory operation.

## 6.0 MISCELLANEOUS ITEMS

### 6.1 Scope

The work under this section of the specifications consists of providing all material and labor, equipment, appliances etc., for supply and proper installation of miscellaneous plumbing items valves, cocks, floor traps, floor drain, clean outs, mirror, electric water cooler, gas water heater, float valve, foot valve, irrigation outlet etc. as specified, herein or as shown on the Drawing or as directed by the Engineer Incharge. The Contractor shall furnish appropriate catalogues and literature and obtain approval of the Engineer Incharge before purchase,

### 6.2 Material and Installation

#### 6.2.1 Bronze Valves

All valves of 100 inch diameter and smaller shall be of bronze unless otherwise specified conforming to BS 5154 and shall be of appropriate class for the working pressure of the system on which they are installed. Open and shut indicators shall be marked on the spindle. The ends may be screwed or flanged.

#### 6.2.2 Taps and Cocks

All the taps and cocks shall be of brass, gunmetal or other equally suitable corrosion resisting alloy conforming to BS 1010 and shall be imported in addition be chrome plated. The nominal size specified shall be the nominal bore of the seating. The area of the waterway throughout the body shall be not less than the area of a circle of diameter equal to the nominal size of tap/cock. Washers for cold water cocks shall be of specially selected leather, rubber asbestos composition or other equally suitable material. Every tap/cock shall be tested, complete with its component parts, to a hydraulic pressure of at least one and half times working pressure. During test it shall neither leak nor sweat.

#### 6.2.3 Floor Drains

Floor drains shall be of cast iron or of other anti-corrosive metal. They shall have minimum water seal of 3/4 inch and shall be provided with removable metal strainers. The traps shall be of self-clearing type. The open area of the strainer shall be at least equal to

the cross section area of the drain line to which it connects. Floor drains shall have provision for connection above the water seal. Floor drain shall be well set in position so that there is no leakage at the joint between trap and the floor.

6.2.4 Cleanouts

Clean outs shall be of the same nominal size as that of the pipe on which it is installed. Cleanout shall consist of tapped heavy duty cast iron ferrule caulked into cast iron fitting and heavy duty brass tapered even plug. Cleanouts shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of cleanout shall be flush with the floor by means of finished metal plate secured in position and screwed firmly to the plug.

Cleanout shall be so installed that there is a clearance of at least 12 inches for pipes less than 3 inches diameter and at least 18 inches for pipes of 3 inches and larger diameter, for the purpose of rodding.

6.2.5 Floor Traps

Floor traps shall be of cast iron or of other corrosive metal. They shall have minimum water seal of  $\frac{1}{2}$  inch, and shall be provided with removable nickel bronze strainers, the traps shall be of self-cleaning type. The open area of the strainer shall be greater than the cross section area of the drain line to which it connects. Floor traps shall be well set in position so that there is no leakage at the joint between trap and the floor.

6.2.6 Float Valve

Float valve shall be of copper alloy, piston type and conform to BS 1212. Float shall be of copper conforming to BS 1968 where required or indicated on the drawing.

6.2.7 Foot Valve

Foot valve shall be installed on the suction line of the pumps where required or indicated on the drawing. Foot valve shall be of brass, and shall be provided with integral strainer. Foot valve shall be provided with a spring loaded vertical check disc with gasket for tight shut-off.

6.2.8 Floor Gully

Floor Gully's shall be of cast iron or of other anticorrosive metal, and provided with removable nickel bronze strainers. The open area of the strainers shall be greater than the cross section area of the drain line to which it connects. Floor gullies shall be well set in position so that there is no leakage at the joint between gully and the floor. Therefore floor gully where required or indicated on the drawing.

6.2.9 Gully Traps

Gully traps in block masonry chamber as shown on the drawing shall be provided with a P-trap having a 1 inch minimum water seal and a cast iron frame and cover of size 12" x 12" and shall be internally plastered with pudlo as approved by Engineer Incharge.

6.2.10 Cowl

All vent pipe terminating above the building shall be provided with best quality cast iron cowl and a stainless steel clamp for clamping of water proofing membrane as approved by the Engineer Incharge.

6.2.11 Orifice Plates

Where the static pressure at any connection exceeds limits an orifice plates shall be installed prior to the valve to reduce the water flow so that pressure does not exceed the required limit. The orifice plate shall be constructed of 12mm thick stainless steel plate and shall be installed between two steel flanges. Size of orifice shall be as obtained from the Engineer Incharge prior to fabrication.

## 7.0 ROOF DRAINAGE

### 7.1. Roof Drains

Roof drains shall be Upvc pipes. They shall have dome shaped strainers extending above the roof surface. Bottom of strainer shall be flush with the roof surface. Strainer shall have an available inlet area, above roof level, of not less than 1-1/2 times the area of the down- pipe to which the drain is connected. The connection between roof and roof drain shall be made watertight by the use of proper flashing material.

7.2 Rain Water Shoe

Rain water shoe shall be of bitumen/asphalt coated cast iron, anti-splash type to B.S. 416. The grade of shoe shall be same as that for rain water pipe to which it connects. The shoe shall be fixed 12 inches above the surface to which it discharges freely.

**8.0 UPVC PIPE & FITTINGS**

**8.1 UPVC Waste and Vent Pipes & Fittings**

Unplasticized PVC pipes for waste and vent shall be non-pressure pipes conforming to BS- 4514. Fittings and specials for use with UPVC pipes shall conform to BS-4346 with elastomeric (Rubber ring) or solvent cement joint to BS-4346, Clamps hangers and supports shall be as required for G.I. pipes.

**9. GALVANIZING:**

Galvanising shall comply with BS 729. The term 'galvanised' shall apply to hot dip or electrolytic galvanising, zinc spraying or cadmium plating. All surfaces shall be degreased, washed with mineral turpentine and given a coat of latex based primer prior to the application of final coats. After fabrication, pickle or abrasive blast clean all steelworks to be hot dipped galvanised.

**10. SEQUENCING AND SCHEDULING:**

- a. Coordinate plumbing piping and equipment installation with other building components.
- b. Arrange for chases, slots and openings in building structure during progress of construction, to allow for plumbing installations.
- c. Coordinate the installation of required supporting devices and set sleeves in poured in- place concrete and other structural components, as they are constructed.
- d. Sequence, coordinate and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- e. Coordinate connection of plumbing systems with other utilities and services. Comply with requirements of governing regulations, service companies, and consultants.
- f. Coordinate requirements for access panels and doors where items requiring access are concealed behind finished surfaces.
- g. Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

\*\*\*END OF SECTION\*\*\*

## TESTING AND COMMISSIONING

### 1.0 SCOPE OF WORK

The work under this section of specifications includes visual inspection, furnishing all plant, labor, equipment, appliances and materials and performing all operations required in connection with testing and commissioning of all water line, drainage system and fixture etc. in parts and as a whole as specified herein or as shown in the Contract Documents or as directed by the Engineer Incharge.

### 2.0 GENERAL

The testing shall include a complete visual inspection of the whole plumbing and firefighting system and verification of performance as stipulated in the material specification and of correct functioning of the electrical and control systems.

All supply documents, operating instructions, acceptance documentation and maintenance regulations shall be checked to ensure that they correspond with equipment described and also all certificates such as that of the inspection authorities, test certificates and data about quality, temperature and pressure shall be submitted.

### 3.0 FIXTURES AND FITTINGS

#### 3.1 Test Program

The type and the catalogue number of the sanitary fixtures shall be checked.

All equipment in general including the accessories shall be checked for service ability, correct operation and freedom from damage.

The flow and water capacity shall be checked on the full connection of lavatories, showers, WC's, etc. and also the draining capacity shall be measured at the same time.

### 4.0 POTABLE WATER SUPPLY SYSTEMS HOT & COLD

#### 4.1 Test Program

The method of laying and sealing the water connection lines to the buildings and through walls shall be checked.

Visual inspections shall be made of the entire network for the water systems with regard to laying, fixing, suspension of pipes and fixtures, particularly the arrangements of the fixed points and the separation of the individual connections in the various parts of the system.

The satisfactory function of all valves, air relief valve check-valves, pressure reducers, thermostats, pumps, etc., shall be checked. The test programme shall also cover.

Checking of type, thickness and professional laying of the piping insulation. Checking number, form and inscription of the equipment labeling.

Checking of all pipe and flanged connections to devices, water-heaters, drainage and vents for symmetry and lack of strain.

Performance of pressure test for the entire network, including fixtures.

#### 4.2 Hydraulic Pressure Test

On completion of the pipe work installation or sections thereof as required, pressure test shall be made before the application of insulation. The pressure tests shall be taken by sectors. All equipment and accessories shall be provided and the Engineer Incharge shall be given notice that the work is ready for testing. Tests shall be made by pumping up the system to the required pressure then closing the valves between the pump and the section under test. The valve shall remain closed for the duration of the test and the pump shall be disconnected. Test pressure, as detailed below shall be applied as detailed for a period two hours or longer, at the discretion of the Engineer Incharge. If, at

the end of period, there is no drop in pressure and no evidence of leak or other faults, the test will be considered satisfactory. Should any fault be revealed by the test, leaks are to be recorded, Faults shall be made good and the pipe work retested as many times as necessary until satisfactory results are obtained.

After all the pipes and fixtures have been properly laid and tested, they shall be flushed clean with water and then disinfected with water solution of chlorine of at least 50 PPM strength for a contact period 6 hours. The system will be finally flushed with clean water.

**4.3 Test Pressure and Procedure**

Fill pipes slowly with potable water to exclude all air. Apply test pressure of 1.5 times the maximum working pressure. There must be no measurable loss of pressure for at least 30 minutes.

**5.0 DRAINAGE SYSTEMS**

**5.1 Test Program**

Check the piping by means of the separation system, In relation to the specified capacity.

Check each connection for dimension and draining capacity.

Check the drain line for laying, fixing, and compliance with specification.

Check the practical arrangement of the fixtures, fixing points, suspensions, cleaning openings, vents, pit covers and ground inlets.

Check all the covers and openings, paying special attention to the separation system for waste/sewage and the storm water.

Generally provide clean water and apparatus for testing.

**5.2 Test Methods**

**a. Water Testing**

All the openings in the piping system shall be tightly closed by inserting testing plug. The highest point will be left open to supply water and may be raised if necessary by temporary jointing, develop a minimum static head of 05 bars for of water at each section of the system. Water is filled to the point of overflow and any drop in the level of water will indicate a leak that will be found by inspection. The water level will be checked for no drop for at least 15 to 30 minutes. Higher stacks will be tested in sections, starting from the top section and then connecting top section to next lower section.

**b. Timing**

Testing shall be carried out as soon as practicable after completion of each drainage stack. All concealed work shall be tested before being finally enclosed.

**\*\*\*END OF SECTION\*\***

## **DISINFECTION**

### **1.0 SCOPE OF WORK**

The work under this section of specifications includes furnishing all plant, labor, equipment, appliances and materials and performing all operations required in connection with disinfecting of all potable water lines in parts and as a whole as specified herein or as shown in the Contract Documents or as directed by the Engineer Incharge.

### **2.0 DISINFECTION**

After successful completion of pressure tests the entire potable water distribution system in the building shall be thoroughly flushed with water to remove all entrained dirt and mud before disinfecting of the system. The disinfecting chemical shall preferably be hypochlorite solution. However, bleaching powder may be used as alternate material with the approval of the Engineer Incharge. Use of gaseous chlorine shall not be allowed for disinfecting.

The chlorine solution shall be introduced into the system until the system is filled with the solution and all entrapped air is expelled from the system. The solution shall be retained in the system for at least 24 hours.

At the end of the period solution will be tested for chlorine residua, which shall not be less than 10 PPM of chlorine throughout the system.

The disinfections process shall be repeated if chlorine required is less than 10 PPM at any location of the system.

After successful completion of disinfection the system shall be flushed with potable water until the residual chlorine is reduced to less than 1 PPM.

During disinfection period all the valves and faucets shall be opened and closed several times to ensure that all parts of the valves are also disinfected.

**\*\*\* END OF SECTION\*\*\***

## **DRAINAGE / SEWAGE AND SEPTIC TANKS**

### **1.0 GULLIES**

- a. To be glazed ware and are to be set truly level and jointed to drain pipes in cement mortar (1:1). Gullies to be encased in cement concrete (1:3:6).
- b. Cleaning eyes are to be provided to gullies, when the distance between the gully and the manhole exceeds 6 meters.

### **2.0 INTERCEPTION CHAMBERS**

To be as described for manholes but to include an intercepting trap of approved pattern, with cleaning arm, having an approved stopper fitted with a galvanized iron lever and chain complete. This trap to be carefully bedded in concrete on the discharge side of the manhole and set so as to ensure that the normal —dropl from inlet to outlet is preserved.

### **3.0 LAYING DRAINS**

Every line of drain shall be accurately laid and be perfectly true to line and gradient from point to point. Every main drain shall be true from manhole to manhole and any change in direction shall take place inside the manhole by the use of taper channels, straight or curved as necessary and not by the use of tapers or bend in the line drain outside the manhole.

### **4.0 MANHOLES**

Will be designed according to the depth and the number of sewage line meeting at the points. These shall be constructed as under.

- a. Excavate in any soil, make good and dispose of surplus spoil.
- b. Foundations shall be 150 mm thick, as shown in drawings.
- c. Bolsters around manhole covers shall be of 150 mm x 150 mm of CC 1:2:4.
- d. Benchings shall be cement concrete (1:3:6) with main and branch channels formed their in raising 45 degrees from channel edges and all surfaces trowelled smooth.
- e. Cover slabs shall be of stone or precast concrete bedded in cement mortar.
  - (1) Stone covers shall be 75mm thick of approved strong slab of self-faced stone.
  - (2) Cement concrete 1:2:4 reinforced with bars as shown in drawings with surfaces and edges finished fair.
- f. Cover and frame will be bedded in mortar bolstered round with 150mm x 150mm cement concrete 1:2:4.
- g. Mortar shall be cement mortar 1:3.
- h. Walls shall be either of the following as ordered.
  - (1) Burnt brick work 230 mm thick in CM 1:3.
  - (2) Approved rubble stone 300 mm thick in CM 1:3.
  - (3) Solid concrete blocks 1:2:4, 200 Poured cement concrete 1:3:6, 230 mm thick.
  - (4) R.C.C 1:2:4, 100 mm thick reinforced with deformed steel bars.
  - (5) mm thick in CM 1:3.
- j. Internal faces of walls shall be hacked for plaster key, cleaned dubbed out with mortar and rendered not less than 13mm thick with CM 1:3.
- k. If rock is encountered in excavation of the manholes, prior orders of the Engineer incharge will be obtained before starting excavation. Extra payment for rock will be excavation will be deducted at the average rate of ordinary and hard soil rates.

### **5.0 MANHOLES COVERS**

Precast Plank covers shall be as specified and as shown in drawings

## **6.0 TESTING**

- a. All new drains, manholes, etc will be tested before haunching with concrete and before the trenches are filled in at the contractor's expense.
- b. All drains are to be tested by filling with water having a head of not less than 0.6 m and not more than 1.8 m above the top of the lowest pipe in the length to be tested.
- c. Manholes and branch drains discharging into manholes will be tested independently. All vent pipes and soil pipes will be tested by a smoke test.
- d. The contractor is to be responsible for any disturbance of the drains, etc, after they have passed the test satisfactory. After drains are laid an interval of at least 48 hrs must elapse before testing to allow sufficient time for the joints to set.
- e. For smoke testing the smoke machine and necessary chemicals or smoke rockets to be provided by the contractor. The tests will be carried out in such a manner as the Engineer incharge will direct and to his satisfaction and at the contractor's expense.

## **7.0 WIRE GUARDS**

To be of stout wire, galvanized after manufacture, dome or balloon pattern as ordered, to be fixed over outlets of down pipes or tops of ventilating pipes.

## **8.0 DAMAGES ETC**

The contractor will be responsible for any disturbance / damage to the sewage lines even after the test within maintenance period.

## **METHOD OF MEASUREMENTS**

### **9.0 PIPE WORK GENERALLY SHALL BE MEASURED**

Net overall length of pipes and fittings as fixed except where otherwise indicated.

### **10.0 MANHOLES**

Internal plan area x height (as defined below).

- a. Uniform area on plan:-  
Height = From invert to top of manhole cover.
- b. With shaft of reduced area:-
  - (1) Chamber Height = From invert to junction of shaft with chamber internal plan area of chamber.
  - (2) Shaft Height = From junction of shaft with chamber or top of manhole cover. Internal plan area of shaft.
- c. The internal area of circular manholes shall be the internal diameter squared. In calculating internal area of shafts, ignore any corbelling out.

### **11.0 CLARIFICATION OF RATES**

The rates, inter alia, include particularly.

- a. Fixing complete in long or short lengths, including running joints in the length.
- b. Making good surface disturbed.
- c. Cutting hole in wall, and roof and making good.

**\*\*\*END OF SECTION\*\*\***

## **ELECTRIC DOMESTIC WATER HEATERS / GEYSERS**

### **GENERAL**

#### **1.1 DESCRIPTION:**

This section describes the requirements for installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.

#### **1.2 RELATED WORK:**

- A. PAINTING: Preparation and finish painting.
- B. COMMON WORK RESULTS FOR PLUMBING.
- C. DOMESTIC WATER PUMPS: Circulating Pumps.
- D. Heater Insulation.
- E. METERS AND GAGES FOR PLUMBING PIPING, GENERAL-DUTY VALVES FOR PLUMBING PIPING, FACILITY WATER DISTRIBUTION: Piping, Fittings, Valves and Gages.
- F. SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraint for Equipment.

#### **1.3 QUALITY ASSURANCE:**

- A. Comply with American Society of Heating, Refrigerating and Air- Conditioning Engineers (ASHRAE) for efficiency performance:
  - 1. ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings, for commercial water heaters.
- B. Electrical components, devices and accessories shall be listed and labeled B as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
- C. ASME code construction shall be a vessel fabricated in compliance with the ASME boiler and Pressure Vessel Code.
- D. Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, —Drinking Water System Components – Health Effects.
- E. The electric domestic water heater shall conform to Seismic restraint requirements, withstanding Seismic movement without separation of any parts from the equipment when subjected to a Seismic event.

#### **1.4 SUBMITTALS:**

A. Submit manufacturer's literature and data pertaining to the water heater in properly bound package, in accordance with contract SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Include the following as a minimum:

1. Water Heaters.
  2. Pressure and Temperature Relief Valves.
  3. Thermometers.
  4. Pressure Gages.
  5. Vacuum Breakers.
- B. For each electric domestic hot water heater type and size, the following characteristics shall be submitted:
1. Rated Capacities.
  2. Operating characteristics.
  3. Electrical characteristics.
  4. Furnished specialties and accessories.
  5. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel code.
- C. Shop drawings shall include wiring diagrams for power, signal and control functions.
- D. Seismic qualification certificates shall be submitted that details equipment anchorage components, identifies equipment center of gravity with mounting and anchorage provisions, and whether the seismic qualification certificate is based on an actual test or calculations.
- E. The domestic water heater shall be certified and labeled by a testing agency.

## **1.5 AS-BUILT DOCUMENTATION**

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended.
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the Employer will be required to employ shall be inserted into the As-Built documentation.

## **PRODUCTS**

### **2.1 ELECTRIC DOMESTIC WATER HEATERS:**

- A. The tank construction shall be steel shell, with a inner tank liner complying with NSF 61 for barrier materials for potable water. The inner liner shall be extended into the tappings. The vessel shall be ASME Boiler and Pressure Vessel Code (BPVC), section VIII, fabricated with a pressure rating of 1035 kPa (150 psig).
- B. Tapping (openings) shall be Factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards B1.20.1 for piping connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls as required. Tappings shall comply with the following:
  - 1. 50 mm or DN50 (2 inch) and smaller: Threaded ends according to ASME B1.20.1.
  - 2. 65 mm or DN65 (2 1/2-inch) and Larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B 16.24.
- C. Tank insulation shall comply with ASHRAE 90.1.
- D. For domestic hot water heater sizes greater than 9 KW, the heating element shall be arranged in multiples of three elements. For heaters less than 9 KW, the heater elements shall be arranged in/single/double/elements.
- E. The domestic hot water heaters shall have screw in or bolt in immersion type, thermostatically adjustable. Set thermostat for maximum water temperature of 55°C (130°F). The electrical characteristics are scheduled on the drawings.
- F. Combination Pressure and Temperature Relief Valves shall be ASME rated and stamped for combination temperature and pressure relief valves. One or more relief valves with total relieving capacity at least as great as the heat input shall be included. The pressure setting shall be less than the domestic water heater working pressure rating.
- G. The anode rod shall be replaceable magnesium.
- H. The drain valve shall be corrosion resistant metal complying with ASSE 1005.

## **2.2 DOMESTIC HOT WATER COMPRESSION TANKS**

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air pre charge shall be set to minimum system operating pressure at tank.
- B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- C. The interior finish shall comply with NSF 61 barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- D. The air charging valve shall be factory installed.

## **2.3 ELEVATED ELECTRIC WATER HEATER DRAIN PAN**

- A. A stainless steel drain pan shall be provided that is large enough to contain the volume of the heater. The drain pan shall include a drain outlet not less than 20 millimeter or DN 20 (NPS 3/4) with ASME B1.20.7 garden hose threads.

## **2.4 HEAT TRAPS**

- A. Heat traps shall be installed in accordance with ASHRAE 90.1, latest edition.

## **2.5 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES**

- A. The combination temperature and pressure relief valves shall be ASME rated and stamped and include a relieving capacity at least as great as the heat input and include a pressure setting less than the water heater's working pressure rating.

## **2.6 THERMOMETERS:**

The thermometers shall be straight stem, iron case, red reflecting mercury thermometer or red liquid-filled thermometers, approximately 175 mm (7 inches) high, 4 to 115°C (40 to 240°F).

## **EXECUTION**

### **3.1 INSTALLATION:**

- A. Water heaters shall be installed on concrete bases unless elevated above the floor. Refer to Specification CAST-IN-PLACE CONCRETE and COMMON WORK RESULTS FOR PLUMBING.
- B. The water heaters shall be installed level and plumb and securely anchored.
- C. The water heaters shall be installed and connected in accordance with manufacturer's written instructions.
- D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains.
- E. Thermometers shall be installed on the water heater inlet and outlet piping.
- F. The thermostatic control shall be set for a maximum setting of 54 degrees C (130 degrees F).
- G. Shutoff valves shall be installed on the domestic water supply piping to the waterheater and on the domestic hot water outlet piping.
- H. All manufacturer's required clearances shall be maintained.
- I. The electric domestic water heaters shall be installed with seismic restraint devices.
- J. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
- K. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic hot water heater storage tanks.
- L. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for electric domestic hot water heaters without integral drains.

### **3.2 LEAKAGE TEST:**

Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 1375 kPa (200 psi) and 1654 kPa (240 psi) for a unit with a MAWP of 1103 kPa (160 psi). Any domestic water heater leaking water shall be replaced with a new unit at no additional cost to the Employer.

### **3.3 PERFORMANCE TEST:**

All of the remote water outlets shall have a minimum of 49°C (120°F) and a maximum of 54°C (130°F) water flow at all times. If necessary, make all corrections to balance the return water system or reset the thermostat to make the system comply with design requirements.

**\*\*\*END OF SECTION\*\*\***

## **SUMP PUMPS**

### **GENERAL**

#### **1.1 DESCRIPTION**

- A. Sump pumps. See Drawings for pump capacity and head.

#### **1.2 RELATED WORK**

- A. COMMON WORK RESULTS FOR PLUMBING.
- B. GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- C. COMMISSIONING OF PLUMBING SYSTEMS.  
  
Requirements for commissioning, systems readiness checklist, and training.
- D. LOW-VOLTAGE MOTOR STARTERS.

#### **1.3 SUBMITTALS**

- A. Submit in accordance with the contract or as directed by the Engineer Incharge, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Pump:
    - a. Manufacturer and model
    - b. Operating speed
    - c. Capacity
    - d. Characteristic performance curves
  - 2. Motor:
    - a. Manufacturer, frame and type
    - b. Speed
    - c. Current Characteristics and W (HP)
    - d. Efficiency
- C. Certified copies of all the factory and construction site test data sheets and reports.
- D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
  - 1. Include complete list which indicates all components of the system.
  - 2. Include complete diagrams of the internal wiring for each item of equipment.
  - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- E. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements COMMISSIONING OF PLUMBING SYSTEMS.

## PRODUCTS

### 2.1 SUMP PUMP

- A. Centrifugal, vertical, submersible pump and motor, designed for 60 82 degrees C (140 180 degrees F) maximum water service. Driver shall be electric motor. Support shall be rigid type. Provide perforated, suction strainer. Systems may include one, two, or more pumps with alternator as required by: Contract Documents Pump Pumps shall be capable of continuous duty cycle.
1. Pump housings may be cast iron, bronze, aluminum, plastic or stainless steel. Cast iron and aluminum housings for submersible pumps shall be epoxy coated.
- B. Impeller: Brass, bronze or cast iron.
- C. Shaft: Stainless steel or other approved corrosion-resisting metal.
- D. Bearings: As required to hold shaft alignment, anti-friction type for thrust permanently lubricated.
- E. Motor: Maximum 40 degrees C (104 degrees F) ambient temperature rise above the maximum fluid temperature being pumped, drip-proof completely enclosed , voltage and phase as shown in schedule on Electrical drawings. Size the motor capacity to operate pump without overloading the motor at any point on the pump curve. GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- F. Starting Switch: Manually-operated, tumbler type, as specified in LOW-VOLTAGE MOTOR STARTERS.
- G. Automatic Control and Level Alarm: Furnish a control panel in a Nema 1 enclosure for indoors or in a Nema 4X enclosure for outdoors. The controls shall be suitable for operation with the electrical characteristics listed on the Electrical drawings. The control panel shall have a level control system with switches to start and stop pumps automatically, and to activate a high water alarm. The level control system will include sensors in the sump that detect the level of the liquid. The sensors may be float type switches, ultrasonic level sensors, transducers, or other appropriate equipment. The high water alarm shall have a red beacon light at the control panel and a buzzer, horn, or bell. The alarm shall have a silencing switch. Provide auxiliary contacts for remote alarming to the Energy Control Center and BAC net compatible open-protocol type interface to DDC Controls System.
1. The circuitry of the control panel shall include:
    - a. Power switch to turn on/off the automatic control mechanism
    - b. HOA switches to manually override automatic control mechanism
    - c. Run lights to indicate when pumps are powered up
      - a. Level status lights to indicate when water in sump has reached the predetermined on/off and alarm levels
      - b. Magnetic motor contactors
      - c. Disconnect/breaker for each pump
      - d. Automatic motor overload protection
  2. Sensors that detect the level of water in the sump shall be so arranged as to allow the accumulation of enough volume of liquid below the normal on level that the pump will run for a minimum cycle time as recommended by the pump manufacturer. Sensors shall be located to activate the alarm adequately before the water level rises to the inlet pipe.

3. Provide two separate power supplies to the control panel, one for the control/alarm circuitry and one for power to the pump motors. Each power supply is to be fed from its own breaker so that if a pump overload trips a breaker, the alarm system will still function. Each power supply is to be wired in its own conduit.
  4. Wiring from the sump to the control panel shall have separate conduits for the pump power and for the sensor switches. All conduits are to be sealed at the basin and at the control panel to prevent the intrusion of moisture and of flammable and/or corrosive gases.
- H. Sump: Furnish cast iron or fiberglass basin with gas tight covers. Cover shall have 280 mm by 380 mm (11-inch by 15-inch) manhole with bolted cover, vent connection, openings for pumps and controls. Sump shall be sized to allow an adequate volume of water to accumulate for a minimum one minute cycle of pump operation.
- I. Provide a check and ball valve in the discharge of each pump.
- J. Removal/Disconnect System: In a system utilizing a submersible pump, where sump depth, pump size, or other conditions make removal of the pump unusually difficult or unsafe, a removal/disconnect system shall be provided. The system will consist of a discharge fitting mounted on vertical guide rails attached to the sump. The pump shall be fitted with an adapter fitting that easily connects to/disconnects from the discharge fitting as the pump is raised from or lowered into the sump. The discharge piping will connect to the discharge fitting so that it is not necessary to disconnect any piping in order to remove the pump. Where the sump depth is greater than five feet or other conditions exist to make the removal of the pump difficult or hazardous, the system shall include a rail guided quick disconnect apparatus to allow the pump to be pulled up out of the sump without workers entering the sump and without disconnecting the piping.

## **EXECUTION**

### **3.1 STARTUP AND TESTING**

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. The tests shall include system capacity and all control and alarm functions.
- C. When any defects are detected, correct defects and repeat test.
- D. An agent of the manufacturer will observe startup and contractor testing of selected equipment. The Contractor will coordinate the startup and testing schedules with the Engineer Incharge and Agent, with a minimum of 7 days prior notice.

### **3.2 COMMISSIONING**

- A. Provide commissioning documentation accordance with the requirements of the Contracts COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.3 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct Employer Personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of the Contract.

\*\*\*END OF SECTION\*\*\*

## **GREASE TRAPS**

### **GENERAL**

#### **1.01 SCOPE**

Grease traps are required wherever wastewater sources contain animal and vegetable derived grease products.

#### **1.02 SUBMITTALS**

Submit shop drawings and manufacturer's literature to the Engineer Incharge for approval in accordance with the Contract - Submittals.

### **PRODUCTS**

#### **2.01 MATERIALS**

- A. Grease traps shall be manufactured in accordance with ASTM C1613 - Standard Specification for Precast Concrete Grease Interceptor Tanks.
- B. All grease traps shall be externally located, RCC units designed specifically for removing FOG (fat, oil, grease) from wastewater.
- C. Use a precast Plank as a man-hole cover.

### **EXECUTION**

#### **3.01 DESIGN**

- A. Grease traps are to be designed for peak flow and sized based on required retention time. Retention time shall be based on the manufacturer's recommendation for operational discharge of less than 200 mg/L of FOG during peak flows.
- B. Grease traps shall be designed and certified to operate efficiently at their maximum flow rate in GPM, and retain a minimum of twice its rated GPM in pounds of grease.
- C. All design calculations and system designs shall be submitted to Engineer Incharge for review and approval.
- D. Grease traps shall be sized in accordance with Standard PDI-G101 from the Plumbing and Draining Institute.

#### **3.02 DELIVERY AND STORAGE**

- A. Inspect materials delivered to site for damage; unload and store with minimum handling.
- B. Store materials on-site within enclosures or under protective coatings to protect against inclement weather and direct sunlight.

#### **3.03 INSTALLATION**

- A. Grease traps shall be installed as shown on the Drawings and in strict accordance with the manufacturer's recommendations.
- B. Grease traps shall not be located under pavement but shall be located within five feet of a paved vehicle access for cleaning and inspection, whenever possible.
- C. Only waste from grease producing sources shall flow through the grease trap. All grease traps shall be located upstream of the location where human waste enters the service line. Sanitary wastes and other wastes shall flow through a separate lateral and connect to the receiving main.

#### **3.04 QUALITY ASSURANCE AND TESTING**

- A. The grease trap shall be fabricated, inspected, and tested for leakage before shipment from the factory as a completely assembled system ready for installation.
- B. Conduct pressure and leakage tests as required by the contract or as directed by the Engineer Incharge.

**\*\*\*END OF SECTION\*\*\***

## SOAK PIT

### 1.01 PERCOLATION TEST

Prior to construction of the Soak Pit, this Contractor shall be required to perform a percolation test to determine the absorption capacity of the soil. The test shall be conducted as follows:

- a. A test pit shall be dug approximately 5 feet in diameter and to such a depth as to reach porous soil, but not less than 8 feet
- b. In the bottom of this pit a 12" square and 12" deep hole shall be made.
- c. The hole shall be filled with water for a depth of 7 inch. For pre-watering purposes, the water level shall be allowed to drop to 6 inches, before time of recording is started.
- d. After the level of the water has dropped to 6 inches, the time required for the water level to drop every inch shall be recorded, till the level is 2 inch.
- e. The hole shall again be refilled and the test repeated.
- f. After the test, the thickness of the porous soil below the point of percolation shall be determined by using a soil auger, and the depth indicated in the test report.
- g. If sub-soil water is encountered, the test report shall indicate the level of the same.

The final number and size of the soakage pits shall be provided to the Contractor after the result of the percolation test are received.

### 1.02 CONSTRUCTION:

**Size:** The soakage Pit shall be constructed as shown on the drawing. The size and quantity of the soakage pits shall be finally determined after receipt of the percolation test results by the Engineer Incharge. Soakage pit shall not penetrate ground water table.

**Excavation:** The excavation of the soakage pit shall be greater in diameter than the outside diameter of the vertical side walls to allow for the footing. To prevent soil collapse, excavation of the soil at an angle may be required.

**Annular Space:** The annular space between the outside of the vertical walls and the excavation shall be filled with broken stone, coarse gravel or other suitable material.

**Bottom:** The soak Pit bottom shall be open, with an outer ring to support the side walls. **Side**

**Walls:** The side walls shall be made of brick up as shown in drawings

**Top:** The Soak Pit top shall be of 100mm thick 1:2:4 RCC and shall be provided with one 24" x 24" RCC Cover with C.I. frame, as approved by the Engineer Incharge.

**Reinforcement:** Reinforcement to construct a structurally sound structure shall be provided as per good engineering standard.

### 1.03 PAYMENT:

Payment shall be made per unit rate for the complete soak well as specified in the BOQ, and shall be deemed to include the cost of the percolation test, excavation, backfilling, all masonry & concrete works, soak-pit fillers, manhole cover and other works required to complete the soak well in all respects.

\*\*\*END OF SECTION\*\*\*

## **TUBE WELL**

### **1.01 SCOPE OF WORK:**

The Specifications are for the drilling of tubewells equipped with pumps. The Contractor shall provide all labor, transport, plant, tools, equipment and materials and appurtenances, and shall perform all works necessary; to satisfaction of Engineer Incharge, including but not limited to the following:

- a. Construct and complete successfully drilled tubewells including lowering of tubewell assembly with PVC casing and Screen and end cap,
- b. gravel pack at appropriate intervals and back fill, close near surface water table aquifer,
- c. cleaning and development of tubewells,
- d. pump test for 3 hours,
- e. chlorinate tubewell,
- f. Construct the concrete structure for the tube well
- g. install the pumping system
- h. Proceed to water security approval by an independent /authorized lab

Refer to drawings and bills of quantities for complementary information.

Please note, that all works, all supplementary materials, linings, accessories, preparation of the surfaces, fixing elements, any types of joints and any other items in connection with the Works not referred to or described in the Bill of Quantities but deemed necessary, should be executed according to the technical card of the material manufacturer and should be carried out in accordance with the Design Drawings, Specifications should be included in the price.

### **1.02 TUBE WELL CONSTRUCTION:**

A typical tube well section / well section are shown in annex 10. Basic methods of drilling are indicated below for following as basic guide, mostly to maintain a few key dimensional specifications.

#### **DRILLING METHODS**

1. The preferred method of drilling in consolidated compact formations is rotary or percussion with air and/or foam flush. Boreholes will be drilled 6 1/2 inches drill bits.
2. In unconsolidated loose, unstable, collapsing formations, rotary with appropriate drilling stabilizer will be used. In such a case the drilling diameters will be 6 1/2 inches. If other chemical fluids or solids are used to arrest collapsing of formations, the Contractor has to use proper tube well development methods and tube well cleaning methods to ensure the tube well water is safe for drinking purposes. The Contractor will use such fluids or solids with the agreement of the Engineer Incharge.
3. Boreholes will be constructed with PVC casing, screen and sand trap. Quality of all these materials used should be in conformity with the drinking water standards.
4. 20 m of slotted screen for Shallow tube well and 20 up to 40 m for Deep Tube Well will be installed in tube wells. All cost of using proper drilling fluids and solids is inclusive of the rate per feet quoted. No additional payments will be made.

#### **TUBE WELL DEPTH**

Tube wells shall be drilled to such depths as to penetrate below the shallow water table aquifers and tap the first potential deeper aquifer or aquifers in confined/semi-confined conditions.

The minimum discharge for each tube wells is 0.25 gpm to sustain continuous pump testing for 3 hours to ensure reliable operation of pumps fitted on them. The depth to be drilled should be, minimum twenty feet (20) feet below the main aquifer to provide proper installation of a hand pump and to provide a sand trap of 10 feet. If the discharge is less than 0.1 gallons/sec., a decision to abandon the tube well or continue to drill deeper will be at the discretion of the Contractor, validated by the Engineer incharge. Any drilling beyond 30 feet of the major strike which has supplied water greater than 0.1 gallon/ sec, Supervision Firm will not pay for that excess drilling and installation of casings etc.

### **TUBE WELL DIAMETER**

1. Tube wells will be drilled with telescopic diameters.
2. The first 20 feet from the surface will have concrete grouting for sanitary protection. For this the bore hole will be reamed to minimum diameter of 6 inches and concrete grouting placed in the annular space between the casing and open tube well wall.
3. Tube well will be drilled with 6 1/2 inches bit. The reaming diameter will be based on the type of temporary casing the implementing partner will use.
4. The implementing partner must take into account the depths he has to drill and lower temporary casing to complete the drilling. This cost must be built in the quoted unit cost for drilling.
5. The client will not be responsible for any loss of temporary casing which the Contractor is unable to pull out or lost due to snapping or breaking from the completed tube wells.

### **SCREEN**

1. The Contractor will use proprietary; factory-made UPVC slotted screens, the slot size and screen length depending on the aquifer materials and aquifer thickness. The Implementing partner will propose a scheme of equipment to the supervision firm who will take the responsibility of the design of the tube well. The Contractor will then assemble and place screen and casing at appropriate.
2. Slotted screens should be of ISO standard and have the following specifications: PVC Class 9/10, drinking water standards, nontoxic and in standard lengths of ten (10) feet in length, diameter of 4 inches, slot width 0.8 mm and not more than 1mm, and open area as percentage of internal surface area 9.26% per linear meter. Depending on the aquifer, the Implementing partner may choose an appropriate lot width other than 0.8 mm.

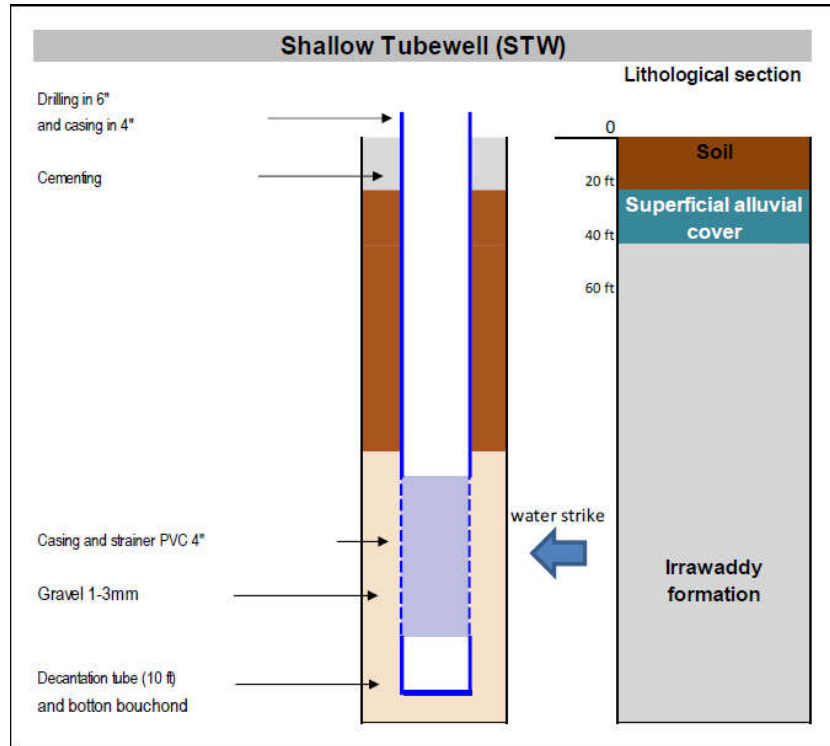
### **CASING PIPE AND SAND TRAP**

1. Casing pipe should be of ISO standard and have the following specifications: U- PVC Class 10, drinking water standards, non toxic and in standard lengths of ten (10) feet in length, diameter of 4 inches wall thickness 5 mm.
2. The tube wells will be fully cased up to bottom of the tube well. The threads both male and female are properly cleaned with a brush and cloth before they are joined. If the pipes used are with bell and socket, these are cleaned using fluids and cemented with recommended solvent cement by the manufacturers of the casing pipes and screen. Wait for recommended time for the joint set firmly before lowering it into the tube well.
3. The Contractor will take all necessary precautions during the transportation and storage of casing pipes from their warehouse to drilling site to prevent distortions, bending or deformation of the pipe that could result in eccentricity along the length of the pipe.
4. A maximum of 10 (10) feet length of sand trap will be part of the well design when tube wells are cased to the bottom. The sand trap will be from PVC casing pipe with specifications described above ; fitted to the end of last screen and bottom end with an end-cap. The end cap is glued with appropriate solvent cement or solutions as recommended by the UPVC manufacturer. Note that the joints sections are properly cleaned with cleaning fluids and recommended time given for the joint set firmly before lowering into the tube well.
5. Pipes and screens must be stored on a proper location and should be kept away from prolonged sunlight exposure.

### **GRAVEL PACKING AND GROUTING**

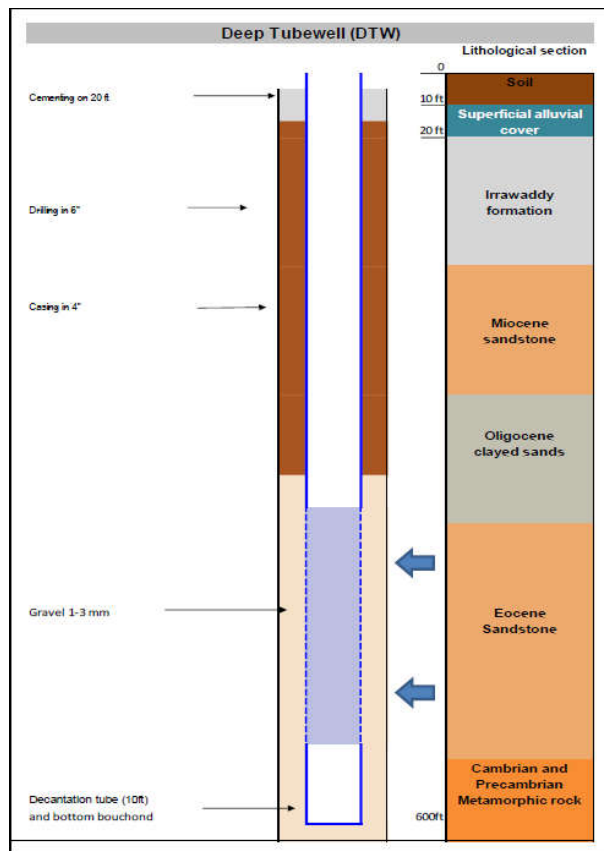
1. The annular space between the casing and tube well wall is filled with filter packing materials in the screen intervals and back filling materials. The gravel packing mixture to be used is 1-3 mm. It can be adapted to the ground condition (observing the cuttings) if necessary
2. Gravel packing is carried out as continuous feed operations done usually by two people filling uniformly along the circumference of the pipe. It is advisable to add some water with a pipe so that the gravel flows down. If the gravel gets inside the temporary casing, the casing is slowly pulled out and gentle well development is done to allow gravel to settle properly to a height of 10 feet above the top of the screen interval or the targeted water bearing formation. The gravel will be installed using the inverse flowing: gravel is poured down during water injection from the bottom of the borehole.
3. Backfilling and grouting is done when the Minimum acceptable yield of 0.1 gallon / second is confirmed by development. The tube well cuttings or clayey soils are back filled up to 20 feet below the ground surface.
4. The grouting is done with a concrete mix in the ratio of 1:2:3 of cement, sand and gravel respectively. The gravel size not more than 10-12 mm.

**PROFILE OF EXPECTED TUBEWELL**



Note:

These 2 diagrams are indicative, and details should be followed in the narrative of the technical specification.



### **1.03 TUBE WELL DEVELOPMENT**

On completion of drilling, the Contractor will choose a suitable and appropriate tube well development method. The tube well shall be developed for a period of one hour in order to obtain a maximum yield of water that is free of suspended matter. Developing shall be carried out by airlift pumping and surging, jetting and block surging, or other techniques the implementing partner feels is more appropriate and efficient to suit the hydro-geological and drilling conditions prevailing in that tube well. All tube wells shall be presented for testing free of any bridging or obstruction to the total depth.

### **1.04 PUMPING AND RECOVERY TEST**

- a. Pumping test will be for three hours for step draw down test at 0.25, 0.5 and 1 gps. Based on the estimated discharge, the Contractor will certify the tube well as either "successful" or "lost".
- b. The minimum discharge is 0.1 gps. Pump test data should be recorded in a standard format approved by the Engineer Incharge. If the discharge is below 0.1 gps then the tube well will be regarded as "Lost".
- c. The Contractor shall have on the site a 900 V-notch weir, preceded by a tank with baffles, for the measurement of flows. Small flow (less than 0.25 liters/second) can be measured by timing the filling of a vessel of known volume. The Implementing partner shall also have on site an operating electric dip meter, calibrated in centimeters, and with visual/audible indicator of when the water level is reached.
- d. Readings of flow and water level shall be taken at the intervals defined on the test pumping form. For accurate measurement, an electrical/ sonic water level indicator with graduated tape for taking water level readings. Recovery readings shall be taken for a minimum of 1 hour, during which period airlifting or pumping equipment shall not be removed from the tube well.

### **1.05 WATER QUALITY TESTING**

The Contractor shall make sampling and quality analysis for arsenic and other common pollutant of water from every bore hole.

### **1.06 SAMPLING AND DRILL TIME LOGS**

Representative samples of the strata intersected shall be collected every three feet or less depending on the changes of geological formation. For collection, the Contractor shall cease drilling, circulate all cuttings to the surface, resume drilling and collect the cuttings then brought to the surface. The Contractor shall take every possible precaution to guard against sample contamination due to poor circulation, tube well erosion, or caving. Cutting samples shall be bagged, labelled with tube well depth at time of collection, and stored in a position where they will not be contaminated by site conditions or drilling operations. The Contractor shall supply strong, transparent sample bags and labels as required. The driller in-charge will also record the drill time logs/penetration rate of each rod or at every three-meter interval.

### **1.07 CHLORINATION AFTER TUBE WELL COMPLETION**

Each successful tube well must be chlorinated following completion. The Contractor will decide on the concentration of chlorine based on the volume of water in the tube well.

### **1.08 STRAIGHTNESS AND VERTICALITY TEST**

1. All tube wells shall be drilled and cased straight and vertical and all casings and screens shall be set round, plumb and true to line. Any delays encountered in running casing and screen considered to be due to poor whole alignment shall be at the Contractor's expense.
2. The Engineer Incharge may ask the Contractor to perform random tests for straightness and verticality alignment after completion of the well and before its acceptance. The Contractor shall provide the necessary 12 meter section of pipe (The plumb), not more than 15 millimeters diameter less than the inside diameter of the casing. Should the plumb fail to move freely throughout the length of the casing to the required depth or should the well vary from the vertical in excess of two-thirds of the smallest inside diameter of part of the tube well being tested per 30 meters of depth, the verticality and straightness of the well shall be corrected by the Contractor at his own expense. Should the Contractor fail to correct such faulty straightness or verticality, the Engineer Incharge may refuse to accept the tube well and no

*payment for those Works and materials used.*

**1.09 PROTECTION**

During the contract period, when work is not in progress, the tube wells shall be kept capped in such a manner as to prevent the entrance of foreign materials. The Contractor shall remove any foreign matter at his own expense. On completion of each tube well, the Contractor shall supply and fit an approved permanent lock-up cap. Casing shall terminate not less than 0.5 meters above ground level and are fitted with the approved lock-up cap.

**1.10 TEST OF ACCEPTABILITY AND REPORTS**

Subject to meeting the requirements of the maintenance period, the tube well shall be accepted for payment on presentation of the following reports at schedules shown in the table below and sample of the formats given in the annexes:

NAME	DESCRIPTION	Time of Submission
1. Pre-execution report	This report indicate all data about the work to implement (location, drawings, the rig tools to be used	At least one week before site intervention
2. Certificate of Completion of drilling activities	This certificate of Completion will comprise: <ul style="list-style-type: none"> <li>• Strata log</li> <li>• Pumping tests interpretation results</li> <li>• Construction log showing casing and all installation for the tube well</li> <li>- Result of the quality analysis</li> </ul>	At least 1 weeks after drilling activities completion
3. Certificate of Completion of civil work and electro mechanical activities	This certificate of Completion will comprise: <ul style="list-style-type: none"> <li>• Drawings of the constructions completed</li> <li>• All documents on the material installed</li> </ul>	At least 2 weeks after civil work and electromechanical activities completion

**\*\*\*END OF SECTION\*\*\***

## **GAS STOVES**

### **1.01 SCOPE OF WORK:**

The work will include, providing, laying, fixing and installation etc., complete in all respect; of Cooking Appliances of types and sizes as specified in the BOQ and as per approval of Engineer Incharge

All appliances shall be constructed entirely of new, unused materials and parts and shall conform to the requirements of Pakistan Standards *PS: 1560-2017; ICS NO. 97.040.20*

### **1.02 INSTALLATION:**

All cooking shall be connected to the building piping by one of the following:

- Flexible pipe
- Rigid metallic pipe and fittings.
- Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.

Installation shall be done by an approved representative of the vendor; in accordance with the manufacturer's installation instructions and NFPA 54.9

### **1.03 TECHNICAL SAFETY**

Installation, repair and maintenance work should be performed by an authorized service technician in accordance with local building and safety codes. Work by unqualified persons could be dangerous and may void the warranty.

Before installing the cooktop, check for externally visible damage. Do not operate a damaged appliance. A damaged gas cooktop is a hazard.

The Contractor will make sure that the appliance is properly installed and grounded by a qualified technician.

Gas Connection The gas supply (service) line must be the same size or greater than the inlet line of the appliance. This range uses a 1/2" (1.3 cm) ID NPT (Sch40) inlet.

The appliance must be disconnected from the gas supply piping system during any pressure testing of that system.

Manual shut-off valve: This installer-supplied valve must be installed in the gas service line before the appliance in the gas stream and in a location where it can be reached quickly in the event of an emergency. Any opening behind the range shall be sealed.

### **1.04 CONNECTION TO UTILITIES:**

The following appliances are covered by this section.

1. Tandoor, full size (Peshawari) along with 20 Rft GI Pipe and fitting brick work are included (Gas burner and internal fitting is available at site) complete in all respect with all accessories, as per BOQ and as per satisfaction of Engineer incharge.
2. 03 Burners and single burner cooking stoves, stainless steel fabrication, of approved make complete in all respect including fire stoves and accessories, as per BOQ and as per satisfaction of Engineer in charge.
3. Providing and fixing of Gas fired, Heavy Duty Cast Iron Burner, with MS pipe frame, of approved make or equivalent make complete in all respect including fire stoves and accessories, as per BOQ and as per satisfaction of Engineer Incharge.

**\*\*\*END OF SECTION\*\*\***

## **SUB SOIL DRAINAGE PIPING**

### **1.01 SCOPE OF WORK:**

The work will include, providing, laying, fixing and installation etc, complete in all respect; of Sub Soil Drainage Piping around/ alongside foundation of the Main building as shown in drawing and as per the approval of Engineer Incharge.

### **1.02 PIPE MATERIAL:**

Subsoil drainage pipe shall be UPVC, coiled, perforated corrugated pipes. Fittings and pipe shall be from single source of manufacture. Pipe shall be manufactured in conformity with DIN 1187.

Diameter of perforation shall be 0.11 to 0.15 and density of holes shall be 40% of total pipe surface area.

### **1.03 INSTALLATION:**

Each pipe shall be examined on arrival; defective pipes shall not be used. Drain shall be laid in straight lines and to even gradients between the levels shown, with pipes and fittings, of the type and diameter as shown on the drawings. Great care shall be exercised in setting out and determining the levels of the pipes and the Contractor shall provide suitable instruments, set up and maintain sight rails, and bench marks etc., necessary for the purpose. Cut pipe shall have smooth regular ends at right angles to length of pipe. All pipes to be cut with an approved cutter. All drains shall be kept free from earth, debris, superfluous cement and other obstructions during laying and until the completion of the Contract when they shall be handed over in a clean condition. Pipes shall be laid with the sockets leading upstream.

No pipes shall be laid on their collar or on blocks, tiles or other temporary supports.

Drainage line shall be accurately laid and shall be perfectly true to line and gradient from point to point in both vertical and horizontal planes.

Special fittings required in the installation not generally cast by manufacturers shall be got specially cast by Contractor matching with the shell thickness specified.

Branch connection shall be made with –WYE and long –TEE-WYE fittings. Short bends, common offsets and double hubs will not be permitted. Short –Tee-Wye fittings are to be used in vertical piping only. All fittings shall conform to code requirements.

Sub Soil Water chamber will be constructed at locations shown in the drawings to the dimensions, sizing, levels, material as specified in the drawings and BOQ.

Pumps installed in sub soil water chambers shall follow the specifications of sump pumps (Section 8)

### **1.04 TESTING AND INSPECTION:**

1. The entire drainage and vent system shall be subjected to testing after installation to ensure a leak-proof installation under operating conditions.
2. All the openings in the piping system shall be tightly closed by inserting test plugs of heavy rubber gasket that fit snugly all around the opening. The highest point will be left open to supply water and may be raised if necessary by temporary jointing to develop a minimum head of five (5) meters of water at each section of the system. Water is filled to the point of overflow and any drop in the level of water will indicate a leak that will be found by inspection. The water level will be checked for no drop for at least 15 to 30 minutes.
3. No section will be tested at a pressure more than 6m of water. High stacks will be tested in sections, starting from the top section and then connecting top section to next lower section.
4. The drainage pipe and building sewer will also be inspected for slopes which must conform to the slopes specified. The slopes will be checked with precision angle measuring instrument like universal protector, plumb and level. Any portion found not laid according to the given slope will be rectified at the Contractor's expenses.
5. This Contractor shall furnish & pay for all devices, materials, supplies, labour and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer Incharge.

6. This Contractor shall also be responsible for the work of other trades that may be damaged or disturbed by the tests, or the repair or replacement of his work and he shall, without extra charge to the Employer, restore to its original condition, work of the trades so damaged and disturbed, engaging the original contractors to do the work of restoration.
7. Defects disclosed by the tests shall be repaired, or if required by the Engineer Incharge, defective work shall be replaced with new work without extra charge to the Employer. Test shall be repeated as directed, until all work is proven satisfactory.
8. This Contractor shall notify the Engineer Incharge, Employer and others having jurisdiction at least ten days in advance of making the required tests, so that arrangements may be made for their presence to witness the tests.
9. The Contractor shall submit test certificates to the Engineer Incharge & obtain his certification that the tested piping system have passed the prescribed tests.

**\*\*\*END OF SECTION\*\*\***

## WATER PUMPS

### 1.01 SCOPE:

These specifications cover supplying, installation testing and commissioning of suction centrifugal pumps for buildings. The Contractor will submit pump curves certifying pump operation, BHP & NPSH curves to the Engineer In charge or approval, prior to the start of work.

### 1.02 SERVICE CONDITION:

Pumps shall be designed and constructed to operate satisfactorily in a typical hydronic application, and shall be the product of a manufacturer regularly engaged in the production and marketing of these pumps.

### 1.03 OPERATING CONDITIONS:

The flow rate, pump head & other required data are indicated in the equipment schedule and the pumps supplied shall conform to these requirements. The Contractor is required to ensure non-overloading selection of motor for parallel pumping operation.

NPSH required by the pump shall be stated & the NPSH as available checked by the Contractor for the specific application. The pump RPM shall be as specified in the EQUIPMENT SCHEDULE (. Pump casing shall be designed to withstand the discharge pressure specified on the Schedule Sheet plus the static head on the system, plus 50% of the total head, but not less than 125 psi (8.5 bars).

### 1.04 PUMP COMPONENTS:

Details of pump construction shall be as follows:

1. Casing shall be vertical split with centerline discharge, foot-supported and made of cast iron. Casings shall be provided with tapped & plugged holes for priming, vent & drain.
2. Casing Connections: shall be ANSI B16.1, 125PSI (8.5 bars), ASA Standard flat face flanges.
3. Casing Wearing Rings: Easily replaceable casing wearing rings of suitable material for service shall be provided in front and rear of impeller.
4. Casing Joint Gasket: An O-ring shall be provided at the casing joint to prevent leakage.
5. Impeller: shall be the single section enclosed type of bronze. Impeller shall be statically and hydraulically balanced. Drilled holes shall be provided through the impeller hub to balance axial thrust loads and keep positive pressure on the stuffing box. Impeller shall be keyed & locked to the shaft with a hexagonal head impeller nut and shall be easily removable without the use of special tools.
6. Shaft: Pump shaft shall be high strength stainless steel sized to provide a minimum amount of deflection. Shaft shall be protected in the stuffing box area by a replaceable shaft sleeve.
7. Seal: Pumps shall be provided with gland packing seal or mechanical seal as indicated in the Equipment Schedule.
8. Bearing Frame: shall be rigid, one piece cast iron construction. Frame shall be provided with catch basin reservoir with tapped drain hole to collect and pipe away stuffing box leakage
9. Bearings: shall be ball type on both ends of the frame. Both bearings shall be locked in place and be sized to provide long life under thrust loads encountered. Both bearings shall be enclosed by replaceable box.
10. Bearing Lubrication: Ball bearings shall be grease lubricated with provisions for the addition & relief of grease.
11. Deflector: A replaceable shaft deflector of non-corrosive material shall be provided to prevent the entrance of contaminants into the pump bearings at the inboard end of the bearing frame.
12. Baseplate: shall be of heavy duty, fabricated steel or cast iron, sufficiently rigid to support the pump and the driving motor with tap hole to pipe away leakage and condensation.
13. Coupling: shall be spacer type.
14. Coupling Guard: shall be metallic and fastened to baseplate and conform to the requirements of ANSI B.15.1.
15. Rotation: Pump shall have clockwise rotation viewed from its driven end.
16. Motor: Motor shall conform to specifications given. It shall be selected in accordance with the pumps non-overloading performance characteristics. Motors shall be mounted with pump on baseplate in manufacturer's plant and shipped as one unit.

17. Foundation: Foundation for the pump shall be 4000 psi concrete, sized to provide an inertia block having a mass equal to 3 times the weight of the pump and motor. The foundation shall be isolated from the structure and plant room floor by using 40mm thick high density cork. Edges of the foundation shall be provided with 25\_25\_3mm angle iron frame work and painted with two coats of oil paint. When shown on drawings, or with pumps mounted on upper floors, the pump's concrete foundation shall be supported on four suitably sized spring isolators.

**1.05 INSTALLATION:**

During installation, the pump shall be properly leveled, grouted in and realigned before operation in accordance with the manufacturer's recommendations. Suction & discharge connections shall be installed through flexible connectors, and electrical wiring shall be done. Drain lines from pump base plate at drip pocket shall be installed equal to the size of the opening.

**1.06 COMMISSIONING AND TESTING:**

The pump shall be commissioned and tested by the Contractor, in accordance with the manufacturer's recommendations. The pump operational curve shall be identified by taking no-flow reading and shall be charted on the pump curve. Operational point at full flow shall be identified and submitted to the Engineer Incharge. Tests shall be conducted and test reports submitted to the Engineer Incharge and approval obtained.

1.07 PUMP SCHEDULE:

Location		Pump Type	Location	Quantity	HP	Single Phase	Three Phase	Pump Type	Location	Quantity	HP	Single Phase	Three Phase
<b>MAIN BUILDING</b>	BASEMENT 2	Pressured Water Supply	AHU-11	1	0.5	✓	---	Suction Pump	Near Ramp	1	1	✓	---
		Pressured Water Supply	AHU-12	1	0.5	✓							
	BASEMENT 1	Centrifugal Pump	Near Engg Room	1	5	---	✓	Suction Pump	External	2	1	---	✓
				1	5		✓			1	1		✓
	GROUND FLOOR	Submersible Pump	Near Wide Passage	1	20	---	✓	Sludge Pump	Near Wide Driveway	1	2	---	✓
		Pressured Water Supply	AHU-1	1	0.5		✓						
		Pressured Water Supply	AHU-2	1	0.5		✓	Suction Pump	Near Wide Driveway	1	2		✓
		Suction Pump	Near Ramp	1	2		✓						
		Submersible Pump		Near Septic Tank	1		0.5	✓	---				
		MEZZANINE FLOOR	Pressured Water Supply	AHU-3	1		0.5	✓	---				
	Pressured Water Supply		AHU-4	1	0.5	✓							

		Pressured Water Supply	AHU-5	1	0.5	√	
		Pressured Water Supply	AHU-6	1	0.5	√	
	FIRST FLOOR	Pressured Water Supply	AHU-7	1	0.5	√	---
		Pressured Water Supply	AHU-8	1	0.5	√	
	SECOND FLOOR	Pressured Water Supply	AHU-9	1	0.5	√	---
		Pressured Water Supply	AHU-10	1	0.5	√	
	ROOF	Pressured Water Supply	FA-AHU-1	1	0.5	√	---
		Pressured Water Supply	FA-AHU-2	1	0.5	√	
<b>FLATS</b>	GROUND FLOOR	Centrifugal Pump	Near Stairs	1	1	√	---
				1	1	√	
<b>BUNGALOW</b>	GROUND FLOOR	Centrifugal Pump	Near Stairs	1	1	√	---

\*\*\*END OF SECTION\*\*\*

## **ELECTRICAL WORKS**

## GENERAL SPECIFICATIONS

### FOREWORD

This document is to describe the minimum requirements for the equipment and installations and to ensure that the Contractor is fully aware of his duties to perform the required works, in accordance with the terms of the Contract.

### 1. SCOPE OF WORK

The works related to the electrical system which are included in the scope of this Contract are shown on the Drawings, stated in the Particular Specifications, Bill of Quantities and explained in these specifications. The works shall broadly include but not limited to the following:

- 1 Medium Voltage Dry Type Distribution Transformer
- 2 Medium Voltage Switchgear
- 3 Medium Voltage Cables
- 4 Low Voltage Switch Boards / Distribution Boards
- 5 Low Voltage Cable and Wires
- 6 Uninterrupted Power Supply (UPS)
- 7 Conduits and Pipes
- 8 Busway System
- 9 Wiring Accessories
- 10 Interior Lighting
- 11 Emergency Lighting
- 12 Exterior Lighting
- 11 Lighting Poles and Accessories
- 12 Earthing System
- 13 Cable Tray, Ladder and Trunking
14. Lightning Protection System
- 15 Structured Cabling System
- 16 Fire Alarm System
- 17 Public Address System (IP Based)
- 18 Access Control System
- 19 CCTV System (IP Based)
- 20 CATV System
- 21 Standby Diesel Generator System

All material and equipment supplied by the Contractor shall be new and in all respects conform to the high standards of Engineering design, workmanship, performance and function as here in specified and fully meet the quality level and rugged requirements of the specifications.

The Contractor shall also be responsible to supply any other equipment not specifically mentioned in these documents but which is necessary for proper operation of the works / system, shall be considered to have been so specified and accordingly shall be provided by the Contractor as part of the Contract.

The Contractor shall be solely responsible for ensuring proper functional requirements of various equipment and shall also be responsible for furnishing any additional piece of equipment and for making modification in the equipment as desired and / or approved by the Owner or his representative, to achieve proper coordination with various equipment offered in the bid and also those installed by others.

Approval of the Contractor's supplied equipment / installation works shall not relieve the Contractor of any of his obligations or liabilities under the Contract, except insofar as provided under the conditions of the Contract.

## **2. RULES AND REGULATIONS**

The entire electrical installation / work shall be carried out by licensed contractor, authorized to undertake such work under the provisions of Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified up to date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers - London, the Contract documents, the Electricity Rules 1937 and bye-laws that are in force from time to time. Any discrepancy between these specifications and any other rules and regulations shall be brought to the notice of Owner or his representative, and his decision shall be final and conclusive.

The Contractor shall be responsible for completing all formalities and submitting the test certificates as per prevailing rules and regulations and shall have the installation passed by the Government Electric Inspector of that region. All requirements of the Electric Inspector and the Electric Company shall be complied with.

## **3. STANDARDS**

All works, equipment and materials shall conform to: On the one hand:

The specification recommended practices, official standards and codes the non - restrictive List of which is given below.

International Electro-technical Commission (IEC) British

Standards (BS)

National Electric Code (NEC)

National Standards

In the event of conflict between standards, the most stringent shall prevail.

Whenever the electrical equipment to be installed, does not hold national standards, the Contractor shall take into account the specific standards chosen by the Owner and make sure that the equipment he has to install, meets these standards.

In addition, even if no mention is stipulated in this specification, it is implied that the equipment be tropicalized, if required, by the conditions of the site of installation.

In any case, the standards and codes to be taken into consideration are those in force at the date of delivery.

## **4. INSTALLATION AND SERVICE CONDITIONS**

### **4.1 Site Conditions**

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material / equipment:

- |  |   |             |
|--|---|-------------|
| a) Maximum outdoor ambient temperature | : | 45 degree C |
| b) Minimum Indoor ambient temperature  | : | 0 degree C  |

- c) Maximum relative humidity : 75 %  
d) Minimum relative humidity : 25 %

#### 4.2 Service Conditions

Equipment shall be designed and built for continuous service with a minimum of supervision and maintenance.

### 5. MAIN ELECTRICAL CHARACTERISTICS

#### 5.1 Power Supply System

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate and function satisfactorily with the following minimum requirements without any de-rating:

- - Voltage 400  $\pm$  10%
- - Phase 3, 4 wire system
- - Frequency 50 Hz.  $\pm$  2 Hz.

#### 5.2 Degree of Protection of Enclosures

For indoors, IP23 minimum degree of ingress protection of the enclosures against contact with line or moving parts and against ingress of solid foreign bodies or liquids, shall be selected, in accordance with IEC 60529.

### 6. GUARANTEE

The Contractor shall furnish written grantee which should clearly state that the works he will carry out as well as the materials he will supply, meet with this specification and that compliance thereto constitutes an official clause, added by implication to the general conditions of his offer when signing the Contract.

Guarantee shall also be for replacement and repair of part or whole of the equipment which may be found defective in material or workmanship. The grantee shall cover the duration of Maintenance Period as defined in the conditions of the Contract. This guarantee shall not relieve the Contractor of his obligations and he will fully be responsible for the repair or replacement of any defective material in time, so as not to cause any undue delay in carrying out the repairs and/ or replacements.

The Contractor shall acquaint himself fully with the existing conditions and limitations at site and all works necessary to complete the project under the Contract, to be carried out by the Contractor.

### 7. EXCEPTIONS TO SPECIFICATION

Any exception or deviation from this specification or the codes and standards shall be listed separately in the Contractor's "List of Deviations". Any exception, which shall not be listed, shall not be considered later.

### 8. AVAILABILITY OF SPECIFICATIONS, DRAWINGS AT SITE

The Contractor shall assume at his own cost the permanent availability of this specification and drawings on site where applicable.

### 9. DISCREPANCIES IN TENDER DOCUMENTS AND DRAWINGS

The Contractor shall carefully examine the documents and drawings and if he finds any discrepancies or omissions from the specifications, bill of quantities or drawings, or is in doubt as to the meaning, he shall at once notify the Owner or his representative for receiving his instructions before proceeding with the works. If such defective or modified work is carried out by the Contractor on his own, he shall rectify the same at his own cost.

### 10. MEASUREMENT OF WORKS

The quantities set out in the bill of quantities are the estimated quantities and they shall not be taken as actual

and correct quantities of work to be executed by the Contractor. The Contractor shall carry out actual measurement of works at the site.

#### **11. INSTALLATIONS DETAILS**

The locations, routings, installation heights, detail etc. for electrical equipment are indicated on the drawings. If any information is not stated on the drawings or wherever modifications are required the Contractor shall obtain prior instructions from the Owner or his representative.

#### **12. DRAWINGS AND DATA**

The Contractor shall provide dimensional outline drawings, arrangement drawings and technical data for the equipment offered, for the approval of Owner or his representative.

##### **PRIOR APPROVAL OF SHOP DRAWINGS, MATERIALS AND EQUIPMENT**

The Contractor shall provide shop drawings for the electrical installations showing the exact routes of all underground cables and ducts, the exact run of all conduits and trunking, draw-in and junction boxes, the number and size of wires in each conduit, the final connection arrangements at distribution boards and the details of ducts for the approval of consultant / Owner's representative before commencing any portion of the works. All such working drawings shall be submitted in suitable number of copies as indicated in the particular conditions and within the periods stipulated below:

- a. Cable entry ducts into buildings.
- b. Working drawings shall be submitted within two weeks of handing over the site. All other working drawings shall be submitted to the Engineer against signed receipt and dated within two months of signing the Contract. Should however the Contractor be obliged to install electrical conduits prior to this period then he shall submit the relevant working drawings at least two weeks prior to the proposed date of commencement of the work. The Contractor shall submit the program indicating the dates on which coordination in different sections will take place, together with the submission of the working drawings. The Engineer shall arrange to return to the Contractor at least one week prior to the commencement of concreting of the section, his comments or approval of the working drawings.

The Contractor shall supply detailed specifications, dimensional drawings, etc., of equipment that he proposes to supply and install.

Where this Contract requires the approval of Engineer to material and goods, the Contractor must seek to obtain this approval within eight weeks after signing of the Contract. No extension of time will be granted for non-availability of material or goods if this clause is not complied with. Approval of the Engineer does not relieve the Contractor of placing his orders in due time for the materials he needs to complete the Contract on time. The approved samples shall be retained on site for comparison with commodities used in works and removed when no longer required.

#### **13. MATERIAL ORIGIN AND QUALITY**

The material and equipment shall be purchased from Consultant / Owner's agreed suppliers.

The consultant / owner shall retain the right to at any time demand the indication of origin of the materials, and to eventually refuse products, the origin of manufacturing of which have not been previously agreed to without consideration of quality.

On specific agreement of the Owner, the materials may be delivered progressively to the field, but in such a manner as to allow sufficient time for their reception.

When choice of manufacturer is allowed for any particular commodity the Contractor shall obtain the whole quality required to complete the work from one manufacturer or obtain approval of any change in source of supply. He shall produce written evidence of sources of supply when requested to do so by the Engineer.

#### **14. IDENTIFICATION OF EQUIPMENT**

For each piece of equipment, identification label shall be fitted in front of the casing. The label shall have block letter 7mm high, black on white back ground of trifoliate and fixed with screws.

#### **15. MARKINGS**

The contractor shall provide —Danger Boards —andl Shock Charts —wherever required to comply with the requirements of local Electricity Rules and according to normal practice.

#### **16. FACTORY TESTS**

All equipment supplied by and installed as part of the Contract such as distribution boards and like shall be fully tested at the manufacturer's works to the requirements of appropriate standards called for later in the particular specification.

The Contractor shall inform the Engineer in writing about the date and time of test of each equipment at least two weeks in advance. The witnessing of test by the Owner or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment and for furnishing the guarantees referred to in Clause 6.0. All test results in the form of certificate of test / test record certificates, signed by all the witnesses, for each item in the scope of Contractor's supply shall be supplied to the Engineer within seven days of the test date, and in any event before delivery to the site.

All expenses for carrying out the tests and witness by the Owner or his representative shall be borne by the Contractor and deemed to have been included in the tender bid.

#### **17. STORAGE**

The Contractor shall store the equipment in such conditions that it cannot be damaged, i.e., in a dry warehouse. As particular concerns; fragile components, these shall be stored on shelves in their original packing, fitted with identification labels so as to avoid unnecessary manipulation or handling.

The Contractor shall handle, store and fix each commodity in accordance with the manufacturer's recommendations. He shall inform the Engineer if these conflicts with any other specified requirement and submit copies of manufacturer's recommendations to the Engineer when requested to do so.

#### **18. LABOR AND STAFF OF CONTRACTOR**

The Contractor shall provide / furnish and arrange for:

- Skilled and unskilled labor required for performing the works in accordance with the technical specifications and drawings within the agreed time schedule.
- Supervisory technical staff with appropriate experience and requisite expertise to ensure quality of work performed.
- Supervisory administration and clerical staff to ensure smooth functioning of the activities at site.
- Construction equipment, megger testers, tools, etc.

The Contractor shall supply all labor, materials and equipment necessary for the installation of low voltage distribution boards, cables, lighting and power equipment, together with all other apparatus shown on the drawings and as detailed in the Particular specification.

#### **19. SMALL INSTALLATION MATERIAL**

The Contractor shall supply all small installation and consumable materials such as nuts, bolts, washers, shims, angles, leveling materials, insulation tape, solder, PVC strap-on or heat shrinkable type cable tags, cable ties, bushes, sealing compound, Avometer, electrical testing and measuring instruments, etc., and all such other material not listed in BOQ, required for complete installation as intended by the specification and scope of works.

#### **20. INSTALLATION INSTRUCTIONS – GENERAL**

The Contractor shall set out the works himself as per specifications and drawings and shall properly position the equipment on specified foundation / location. In general, the manufacturer's instructions for installation shall be followed. Any defect or faulty operation of equipment due to Contractor not following the manufacturer's instructions shall be corrected and repaired by the Contractor at his own cost.

#### **21. ASSOCIATED CIVIL WORKS**

The expression 'Associated Civil Works' shall mean civil work to be carried out by the Contractor under the direction of the Engineer in connection with the Electrical Service.

The Contractor shall prepare accurate drawings giving details of all holes, fixings, bases and other civil work requirements and shall be responsible for their accuracy. The cost of preparing shop drawings shall be considered to have been so specified in the tender price.

The following is a summary of the work to be carried out by the Contractor:

- a. The cutting and forming of holes for conduits or pipes, or conduit or pipe fixings through walls, floors, ceilings, partitions, roofs, etc., and making good after the work is sufficiently advanced.
- b. The building of concrete and / or brick ducts in floors, walls, etc.
- c. The formation of concrete bases, etc., for equipment
- d. Excavation forming for underground services of ducts and courses and then covers it.
- e. The cutting or forming of chases, recesses, etc., in floors, walls, etc., for conduits and fittings in and making good.
- f. Excavation and laying of cable carrying pipes.
- g. The building in of brackets and supporting bars or other form of conduit or pipe suspensions.
- h. The painting of all pipes, tube and conduits etc. after fixing unless specified to the contrary. The providing and building in of sleeves through slabs and walls.

In general all required holes through walls, floors and beams for pipes and ducts will be left out by the Contractor during the process of building.

Where conduits, pipes or fittings are fixed to concrete or woodwork by means of saddles or clips, the Contractor shall himself execute the work necessary and the cost of such work shall be considered to have been so specified in the price.

Cutting, fitting, repairing, patching or plastering and finishing of carpentry work shall be done by craftsmen skilled in their respective trades, when cutting is required it shall be done in such a manner as not to weaken structure, partitions or floors. The holes required to be cut must be directed without breaking out around the holes. Where patching is necessary in finished areas of building, the Engineer shall determine the extent of such patching or refinishing.

## **22. TESTING - GENERAL**

Upon completion of installation, at least seven days notice is to be given of intention to perform any test. The Contractor shall perform all static, semi-dynamic (by simulation), and dynamic field testing on all the equipment and systems.

All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the test procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials, etc., and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of Contractor.

The Contractor shall record all test values of the tests made by him on all equipment. Four copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment, diagrams, etc.

The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantees for materials, equipment and workmanship, or as any obligations of Contract.

In addition to installation testing, the Contractor is to carry out operation testing of all sections and is to clean, set, calibrate and fully commission, demonstrate and hand over to the Owner the entire Contract works in a thoroughly complete and operational state to the satisfaction of the Engineer.

The acceptance - provisional or final- shall be made by the Owner. This reserves him the right to be represented or assisted by a representative or an organization ( whether official or not) of his choice, which may decide on his behalf any repairs deemed necessary resulting from lack of observations of this specification, or of the rules and standards. In addition, he may judge the quality of the works and the materials supplied.

This remains in force in case of sub-contracting.

The Contractor shall formally engage his direct responsibilities to the Owner or his representative, and likewise, shall assume all responsibility for work performed by sub-contractors and materials he has supplied and installed.

#### **22.1 Insulation Resistance Test**

Insulation resistance test shall be made on electrical equipment by using a megger of 1000 volts for circuits between 250 and 500 volts. The insulation resistance of distribution boards, cables, etc., shall be as per IEC, IEEE, BSS and Pakistan Electricity Rules.

The distribution boards shall be given an insulation resistance measurement test after installation, but 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 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. Where corrective measures are carried out, the insulation resistance readings shall be taken after the correction has been made and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all tests have been made, the equipment shall be reconnected as required.

#### **22.2 Earth Resistance Test**

Earth resistance tests shall be made by contractor on the earthing system, separating and reconnecting each earth connection as may be required by the Engineer. If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The electrical resistance of the E.C.C. together with the resistance of the earthing lead measured from the connection with earth electrode to any other position in the completed installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earthing sets are installed, the earth resistance test between two sets shall be measured by means of Resistance Bridge Instrument. The earth resistance between two sets shall not exceed one ohm.

#### **22.3 Switchgear**

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams given by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for connections to give proper phase sequence.

Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses, disconnect switches, number of interlocks, indicating lights and alarms shall be in accordance with approved manufacturer drawings. Nameplates shall be checked for proper designation of equipment served. Protective relays shall be tested and set at site prior to commissioning of the equipment.

#### **22.4 Special Systems Tests**

The special systems such as telephone, intercom, etc., shall be tested according to the procedures laid down in the respective sections of the technical specifications. However, any specific tests recommended by the manufacturer shall also be carried out as approved by the Engineer.

#### **22.5 Complete Tests**

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer, the Contractor shall be responsible for the proper protection of that equipment so that subsequent testing of other equipment do not cause any damage to the already tested equipment.

### **23. ELECTRICAL CONNECTION**

Electrical connection for each building shall be supplied by other but necessary arrangement coordination to be done by this Contractor.

### **24. AS BUILT DRAWINGS AND SERVICE MANUALS**

A record shall be kept as the work proceeds of any work not in accordance with the working drawings, and upon completion of the work, the Contractor shall prepare the following drawings and forward them to the Engineer for approval:

- a. Duplicate prints of as built single line diagram of the main and sub main distribution network, indicating all cables, their size and type, and the rating of all protection devices such as circuit breakers, fuses, etc.
- b. Duplicate prints of as built drawings of Lighting, Power, Telephone, Data, Fire Alarm, Nurse Call, Public Address, CCTV, Access Control, Queue Management systems, as applicable.
- c. Duplicate prints of as fixed control and wiring diagrams for the equipment installed as part of the Electrical Contractor works.

After these drawings have been approved, the Contractor shall supply two prints on paper of each and insert these in the operating and maintenance manual specified below.

The Contractor shall submit to Engineer for approval a sample of manufacturer instructions for installation, testing, commissioning, operation and maintenance manuals including manuals of spare parts and tools of the equipment. Upon acceptance, the Contractor shall supply three copies to the Engineer for forwarding to the Owner. These manuals should be in properly bound form. At least two copies of the documents shall be submitted in original. The installation instruction shall be submitted two weeks prior to commencement of installation of each equipment, and operation and maintenance instruction at the time of commissioning. If the Contractor fails to provide the documents, the Engineer shall withhold issuance of requisite certificates and deduct suitable amount from the payments to the Contractor.

### **25. WORK COMPLETION**

The Contractor shall further make good, repair, replace all defective works and clear away on completion and leave all installations in perfect working order and to the satisfaction of the Owner or his representative.

### **26. PAYMENT**

No separate payment shall be made for work involved within the scope of this section unless specifically stated in the Bill of Quantities or herein.

**\*\* END OF SECTION\*\***

## **DRY TYPE POWER TRANSFORMER**

### **1. GENERAL**

#### **1.01 DESCRIPTION**

**A. Work Included:**

1. The scope of work under this section includes the following for Dry – type distribution transformers with medium-voltage primaries as specified here in.
2. The contractor shall supply, install, commission & test dry cast resin transformer complete with connections, terminations and accessories. The cast resin transformer shall be designed and manufactured for continuous indoor operation in a tropical climate on a 3 phase distribution system with solidly earthed neutral. It shall be of a short circuit, impulse and moisture-proof design. The case resin transformer shall be designed, manufactured and tested according to the latest edition of International Electro technical Commission (IEC) Standard 60076-11. It shall be compact and suitable for easy installation on site.
3. The transformer shall be designed to operate in an enclosure of the protection class IP23 without de-rating.
4. The electrical connections to other equipment shall be properly coordinated to form a complete system (s) complying with this specification.
5. Workshop drawings shall be provided for each transformer. These drawings shall include fully dimensioned external and internal general arrangements showing all principle dimensions, weights, foundation/cable/bus bar entry details and the positions of all functional devices, schematic drawings showing all windings, method of connection, terminal markings, and IP rating.
6. Transformers in the context of this specification shall comprise assemblies of a magnetic core, primary and secondary windings, supporting framework and enclosure.
7. Unless otherwise specified all terse used shall comply with IEC 60076-11 and DIN/VDE standards
8. The design, manufacture, selection, installation, testing, commissioning and subsequent maintenance of all equipment and materials described in this specification shall comply with the requirements of, the electricity at work regulations and the IEE wiring regulations.
9. Where more onerous requirements are specified herein, the conditions of this specification shall take precedence.

#### **1.02 PROJECT CONDITIONS**

**A. GENERAL**

The transformers shall comply with the requirements of IEC 60076 - 11 in respect of partial discharge, impulse withstand short circuit strength.

**B. SERVICE CONDITIONS: IEEE C37.121, usual service conditions**

**C. RATED VOLTAGE**

Unless otherwise specified the rated voltage class of the primary windings shall be 11kV and secondary windings 0.415 kV, at a frequency of 50Hz. The windings shall be connected for vector group DYn11.

**D. THERMAL RATING**

Transformers shall be designed and manufactured to operate continuously at the nameplate rating, in an ambient temperature not exceeding 50 deg C and RH not exceeding 100%, unless otherwise specified.

The manufacturer shall confirm any de-rating necessary, should the transformers be required to operate in conditions exceeding those specified.

Transformers which are mechanically cooled shall have increased thermal range not less than 40% of the name plate rating.

**E. LOSSES**

Losses at no-load and loaded conditions shall be the lowest achievable for the transformer type specified. These losses shall be stated in the schedule(s) which accompany this Specification.

**F. NOISE LEVELS**

The manufacturer shall confirm the guaranteed noise levels, Measurement of sound levels shall comply with IEC 60076-10. The transformer shall be provided with noise reduction support blocks in order to reduce noise level.

G. **ELECTROMAGNETIC COMPATIBILITY**

Radiation of electromagnetic signals shall not exceed the limits of BS 800 and BS 6667.

Where transformers may be vulnerable to voltage transients, they shall be protected by surge suppressor, which will reduce transients below the levels of the type tests.

**1.03 QUALITY ASSURANCE**

Electrical components, Devices and Accessories; Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

**1.04 SUBMITTALS**

1. Only type-tested transformer will be considered.
2. Upon the request of the Engineer, the Contractor shall submit type test certificate issued by a National or International Testing Authority such as ASTA or KEMA on type tests which have been successfully performed on the transformer tendered.
3. The type test certificate shall show evidence of the following test:
  1. Impulse voltage withstanding tests made in accordance with IEC 76 and IEC 60.
  2. Temperature rise tested in accordance with IEC 76. Short-circuit tested in accordance with IEC 76. Oscilloscopic records shall also be submitted.
  3. Measurement of zero-sequence impedance.
  4. Measurement of acoustic sound level.
  5. Measurement of the harmonics on the no-loads current.
4. Should modifications be made to the manufacturer detail on the transformer, which may affect any, or all of the performance obtained from type tests already completed, the relevant type tests shall be repeated at the expense of the Contractor
5. At the appropriate stages of the Contract, the following shall be submitted for approval:
  1. Detailed schedule of equipment and components and manufacturer's data.
  2. Electrical control wiring diagrams.
  3. Manufacturer's recommendations on all adjustable tripping devices.
  4. Equipment weight.
  5. Builders work requirements.
  6. Heat dissipation from the transformer.
  7. Testing and commissioning procedures.
  8. Site test report.
  9. As built drawings.
  10. Operation and maintenance procedures.

**2. PRODUCTS**

**2.01 MANUFACTURERS**

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the list of manufacturers given.

**2.02 DESIGN REQUIREMENTS:**

A. **CORE CONSTRUCTION**

The transformer core shall be built of lamination, comprising grain orientated silicon sheet steel which is insulated on both sides. To protect the core against corrosion and improve noise levels the core assembly shall be coated after assembly with resin based paint.

The lamination shall be clamped at top and bottom by steel channels, which are interconnected by vertical steel bolts. The bottom steel channels shall be used to support the transformer and the top steel channel shall incorporate lifting lugs.

The bottom core clamping channels shall be bolted to supporting steel cross-channels placed at 90o to the

transformer length, such that the whole unit is stable and able to support the whole weight of the transformer with a safety factor of two. Wheels shall be fitted to the cross-channels which shall be bi-directional or steerable

The supporting cross-channels shall be insulated from the core- clamping channels by anti- vibration pads.

The core-clamping and supporting steel work after all forming, drilling and shaping operations shall be thoroughly digressed and rinsed prior to application of a zinc phosphate primer, rinsed again and finally coated with an oven baked epoxy paint.

#### B. COIL CONSTRUCTION

Each transformer shall be a double wound type with both the H.V. and L.V. windings individually encapsulated in rigid steel mould. The coils shall be impregnated with quartz filled epoxy resin and cast under vacuum, to produce a smooth finish without voids and undulations.

The size and spacing of the conductors used in the windings shall be such that the coils are self- supporting prior to impregnation and where applicable, shall allow the epoxy resin to fill all of the space in and between adjacent layers and turns.

The coefficients of expansion of the windings and epoxy resin shall not differ by more than 15%.

The windings shall be made of copper, utilizing round or rectangular sections, or foil, as detailed in the attached schedule(s)

#### C. MECHANICAL FORCED VENTILATION (AF)

Where specified mechanical forced ventilation shall be employed to further cool the transformer windings and thus increase the performance rating during short highly loaded periods.

The cooling system shall be automatically controlled by sensing the low voltage top winding temperature.

The system shall comprise a number of single-inlet, single-width centrifugal fans, each connected to a discharge duct situated directly below the transformer coils, or axial fans, situated to direct the air flow through the coils.

Duct work shall be of sheet metal construction to DW/142 low pressure classification, or of greater thickness to suit manufacturing procedures, or incorporated as part of the base frame construction if required.

Ducts shall have discharge outlets, protected with metal mesh screens to exclude debris, to correspond with core positions on each side. Ends shall be capped.

Fans shall have spigot inlets, with 6 mm protective wire guard, and flanges outlets to connect to mating flanges on the air ducts, and joint to incorporate a flexible gasket.

Fans shall be direct driven by an internally fitted external rotor type motor with extended lubricators.

Each motor shall be supplied from a starter, complying with DIN/VDE standards and shall be housed in a purpose-mad cabinet also accommodating automatic control elements and status indication lamps.

The duty of each fan shall be identical and selected so that the total quantity of air delivered is sufficient to maintain the transformer temperature within the specified limits.

Fans shall be type tested to DIN/VDE Standards Impeller shall be mild steel to DIN/VDE standards and of welded construction, shaft height machined steel, bearings roller type or sealed for life. Fan scrolls shall be of welded construction.

For shaft powers below 1kW stamped formed strip impellers may be used provided required efficiency and balance grade can be achieved.

Where fan static pressure is less than 1kpa lock-formed joints and spot welds may be used.

Fans and ductwork shall have a fully protective paint system to the same standard as the core construction.

D. INTERTURN INSULATION

High and low voltages coils shall be provided with very high integrity inter turn insulation to Class F, to withstand the thermal and mechanical stresses under the specified operating conditions.

E. MOUNTING OF COILS

Coils shall be sandwiches between the core clamping channels but separated from them by insulated support blocks. These blocks shall be radially located top and firmly fixed to withstand vibration and absorb coil expansions and contractions.

F. INSULATION CLASS

The HV and L.V windings shall be of insulation class F in respect of mechanical and electrical strength (Partial Discharge Test). The maximum continuous operation temperature shall be within the limit of the maximum system temperature according to IEC 60076-11 i.e. 155oC. The maximum temperature rise shall be limited to 90K at 50oC ambient. The transformer shall operate at higher ambient temperature with reduced load without getting damaged.

G. DEGREE OF PROTECTION

When specified, a transformer enclosure shall be designed to suit the location and anticipated environmental conditions. This shall provide a degree of protection not less than IP23 in compliance with IEC 60529, and shall comply with their Electricity at work Regulations.

H. TYPE OF RESIN, FILLER ETC

The particular manufacturer's insulation system shall dictate the type of resin and filler but the following guidelines shall be complied with.

The resin shall ensure a minimum power frequency breakdown stress 10kV/mm when tested to IEC 60243.

The completed cast resin coil shall be self-extinguishing in the event of fire. The testing method shall comply with IEC, DIN/VDE standards. Type test certificates are required to confirm the above.

**2.03 DRY-TYPE DISTRIBUTION AND POWER TRANSFORMERS**

- A. Description: Cast Resin and with insulation system rated at 220 deg C with and 80 deg C average winding temperature rises above a maximum ambient temperature of 45 deg C.
- B. Primary Connection: Air Terminal compartment with removable cover and predrilled copper busbars.
- C. Secondary Connection: Air Terminal compartment with removable cover and predrilled copper busbars.
- D. Secondary Connection: Transition terminal compartment with connection pattern to match switchgear.
- E. Insulation: Rated at 220 deg C with temperature rise of 115 deg C, maximum rise above 45 degC.
- F. Basic Impulse Level: 95 kV
- G. Full-Capacity Voltage Taps: Four, 2.5 percent taps, 2 above and 2 below rated primary voltage;with externally operable de-energized, tap changer; position indicator and padlock hasp.
- H. Cooling System: Force cooled.
- I. Sound level may not exceed sound levels listed in BS, without fans operating.
- J. Impedance: 6.0 percent.
- K. High Temperature Alarm: Local, audible and visual alarm and contacts for remote alarm.

**3. EXECUTION**

**3.01 INSTALLATION**

- A. Install and anchor transformers on concrete bases according to manufacturer's written instructions and according to seismic codes applicable to project.

Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit and 4 inches (100 mm) high.

1. Use 3000-psi (20.7 – Mpa), 28 day compressive strength concrete and reinforcement as specified in Division 03 Section —Cast in Place Concrete.
2. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch (450 mm) centers around full perimeter of base.
3. Anchor equipment with epoxy embedded anchor bolts that extend through concrete base and anchor into structural concrete floor.

Maintain Minimum clearness according to manufacturer's written instructions and NFPA 70.

### **3.02 HANDLING FACILITIES**

#### **A. LIFTING**

Transformers shall be provided with permanently fitted lifting lugs or eye bolts to facilitate handling by crane or hoist.

Transformers shall be equipped with jacking points to facilitate the removal and or insulation pads.

The bottom supporting steel work shall be fitted with holes or have lugs attached for the attachment of hauling apparatus.

#### **B. FRAME WHEELS**

Transformers shall be designed for floor mounting and be provided with removable bi-directional or steerable rollers.

The rollers shall be lockable or means provided to prevent movement of the transformers after Installation

### **3.03 CONNECTION FACILITIES**

#### **A. CONNECTION METHODS**

Connection methods shall comply with IEC 60076 Provision shall be made by the manufacturer for the mounting and connection of cable boxes and/or bus bars as specified for the HV and LV conductor connections.

Where HV and LV cable boxes and/or bus bars are specified these shall generally be arranged on opposite sides of the transformer. However exact positions shall suit the specified requirements of each individual situation.

LV cable terminations shall be kept separate from the HV cable connections and insulated to the specified voltage and able to withstand the specified short circuit currents.

All HV coil interconnections shall be insulated for the specified voltage, and able to withstand the specified short circuit currents.

An earthing terminal shall be provided at a convenient point on the supporting steel work. All steel work shall be bonded to the earthing terminal if it is not electrically continuous. Provision shall be made for making an earth connection to the neutral of the LV windings, should this be required.

#### **B. TERMINAL MARKINGS**

HV and LV winding terminals shall be clearly marked with characters in accordance with IEC 60076. The characters shall be stamped or engraved on securely fixed, durable and non-corrodible plates.

### **3.04 TAP CHANGING FACILITIES**

#### **A. TAP CONNECTIONS AND LINKS**

Each transformer shall be provided with tapping on the HV winding to cater for supply voltage variations in the range +2.5% and + 5% in compliance with IEC 60076. Tap changing shall be effected by off-circuit tapping links. A visible warning notice shall be fixed adjacent to the tapping links and worded as follows:

**"WARNING - OFF LOAD TAP CHANGING LINKS - ISOLATE HV AND LV  
SUPPLIES TO TRANSFORMER BEFORE OPERATION"**

### **3.05 THERMAL PROTECTION**

Each transformer shall be provided with a system of thermal protection and temperature monitoring.

Temperature sensing thermistors shall be mounted in each LV coil as close as practicable to its hot spot. The thermistors shall be wired back to an electronic controller fitted on the transformer.

The thermistors shall be used to indicate winding temperature, and provide alarm and trip indications, and to operate forced cooling fans and trip HV circuit breakers where specified. Volt- free contacts shall be provided for relaying signals to remote equipment.

Wiring from the thermistors to the temperature controller shall be carried out with single core copper cables to DIN/VDE standards with LEF insulation. Cables shall be contained in galvanized steel conduit supported from the transformer steel work.

The temperatures at which the cooling fans shall be switched on and off shall be adjustable within preset limits.

The power supply for the cooling fans shall be provided from the particular transformer via a suitably fused switch. This switch shall bear the inscription in yellow letters on a black background:

**"WARNING - SUPPLY FOR TRANSFORMER COOLING FANS - DO  
NOT SWITCH OFF"**

The starter assembly for the cooling fans shall comply with this Specification. A warning label shall be fixed adjacent to the main isolating switch bearing the inscription:

**"WARNING - SUPPLY FOR TRANSFORMER COOLING FANS - DO NOT  
SWITCH OFF"**

### **3.06 RATING PLATES**

Rating plates shall be fitted complying with IEC 60076-11

#### **A. FOLLOW-UP SERVICE**

##### **VOLTAGE MONITORING AND ADJUSTING:**

Perform the following voltage monitoring after substantial Completion but not more than six months after Final Acceptance.:

1. During a period of normal load cycles, perform seven days of continuous three phase voltage recording at secondary terminals of each transformer. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period is unacceptable.
2. Corrective Action: If test results are unacceptable, perform the following corrective actions, as appropriate.
  - a. Adjust transformer taps.
  - b. Prepare written request for voltage adjustment by electric utility.
3. Retest: After corrective actions have been performed repeat monitoring until satisfactory results are obtained.

4. Report: Prepare written report covering monitoring and corrective actions performed.

### 3.07 TESTING INSPECTION AND COMMISSIONING

The tests to be carried out in accordance to IEC 60076-11 and in presence of owner's consultant and owner at factory. Test report shall be provided and shall include but not necessarily be limited to:

#### A. VISUAL AND MECHANICAL INSPECTION

1. Inspect physical and mechanical condition including evidence of moisture and corona.
2. Inspect anchorage, alignment, and grounding.
3. Prior to cleaning the unit, perform as-found tests, if required.
4. Clean the unit.
5. Verify that control and alarm settings on temperature indicators are as specified.
6. Verify that cooling fans operate.
7. Inspect bolted electrical connections for high resistance using one of the following methods:
  - Use of low-resistance ohmmeter
  - Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
  - Perform thermo graphic survey.
8. Perform specific inspections and mechanical tests as recommended by manufacturer.
9. Perform as-left tests.
10. Verify that as-left tap connections are as specified.
11. Verify the presence of surge arresters.

#### B. ELECTRICAL TESTS

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
2. Perform insulation-resistance tests winding and each winding ground with test voltage. Calculate polarization index.
3. Perform power-factor or dissipation-factor tests in accordance with the test equipment manufacturer's published data.
4. Perform a power-factor or dissipation-factor tip-up test.
5. Perform turns-ratio tests at the designated tap position.
6. Perform an excitation-current test on each phase.
7. Measure the resistance of each winding at the designated position.
8. Measure core insulation-resistance at 500 volts dc if core is insulated and if the core ground strap is removable.
9. Perform an over potential test on all high- and low-voltage windings-to-ground. See ANSI/IEEE C57.12.91, Sections 10.2 and 10.9.
10. Verify correct secondary voltage phase and phase neutral after energization and prior to loading.

#### C. TEST VALUES

1. Compare bolted connection resistances to values of similar connections.
2. Bolt-torque levels should be in accordance with Table 10.12 unless otherwise specified by manufacturer.
3. Micro ohm or mV drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.
4. Insulation-resistance test values at one minute should be in accordance with Table 10.5.
5. The polarization index shall be compared to previously obtained results and should not be less than 1.0.
6. Turns-ratio test results should not deviate more than one half percent from either the adjacent coils or the calculated ratio.
7. CH and CL power-factor or dissipation-factor values will vary due to support insulators and bus work utilized on dry transformers. The following should be expected on CHL power factors:
  - Distribution transformers: 5.0 percent or less
  - Consult transformer manufacturers or test equipment manufacturer's data for additional information.
8. Tip-up test watts loss values should indicate no significant increase in power factor.

9. Temperature corrected winding-resistance test results should compare within one percent of previously obtained results.
10. Typical excitation current test data pattern for three-legged core transformer is two similar current readings and one lower current reading.
11. Core insulation-resistance values should be comparable to previously obtained results but not less than one mega ohm at 500 volts DC.
12. AC over potential test shall not exceed 65 percent of factory test voltage for one minute duration. DC over potential test shall not exceed 100 percent of the AC r.m.s test voltage specified in ANSI C57.12.91, Section 10.2 for one minute duration. The insulation should withstand the over potential test voltage applied.

D. Site Tests

All site tests shall be carried out in accordance with this Specification.

After delivery to site each transformer shall be inspected in the presence of the Owner's consultant, prior to installation.

After installation on properly prepared foundations each transformer shall be tested and inspected in the presence of the Owner's consultant.

The HV and LV winding connections shall be demonstrated as providing the specified polarity and phase rotation and tap connections.

The HV and LV windings shall be tested for continuity and insulation resistance with a 1000v insulation tester. The insulation resistance between adjacent windings shall not be less than 100 M ohm.

After the HV windings are energized, it shall be demonstrated that the voltage and phase rotation at the LV terminals are as specified.

**3.08 PARTICULAR REQUIREMENT – ACCESS**

The specified transformers are located as indicated on the drawings.

This places restrictions on the transformers' physical dimensions in case it is necessary to remove/replace a transformer once the installation is handed over and in use.

The Contractor shall demonstrate to the Owner's consultant that the manufacturer's transformer type selected could be removed/replaced (without incurring builders work) with access through the proposed location.

If required by the Owner's consultant, detailed dimensioned drawings proving removal/replacement is practical shall be provided.

## TECHNICAL REQUIREMENTS / SCHEDULE

HV Supply System	11000V
Number of phases	3 phase
System neutral	not applicable
Fault level (nominal design)	500 MVA
LV Supply System	415V
No-load voltage	3 phase
Number of phases	4 wire
Rating	1600 kVA
Supply Frequency (HZ)	50 HZ
HV winding connection	Delta

LV winding connection	Star	
Vector group reference	DYn 11	
Impedance at 75° C	6%	
HV Tapping (% of no-loads volts)	±2.5 %, 0%, -5% & -7.5%	
Method of cooling	(ANAF) Air Natural + Air Forced ventilation for at least 40% extra rating	
Secondary voltage at:		
Full load	300 V	
No load	415 V	
Rated Voltage	11000 V / 415/230V	
HV Insulation Level	12 KV	1.1 KV
Impulse KV Peak	95 BIL	-
Power Frequency (KV RMS)	28 KV	3 KV

Paint finish color	Manufacturer Standard
HV conductor and type	Top entry XLPE Cables
LV conductor and type	Top entry bus-way/Cables
Indoor or outdoor Installation/space limitations	Indoor – refer to layout drawing
Coil material (HV)	Aluminum or Copper
Coil material (LV)	Aluminum or Copper

**\*\* END OF SECTION\*\***

## MEDIUM VOLTAGE SWITCHGEAR

### 1. GENERAL

#### 1.1. DESCRIPTION

- a) This section of Specification defines the technical requirements for Medium voltage (MV) indoor air-insulated metal-clad switchgear and accessories.
- b) The works shall comprise the manufacture's, routine testing at manufacture's premises, supply and delivery to site, installation, testing and commissioning at site of MV switchgear equipment specified herein.
- c) All items of accessories, fittings, sundries, apparatus or labour whether specified in detail or not but which in the opinion of the Engineer are usual or necessary for the satisfactory completion of the project shall form part of the work.
- d) The complete Medium Voltage Switchgear installation shall be engineering, manufacture to Local Authority's specification and acceptance. The Contractor shall arrange whatever required to satisfy Local Authority's takeover requirement.

#### 1.2. SERVICE CONDITION

All components of the switch panel shall be manufactured to be used indoors under the following conditions without the need for dehumidifiers or space heaters.

A maximum switch room temperature of 50°C and an average switch room temperature of 35°C. A mean relative humidity of 80%, the maximum being 100%.

#### 1.3. STANDARDS

All plant items shall be manufactured and tested generally in accordance with the following standards:

<u>Item</u>	<u>Standard</u>
1. Circuit Breakers	IEC 56-1 to 56-6, IEC298, IEC 267, IEC 62271-100
2. Jointing Devices	IEC 139
3. Earthing Devices	IEC 129, BS 5253
4. Isolating Devices	IEC 129, BS 5253
5. Current Transformers	BS 3938, IEC 60044-1
6. Voltage Transformers	BS 3941, IEC 60044-2
7. Insulators	BS 223
8. Protective System	BS 3950
9. Relays	BS 142
10. Instruments	BS 89
11. Earthing	BS7430
12. Current Ratings	IEC 59
13. Insulating Oil	BS 148
14. Medium Voltage Test Technique	IEC 60, BS 923
15. Transformers	BS 171
16. Annealed Copper For Cable Conductors	BS 6360, IEC 228
17. Determination Of Current Ratings of Power Cables	IEC 287
18. Fuse Switches	IEC 265
19. Oil Switches	BS 5463
20. Motors	BS500 Pt 10, 11 and 99
21. Motor Starter & Control Gear	BS 5-124 Pt 1
22. Wires And Wiring	BS 6231
23. Galvanizing	BS 729

BS/IEC or other National Standards not mentioned above but are applicable to the installation shall also apply.

If the specification conflict in any way with any or all of the above standards, the specifications shall have precedence and shall govern.

Where deviation from the above standards is minor, the approval of the Engineer may be given to the use of other national or international standards prevalent in the country of manufacture. No departure from the standards specified will be considered after the Contract has been awarded unless specific authorization has been granted by the Engineer.

Where the number of the IEC or BS standard is not specifically stated above, the IEC or BS standard used shall be one most appropriate to the class of equipment, material or work done specified by the Contractor.

#### **1.4. SUBMITTAL**

Upon the request of the Engineer, the Contractor shall submit reports issued by a national or international testing authority on Type Tests, which have been successfully performed on the switchgear offered. The Engineer reserves the right to reject switchgear for non-compliance with this requirement.

The Type Test shall be performed in accordance with the relevant standards mentioned above and shall include:

1. Mechanical tests on circuit breaker in accordance with BS 5311 Part 4.
2. Mechanical tests on disconnections and earthing switches in accordance with BS 5253.
3. Temperature rise and mill volt drop tests in accordance with IEC 298.
4. Impulse withstands voltage tests in accordance with BS 5311, BS 5253 and IEC 298.
5. Power frequency voltage tests in accordance with BS 5311, BS 5253 and IEC 298.
6. Short circuit making and breaking tests in accordance with BS 5311. Where circuit breakers having a critical current of less than 10% of the short circuit breaking current. critical current test shall be made in accordance to BS 5311.
7. Short-time current tests in accordance with BS 5311.
8. Cable charging current breaking tests in accordance with BS 5311.
9. Small inductive current breaking tests.
10. Arcing due to internal fault in accordance with IEC 517 and IEC 298.
11. Peak short circuit current tests in accordance with BS 5253.
12. Verification of degree of protection in accordance with IEC 529.

Should modifications be made to the manufacturing on the switchgear which may affect any or all the performance obtained from type tests already completed, the relevant type tests shall be repeated at the expense of the Contractor. As a minimum, the following shall be submitted for the Engineer's approval at appropriate stages of the works.

1. Detailed schedule of equipment, components and manufacturers data including time-current curves for each type of relay.
2. Detailed switchboard construction drawings to show the bus bar arrangement, panel layout, etc.
3. Electrical control wiring diagrams showing details of all wiring internal and external to the switchboard. together with terminal numbers for cable termination.
4. Setting levels of all adjustable tripping devices.
5. Equipment weight.
6. Builders work requirements.
7. Maximum heat dissipation from the switchboard.
8. Schedule of labels, inscriptions and colors.
9. Surface treatment of the switchboard.
10. Testing procedures and report format for testing of switchboard at the manufacturers works and on site.

Upon the request of the Engineer, the Contractor shall submit the following documents. The Engineer reserves the right to reject switchgear work for non-compliance with these requirements.

02 sets of shop drawings for preliminary checking of the Consultant. 02 sets

of final approved shop drawings for the Client record.

01 set of catalogue/ literature relevant with material require for the complete installation, testing and commissioning of the Job.

02 sets of As-built drawing for preliminary checking of the Consultant.

04 sets of final approved as-built drawing + 01 No CD (soft copy on auto cad) for the Client record. Site test reports

Testing and commissioning procedures. Operation & maintenance manuals/ procedures.

The Contractor shall be responsible for ensuring protection discrimination will be maintained throughout the MV and the LV electrical systems and shall submit for approval recommended relay settings, supported by fault calculations, for all protective equipment being supplied.

## 1.5. SHOP DRAWINGS

The shop drawing submittals shall include, but not be limited to, the following:

- a) Dimensioned drawings of metal enclosed switchgear showing accurately scaled basic units including, but not necessarily limited to, auxiliary compartments, unit components, combination units, bus bar chambers, outline dimensions, top & bottom views showing entry and exit spaces for conduits and front & side elevations showing arrangement of all devices.
- b) Total full weight of unit.
- c) Single-line diagram.
- d) Schematics and wiring diagrams for metering and controls.
- e) Instrument transformer data
- f) Coordination curves for each type and rating of vacuum circuit breaker.
- g) Arc flash calculation to determine the energy/heat available during short circuit conditions.
- h) Furnish, upon request, manufacturer's product data of metal enclosed switchgear and all related components.
- i) Test Reports for VCB and all other components.
- j) Installation procedures.
- k) Operation and Maintenance Manuals.

## 2. PRODUCT

### 2.01 RATING AND PERFORMANCE

The intended operating voltage of the switchgear is shown on the Specification Drawings.

### 2.02 PRIMARY COMPONENTS

The ratings of primary components have the following values unless otherwise specified.

Operation Voltage	11 kV
Rated frequency	50 Hz
Rated voltage	12 kVrms
One min. power frequency	28 kVrms
Impulse withstand voltage	95 kVpeak
Rated short time current /duration	31 kA/1sec.
Rated 15 min DC withstand voltage of parts directly connected to power cables	20 kVdc
Visible or audible corona (between one phase and all other phases to earth)	None with Switchgear energised at 30 kV

#### a) Circuit Breaker

In addition to the ratings specified for primary components, the circuit breakers shall be rated in accordance with BS 5311 except as otherwise specified.

a. Operation Voltage	11 kV
b. Rated operating sequence	0-3min-CO-3min-CO
c. Rated short circuit making current	50 kA peak
d. Rated AC component short circuit breaking current	31 kA/1sec.
e. TRV peak value for terminal faults at rated short circuit breaking current, Uc	20.6 kV peak
f. Time coordinate t3	60 us
g. Time delay td	9 us
h. Voltage co-ordinate.....	6.9 kV
i. Time co-ordinate t'	29 us
j. Rate of rise Uc/t 3 .....	0.45 kV/us

All values for rated transient recovery voltage shall be in accordance with BS 5311. representation by 2 parameters, first-pole-to-clear factor = 1.5. Representation of rated TRV to be in accordance with BS 5311.

b) Current Transformer

In addition to the ratings specified for primary components, current transformers shall be rated in accordance with BS 3938 and as follows.

1. Current transformers for IDMTL over current protection and earth fault protection.

	<u>11 kV switchgear</u>
Class	5P20
Burden	15 VA

Tenant transformer over current and balanced earth fault protection (for transformer panel)

Overcurrent and balanced earth fault protection CT	<u>11 kV switchgear</u>
earth fault protection CT (for transformer panel)	
Class	X
Rated ratio	200/100/5A
Rated knee Point voltage at max. secondary turns	> 100 V
Max. exciting current at rated knee point voltage	< 250 mA
Max. resistance of the secondary winding corrected to	< 0.08 Ohm 75°C

2. Current transformers for tariff metering

Class	0.5
Rated ratio	200/100/5A
Burden	15 VA

3. Voltage Transformer

In addition to the ratings specified for primary components, voltage transformers shall be rated in accordance with BS 3941 and as follows:

	<u>11 kV switchgear</u>
Class designation	1.0
Rated output per phase for star- connected VTs	100 VA
per phase for star- connected VTs	
Rated output per phase for V- connected VTs	180 VA
per phase for V- connected VTs	
Rated ratio	As shown on Drawings
Voltage factor	1.5 times rated voltage

### **2.03 SWITCHGEAR CONSTRUCTIONAL FEATURES**

- a) The switchgear shall be of the indoor, metal-clad detail as defined in IEC 298. The switchgear shall be of three-phase equipment comprising the busbars, a circuit breaker/fuse switch, current transformers, voltage transformers, protective relays, auxiliary relays, complete wiring and other necessary accessories whether specified in detail or not.
- b) The busbars, circuit breaker, fuse switch, current transformers cable terminals and voltage transformer of a switch panel shall be segregated from one another by means of separate compartments.
- c) Protective relays, auxiliary relays and control devices shall be mounted in easily accessible position.
- d) The switch panels shall be so manufactured that an extension panel can be put into position, cabled up and made ready before making dead the existing busbars. When extending either end of a switchboard, it shall not be necessary to interfere with the busbars or other components of existing switch panels except opening of the busbar and cover for the connection to be made and connecting tip of the secondary wiring.
- e) The various compartments of the switchgear shall be so arranged that in the event of water accumulating on the switchroom floor, there shall be no danger of water penetrating into compartments housing active components e.g. busbars, relays etc.

### **2.04 TYPE AND RATING**

- a) The switchgear shall be indoor, having a degree of protection of IP 5X, floor mounted, extensible metal clad detail suitable for service at the rated voltage and tested in accordance with BS 5311 certified by A.S.T.A., K.E.M.A. or other approved international Testing Authority and acceptable to Local Authority of Tripoli, Libya. Type test reports shall be submitted upon request.
- b) The switchgear shall be capable of withstanding as a whole, without damage the electrical, mechanical and thermal stresses produced under short circuit conditions equivalent to 500 MVA at 11,000 volt 3 seconds as defined in BS 5311.

### **2.05 INSULATION**

- a) Non-tracking and non hygroscopic solid insulant of cast epoxy resin or equivalent shall be used for the insulation of the busbars, busbar to circuit breaker connectors, circuit breaker isolating contact orifices, circuit breaker to cable box connectors, primary conductor of current transformers and voltage transformers.
- b) Post insulators of cast epoxy resin or equivalent material shall comply with IEC 272 and with these specifications, and shall be type and routine tested to IEC 660.
- c) The insulated components shall be rigidly mounted in alt- and where appropriate graded Insulation in the form of condenser bushings shall be used.
- d) Where individual poles are provided for the circuit breakers, these shall be encased in and mounted on bushings of solid insulant specified above.
- e) All five conductors shall be fully insulated throughout their lengths and joints.
- f) it shall not be possible for any personnel to be in contact with any exposed solid insulant in the course of their ordinary duties when the switchboard is energised.

### **2.06 BUSBARS AND CONNECTORS**

- a) Busbars and connectors shall be of electrolytic copper and the conductors for the busbars and the various connectors shall be of electrolytic copper, adequately dimensioned for the normal current and short-circuit ratings in accordance to BS 159. As a minimum, all busbars shall be silver plated or electro-tinned at joints.
- b) Connection of busbars between panels shall be made without the necessity of loose interconnection links. The fixed (orifice) and movable isolating contacts of the panel and circuit breaker respectively shall be silver-plated to provide good conductivity. Busbar end covers shall be accommodated inside an end switch panel without the necessity of an additional panel space.
- c) The detail of the joint between lengths of busbars and those from the busbars and connectors to other components of the switch-ear equipment shall be such as to permit easy dismantling. Busbars and connectors shall be insulated. The conductor shall be rigidly supported by solid insulators.
- d) Busbar shall be colour coded for the phase identification and shall conform to the phase sequence R-Y-B.

### **2.07 CIRCUIT BREAKERS**

Circuit Breakers shall be of vacuum type and shall be mounted on a carriage with wheels for location with the fixed portion of the switch panel. The carriage shall be provided with the necessary orifice shutter operating mechanism, earthing contacts, secondary circuit plugs and other devices required for the safe operation of the circuit breaker.

e) Circuit Breaker Contacts

1. Circuit Breaker contacts shall be of adequate dimensions to cater for the rated normal current and short circuit currents of the circuit breaker.
2. The normal current carrying contacts shall be of copper shall and be silvered plated. Either the fixed or moving contact shall comprise of spring loaded multi-finger segments with self-aligning features. Arcing contacts shall be tipped with tungsten or equivalent material to minimise deterioration during arcing.
3. The contacts shall be arranged to ensure that the arcing contacts make before the main current contact in a closing operation and break after the main current carrying contacts in an opening operation.

f) Arc Control Device

1. Each break of a circuit breaker shall be provided with an arc control device of an approved detail which will ensure high speed arc extinction and adequate control of pressure during current breaking operations.
2. Excessive over voltages shall be limited by the manufacturer detail and careful consideration shall be given to the switching of small inductive current and cable charging current.

g) Operation Mechanism

1. The circuit breaker operating mechanism shall be manufactured for high speed opening and closing of circuit breaker under all operating conditions. All mechanical parts shall be adequately sized to ensure consistent operation of the mechanism when subjected to force due to heavy short-circuit currents. The operating mechanism shall be such that the maximum difference between the instances of contacts separating during opening shall not exceed one tenth of a cycle of rated frequency.
2. It shall be possible to lubricate and service the moving parts of the mechanism without dismantling major components.
3. All important operation procedures of the switchgear shall be stenciled on an approved place (to be finalized upon award of tender).
4. The operating mechanism for the circuit breaker shall be "trip free" as define in BS5311.

h) Closing Mechanism

1. Closing mechanisms for the circuit breakers shall be one of the following versions. Spring operated power closing mechanism for closing a circuit breaker by means of energy which has been previously stored in a motor charged spring, with electrical release. For this version of closing mechanism:
  - a. It shall not be possible for the circuit breaker to close whilst the closing spring is being charged.
  - b. It shall be necessary for the spring to be fully charged before it can be released to close the circuit breaker.
  - c. The mechanisms shall be so arranged to ensure that the circuit breaker shall always open at normal operating speed even if the mechanism fails to latch on closing.
  - d. It shall be possible to charge the spring with the circuit breaker in the closed position and if the spring is released the circuit breaker shall not open.
  - e. A visual mechanical indicating device shall be provided to indicate the state of the spring and inscribed "SPRING CHARGED" when the mechanism is in the position to close the circuit breaker and "SPRING FREE" when it is in any other condition.
2. Mechanisms shall be provided with means for charging the spring by hand. A safety feature should be incorporated in the electrical circuitry of the spring motor charging such that when the charging handle is inserted in the manual charging entry. AC supply to the motor charging is automatically cut off so that it is not possible to motor charging the spring at the same time. The circuitry should be restored to normal after the charging handle is removed.

i) Tripping Mechanisms

1. Tripping of the circuit breaker shall be by means of a spring or springs charged up during the

closing operation.

2. Each mechanism shall be provided with a shunt release and the necessary auxiliary switches.
  3. A counter shall be fitted to the mechanism of each equipment, arrange to summate all "opening" operation of the interrupter.
  4. Means shall be provided for the local manual tripping of the circuit breaker, preferably by push button, shrouded to avoid inadvertent operation.
  5. Facilities shall be provided for locking off the manual tripping of the circuit breaker.
  6. It shall not be possible to gain access to the tripping toggle or any part of the mechanism which would permit defeat of the locking of the manual tripping.
- j) Mechanism Control
1. Mechanisms shall be provided with the following control facilities:
    - a. Remote electrical closing-release and trip with selection at the circuit breaker.
    - b. Local electrical closing-release and trip with selection at the circuit breaker.
    - c. Local manual closing release and trip preferably by push buttons shrouded to prevent inadvertent operation.
    - d. Automatic re-charging of the spring after the completion of a closing operation, with a control switch on each panel to cut off the AC supply so as to disconnect this facility.
    - e. An auxiliary switch shall be provided to give remote indication of "Spring-Charged" status.
- k) Selector And Control Switches On Switchgear
1. Selector switches shall be of the two-position type (i.e. on, off and neutral position) with facilities for locking in both the local and remote positions.
  2. Control switches shall be arranged to return automatically to the neutral position when the handle is released after being turned to either the "close" or "trip" positions. Sequence devices shall not be fitted.
- l) Position Indicators
1. The following are the minimum position indicators that shall be provided on the switchgear:
    - a. Spring Charged
    - b. Spring Free
    - c. Circuit breaker "ON"
    - d. Circuit breaker "OFF"
    - e. Earth "ON"
    - f. Earth "OFF"
  2. All above indicators shall be operated through mechanical means subjected to the approval of Engineer. Additional electrical indicator lamps (LED type) showing the status (e.g. circuit breaker "ON" or "OFF") shall be provided on the front of the switch panel. Supply to these electrical indicators shall be fed from the battery charger through an independent circuit.
- m) Circuit Breaker Auxiliary Switches
1. Auxiliary switches shall be positively driven in both directions. They shall be mounted so as to be readily accessible for maintenance and shall be manufactured to facilitate inspection, cleaning and adjustment.
  2. A sufficient number of auxiliary switches shall be provided on each circuit breaker for the various control and indication functions.
- n) Circuit Breaker Isolation
1. Circuit Breakers shall be the horizontally isolated withdrawable version. A horizontally isolated circuit breaker shall be provided with racking handles where necessary for ease of insertion or withdrawal of the circuit breaker.
  2. Isolating contacts shall be of the multi-fingers self-aligning detail and shall be silver-plated.
  3. When the circuit breaker is in the service position, the orifices shall be sealed to prevent any ingress of dust to the fixed contacts.

o) Orifice Safety Shutters

1. A set of shutters shall be provided to cover each three-phase group of stationary isolating contacts. The shutters shall open and close automatically by a positive drive
2. The shutters shall be automatically in closed position when the circuit breaker is in the following position:
  - a. Disconnected Position
  - b. Test Position
  - c. Removed Position (Maintenance Position)
3. For circuit breakers with integral method of earthing, the shutters for unearthed stationary isolating contact shall be in closed position when the circuit breaker is in earthed position.
4. Busbar shutters shall be painted "Signal Red" colour 537 in-BS 381C and shall be clearly labelled "BUSBAR' in large white letters. Circuit shutters shall be painted "Lemon" colour 355 in BS 391C. Circuit shutters shall not be lettered.
5. On bus-section panels both sets of shutter shall be painted "Signal Red" colour 537 in BS 331 C and labeled "BUSBAR' in large white letters. In addition, an arrow shall be painted in white on each shutter of bus-section units. This arrow shall point towards the section of busbar with which the shutter is associated.
6. The mounting, of the shutters shall be so manufactured that it is not possible to interchange the busbar and circuit shutters.

p) Circuit Breaker Location

1. For switchgear panels provided with circuit earthing facilities through the circuit breaker, it shall be possible to locate the circuit breaker in the following positions:
  - a. Service Position
  - b. Disconnected Position or Test Position
2. For switch panels provided with quick-acting fault making earthing switches for the circuit the following positions are required:
  - a. Service position
  - b. Disconnected position
  - c. Test position
  - d. Removed position (maintenance position)
  - e. Earthed position
3. It shall be possible to leave the circuit breaker within the switchgear compartment in the disconnected, test and earth position and have the panel door in closed position. If quick-acting-fault-making switch is used. be it in earthed on opened position, the circuit breaker shall be able to be left in disconnected/test position with the door closed.
4. Indication of circuit breaker location shall be at the front of the switch panel and shall be an approved mean.

## 2.08 CIRCUIT EARTHING

Each switch panel shall be arranged to permit earthing of the circuit side of the equipment.

2.08.1 The earthing equipment shall form an integral part of each switch panel without loose accessories being required.

2.08.2 Earthing shall be carried out by either one of the following methods:

2.08.2.1 Through the circuit breaker after it has been transferred to the appropriate earthing location within its compartment.

2.08.2.2 By means of three phase quick acting fault acting earthing switches instead on the circuit side of each switch panel. The switches shall be closed by manual charged spring.

2.08.2.3 Earthing which requires the use of separate earthing truck (or equipment of similar nature) is not acceptable.

2.08.3 Busbar earthing is not required.

## 2.09 INTERLOCKS

- A. Each switch panel shall be provided with complete inter-locking facilities to prevent any dangerous or undesirable operation.
- B. The interlocks may be mechanical, electrical or a combination of both types.

- C. The following shall be the minimum interlocks provided: Interlocks to prevented:
  1. A closed breaker from being withdrawal from or inserted into the isolating contacts.
  2. A, circuit breaker from being inserted into its service position or positions when its pole parts or tank are not in their proper position.
  3. The closing of a circuit breaker unless it is in service isolated, or earthed position or when it is completely withdrawn from its compartment. Tripping by attempted isolation.
- D. A circuit breaker from being advertently located or removed from a selected earth location.
- E. Closing of circuit or busbar earthing switches on a panel unless the circuit breaker is isolated.
- F. Where they are required by the switchgear manufacturing detail, other interlocks shall be provided for safe operation of the switchgears.
- G. The overall arrangement of the switchgear shall be such that all the circuit breakers can be clearly seen to be isolated before the earthing switch is closed.

#### **2.10 CURRENT TRANSFORMERS**

- A. Current transformers shall be of the bar primary type. The primary conductor shall be insulated in accordance with this Specification.
- B. The current transformers shall be mounted either on their own chamber in the fixed portion of the switch panel on be circuit side or alternatively they may be mounted in a chamber on the withdrawn circuit breaker.
- C. The current transformers shall be mounted in air over condenser bushings where necessary. If these are on the circuit breaker, special precautions shall be taken to ensure good connection of the secondary leads to the protective relays on the fixed portion of the switch-gear. An interlock shall be provided to prevent the circuit breakers being put into service when the secondary leads are not correctly or effectively connected to the relays. When the current transformers are disconnected from the relays, their secondary leads shall be automatically shorted out.
- D. The number of current transformers per phase for the various types of switch panels shall be in accordance with the Specification. Sufficient space shall be provided in the current transformer chamber for the accommodation of at least three current transformers per phase whether all three are in fact specified for the individual switch panels.
- E. The complete manufacturing detail of the CTs inclusive of the mounting shall be such that PI tests can be carried out at site without the need to dismantle the CTs from the switchgear.

#### **2.11 VOLTAGE TRANSFORMERS**

- A. The primary windings of the voltage transformers shall be insulated in accordance with this Specification.
- B. Voltage transformers shall be mounted in air on the circuit side of the switch panel in their own compartments and shall be within the zone of the circuit protective system. They shall be housed in a separate compartment.
- C. The voltage transformers shall be protected by Medium voltage HRC fuses.
- D. The secondary winding of a voltage transformer shall be protected from external short circuits by miniature circuit breaker (MCB)).
- E. HT fuses shall be provided on the primary side to isolate the voltage transformer for the purpose of power frequency voltage withstand test on the circuit breaker and also to enable DC pressure test to be carried out on terminated power cables.
- F. All components of the voltage transformers shall be rated for system short-circuit capacity and insulation level.
- G. Tenderers shall submit drawings showing the detailed mounting and location of the voltage transformers and its components.

#### **2.12 CABLE TERMINATION**

- A. Each switch panel shall be provided with a cable connection compartment for the termination of power cables supplied under the Contract.
- B. The cable connection compartment shall also be for control cable and shall be provided with each switch panel as required. They shall be suitable for the termination of control cables supplied in the contract.

#### **2.13 NEON POTENTIAL INDICATORS**

- A. Each switch panel cable shall be provided with three phase neon potential indicators which will show whether the cable is electrically energised.

#### **2.14 SWITCHGEAR METAL ENCLOSURES**

- A. Switchgear metal enclosures shall be of robust construction and shall be manufactured to prevent the ingress of vermin. Metal panels shall be provided with seals of non-rust material to keep out dust likely to be present in switch room.
- B. Each metal panel shall be reinforced with cross members so that the panel cubicle is rigid and will not distort under short circuit conditions.

#### **2.15 PROTECTIVE RELAYS**

- A. Relays shall comply with the requirements of BS 142 and be of GEC or Reyrolle manufacturer or equivalent.
- B. Relay elements shall be accommodated in either of the following manners:
  - 1. On racks of standard dimensions in which case the elements, racks and auxiliary items shall be housed in dust-proof and vermin proof compartments and transparent front covers shall be provided.
  - 2. In dust-proof draw out type cases. The relays shall be mounted in a manner to provide access to their wiring terminals.
- C. Circuits and components used for the relays shall as far as possible be standardized and in the event of a fault, components shall be easily replaceable. All parts of the relays shall be fully treated to withstand the temperature and humidity conditions likely to be encountered in Tripoli, Libya.
- D. When relay elements performing a plural number of functions are installed in a common case, each function shall be provided with its own flag indicator to enable the type of fault condition to be identified. Each indicator shall be capable of being reset by hand without opening the relay case. Each indicator shall be so manufactured that it cannot be operated before the relay has completed its function.
- E. All relays shall be suitably marked with the following information:
  - 1. Function of relay (e.g. over current)
  - 2. Phase
  - 3. Characteristic: curve where appropriate
  - 4. Rated current or voltage
  - 5. Rated making capacity of contacts
- F. Markings shall be visible from the front of the relay without removing the cover.
- G. In order to minimize the effect of electrolysis, flag indicator coils and D.C relay operating coils shall be so placed in the circuit that they are connected to the positive pole of operating battery except through contacts which are normally open but shall preferably be directly connected to the negative supply.
- H. All relays shall, except where otherwise approved, be provided with contacts for controlling double tripping circuits for use when two circuit breakers are to be opened simultaneously and for any other interlocking or alarm purposes which may be required.

#### **2.16 AUXILIARY RELAYS**

- A. All auxiliary relays and switches for tripping alarm, indication and control functions shall be of a robust construction. Constructional features shall comply generally with the relevant Specification. Additional spare contacts for remote indication purposes and other functions shall be supplied.
- B. All D.C equipment shall be suitable for operation at the existing D.C voltage and shall operate

satisfactorily between the limits of 20 percent below and 10 percent above normal operating voltage and over its complete range of operating temperature.

#### **2.17 AUXILIARY SWITCHES, FUSES AND MINATURE CIRCUIT BREAKERS**

- A. Auxiliary control switches for circuit breakers shall be of the pistol grip or other approved type and shall be arranged to operate in one direction when closing the circuit breakers and in the opposite direction when opening them.
- B. The control switches shall be so manufactured as to prevent them from being operated inadvertently and shall be so interlocked that after having once been moved to the "close" position they cannot again be moved to that position without first passing through the "open" position. Approved means shall be provided for locking the control switches when they are in the "neutral" position. A label shall be fixed adjacent to the control switch to indicate the name or distinguishing number of the circuit concerned. The control switch shall be so manufactured that when released by the operator it shall return automatically to the neutral position after having been turned to the "closed" position, and shall at the same time interrupt the supply of current to the operating mechanism of the circuit breaker.
- C. Fuses or miniature circuit breaker of an approved type shall be supplied with all voltage transformer secondary circuits. D.C circuits and motor supply circuits.
- D. The fuses and miniature circuit breakers shall be of a robust construction and installed at a convenient position within the panels for easy access and identification. Each breaker shall be provided with auxiliary spare contacts for remote indication purposes. When fuses are employed auxiliary relays for the same purpose shall be provided. Miniature circuit breakers shall be provided for the motor and switch position indication circuits.

#### **2.18 INDICATING INSTRUMENTS**

- A. All indicating instruments shall be to BS 89 Industrial Grade, and shall be of an approved type. They shall be of the deadbeat type and of approved make and sizes and shall be capable of carrying their full load currents continuously without undue heating. They shall have long clearly divided and indelibly marked circular scales extending over an angle not less than 90° and the pointers shall be of clean outline.
- B. The points and scales shall be approved. The marking on the dials shall be restricted to the scale marking. Instruments connected to double ratio current transformers shall be provided with reversible scales. In addition to instantaneous indicators, ammeters shall be provided with half-hour maximum demand indicator. Instrument transformer ratios, makers' names, BS Grade, etc. shall not appear on the dials, but shall be marked in an approved position.
- C. The instruments shall not be damaged by the passage of fault currents through the primary of their corresponding current transformers, and approved means shall be provided for zero adjustment, without dismantling the instrument. The scale of all direct current instruments shall be arranged so that the instruments will read 10 percent of the full scale reading and this part of the scale shall be marked in red. In duo-directional circuits, however, centre zero instruments or displaced zero instruments with a changeover switch shall be employed as approved.
- D. All voltmeters and ammeters shall be mounted at the front of the switch panels at convenient position.

#### **2.19 SECONDARY WIRING AND CABLE**

- A. All secondary wiring for the switchgear, relays, instruments, cubicles etc. shall have approved insulation of PVC to BS 6231 of 600 volt grade.
- B. Unless otherwise approved, all wiring shall have a conductor size of not less than 2.5 mm<sup>2</sup> tinned copper.
- C. All wiring shall be neatly run and groups of wires shall be securely fixed by cleats so that wiring can be checked without the necessity of removing the cleats. The cleats shall be made from moulded insulating material or no-rust metal. Wiring between fixed and moving portions of the switch panel shall be run in no-rust flexible tubes. The wires and flexible tubes shall be mounted to obviate any damage to them when the circuits are moved.
- D. Each wire shall be terminated with either the "Rose Courtney" or crimped type of terminal stud; and

- number by an approved type of interlocking ferrules. Ferrules shall be of an approved type of preferably white and shall be provided with a glossy finish to prevent staining. Ferrules shall be clearly and durably marked in black and shall not be affected by damp or oil. All wires associated with tripping circuits shall have red ferrules marked "Trip". Wires shall not be jointed or reed between terminal joints.
- E. Bus wires shall be fully and separately installed along the top or/bottom of the relay, alarm and control compartments. Means shall be provided to enable all circuits in the cubicle, except the lighting circuit, to be isolated from the bus wires.
  - F. Wherever practical all circuits, in which the voltage exceeds 125 volts, shall be kept physically separated from the remaining wiring. The working voltage of each circuit shall be marked on the associated terminal boards.
  - G. The D.C trip supplies, closing supplies, A.C supplies, wiring to the different protective system etc. shall be segregated from each other. Each such group where required and appropriate shall be fed through separate fuses or miniature circuit breakers from the bus wires. There shall not be more than one set of supplies to the apparatus to each group.
  - H. The clearance between relay stems or connecting studs shall not be less than 2.5 cm unless otherwise approved.
  - I. Resistance shall be provided with stud terminals. Set screws shall not be used. Wiring diagrams for control and relay circuits shall preferably be drawn as if viewed from the back and it shall be clearly stated on each diagram which view is employed. They shall show the terminal boards arranged as in service.
  - J. Control cables shall be PVC insulated and shall be of 600 volt grade comply with BS 6231. Wire conductors shall be at least 2.5 mm<sup>2</sup> tinned copper unless otherwise approved.
  - K. Multicore tails shall be so bound that each wire may be traced without difficulty to its associated cable.
  - L. The spare cores of all multi-core cables shall be numbered and terminated at the top of a terminal block in the panel. Where cables are terminate in a junction box and the connections to a relay or other instruments are continued in conduit an approved number of spare cores shall be taken through the conduit and terminated in the cubicle.
  - M. Screen cables shall be used and the screens of screened pairs of multi-core cables shall be earthed at one end of the cable only. The position of the earthing connections shall be shown clearly on the diagrams.

## **2.20 TERMINAL BOARDS**

- A. Terminal boards shall be provided with stud terminals for incoming and outgoing wires and not more than two wires shall be connected to any one terminal. Insulating barriers shall be provided between adjacent connectors. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals.
- B. Covers of transparent insulated material shall be provided on all terminal boards. Labels shall be provided on the fixed portion of the terminal boards. Terminal board studs shall not be numbered. No live metal shall be exposed at the back of the terminal boards. Unless otherwise approved terminal boards shall not be used as junction points for wires which are not required in the associated panel.

## **2.21 TEST FACILITIES**

- A. The switchgear shall be provided with facilities for:
  - 1. The Medium voltage testing of the insulation of its primary components and power cables connected to the switchgear. This shall include AC pressure testing of equipment, DC pressure and insulation testing (via insulation tester) of cables.
  - 2. The primary injection testing of all current transformers.
  - 3. Means to place phasing out components at the termination end for the purpose of core identification in the course of work (e.g. cable diversion) without the need to dismantle the terminated cable.

## **2.22 SECONDARY TESTING FACILITIES**

- A. Testing facilities in all current transformer secondary circuits shall be incorporated in the protective

- relays of the draw-out type as specified in the relevant Clauses of the Specification and suitable for the insertion of portable test pugs for the purpose of checking all components within a relay.
- B. Secondary circuit earthing points shall be connected via a test link for the purpose of checking the insulation resistance of all circuits.
  - C. Testing facilities for metering current and voltage transformers shall be as specified in the relevant Clauses of the Specification.
  - D. All test terminals shall be easily accessible without having to dismantle any part of the switchgear.
  - E. Any testing accessories/test plug that are necessary to facilitate the above mentioned testing shall be considered to be included in the contract price and adequate sets shall be supplied.

### **2.23 MOTOR**

- A. Unless otherwise approved, motor shall be of the squirrel cage screen protected type. The motors shall be suitable for a three phase 400 volts 50 Hz supply. They shall be suitable for direct starting at full voltage without the use of star-delta switches, autotransformer starters, or starting resistance. The motors shall comply with BS 2613 and shall be continuously rated unless otherwise specified. The motors shall be supplied by an approved manufacturer.
- B. The motor shall operate at all loads without undue vibration and with the least amount of noise.
- C. The starting current at full voltage shall not exceed six times full load current. The starting current shall be determined by a locked rotor test and if this is carried out at reduced voltage it shall be made with not less than full load stator current and the starting current at full voltage shall be taken as the current measured at reduced voltage increased to the ratio of the full voltage to the reduced voltage. No tolerance shall be applied when tested in this manner.
- D. The motor windings shall be insulated with Class 'E' insulating material defined by British Standards or to approval. The stator coils after assembly in the slots shall be dried by heating and afterwards impregnated by dipping in insulating composition so as to render the windings non-hygroscopic and solid in structure.
- E. The outside of all end coils shall be coated with oil resisting non-hygroscopic varnish or compound and the coils shall be supported as to prevent movement under shock. The insulation and impregnation of end winding shall be such that the coils can be readily removed and replaced.
- F. The rotor and stator shall be skewed relatively to each other
- G. The rotor winding construction shall be manufactured to minimize the possibility of conductors breaching and all joints shall be made by means of electrical bring or in other approved manner so as to prevent all possibility of their working loose.
- H. Unless otherwise approved all motors shall have ball or roller bearings and motors of vertical spindle type shall have approved thrust bearings.
- I. Bearings shall be fitted with hexagon nipples for grease lubrication to BS 1486
- J. All motors of the vertical spindle type shall be provided with a substantial canopy of approved detail.
- K. Motor terminals shall be of the stud type, totally enclosed and to approval. They shall be substantially manufactured and thoroughly insulated from the frames. Cambric or other
- L. Approved insulation shall be used for connections for the windings to the terminals.

- M. Each motor shall be fitted with a terminal box either suitable for screwed conduit entry or provided with an approved cable box as may be specified.
- N. If a cable box is specified it shall be provided with all necessary fittings, including a filling plug, an air vent hole, of approved capacity, a brass wiping gland and for wire armoured cable, for combined armour and earthing clamp. The gland plate shall not be split and a removable front cover shall be provided.
- O. Each motor shall be equipped with three pole control gear suitable for the direct starting by the switching of full line voltage on to a standing motor.

#### **2.24 CONTACTOR**

- A. Contactors shall be of robust construction and shall operate without undue noise or vibration. Contactor operated from a D.C supply shall comply with the relevant Clause. All contactors shall be suitable for the direct starting of motors by the switching of full line voltage on to a standing motor.
- B. Contactors shall be mounted in ventilated metal cubicles of an approved type. The ventilating openings shall be provided with close mesh guarding with holes not exceeding 2.5 mm. The metal surfaces of the cubicle walls adjacent to the contactors shall be protected by fireproof insulating materials unless otherwise approved. Where two or more contactors are contained in the same cubicle they shall be separated by barriers of fireproof insulating materials. All bare copper connections shall be taped and all secondary wiring shall be arranged and protected as to prevent it being damaged by arcing.
- C. All motors, contactors and their associated apparatus must be capable of holding in and operating satisfactorily and without overheating for a period of ten minutes if the supply voltage falls for that period to 70 percent of the normal value at normal frequency. The motor contactors and associated apparatus shall be capable of operation with a supply voltage of 85 percent of the normal value and at normal frequency.
- D. All terminals shall comply with the Specifications.

#### **2.25 EARTHING OF NON-ELECTRICAL PARTS**

- A. All parts of the switchgear metal enclosure, metal cases of relays and instruments, cable glands and all other non-electrical metal work on the switchgear shall be connected to a sub-station earth terminal by means of a main and auxiliary earth bars.
- B. The earthing system shall be such as to ensure:
  1. That the potential of the conductors of the systems are maintained at a level consistent with the insulation levels applied.
  2. Low resistance is provided for the flow of fault currents to achieve fast and definite operation of protection relays, and
  3. The appearance of dangerous voltages on metalwork to which a man has legitimate access under normal and abnormal conditions is prevented.
- C. The size of the main and auxiliary copper earth bars shall be selected in accordance with recommendations contained in BS7430, taking into consideration the short time current rating, of the switchgear in the switch room.
- D. Earthing requirements shall be generally in accordance with BS7430.
- E. Earth electrodes shall be insulated in accordance with recommendations contained in BS7430.

#### **2.26 SUPPORTING STRUCTURES**

- A. The contractor shall provide any rails, beams, frames or structures required for supporting the switchgear panels, control panels, battery units etc. on the concrete floor of the switch room.

- B. All detachable switchgear metal frames shall be galvanized and fastened with stainless steel bolts and nuts. Screws shall not be allowed for such purpose.

## **2.27 PANEL LIGHTING**

- A. If the manufacturing of the switch panels are such that normal switchroom lighting is inadequate for work on the equipment, panel lighting shall be provided together with all miniature circuit breakers, control switches etc.

## **2.28 SWITCHBOARD BATTERY UNITS**

- A. Each MV switchboard shall be provided with a charger and battery unit.
- B. The battery shall have the capability to trip four switchgear panels simultaneously for at least 20 times (this must be verified by calculations). When sizing the AH capacity of the battery, the effect of ageing shall be taken into consideration.
- C. The AH capacity of the battery supplied shall be greater than the calculated AH requirement, but shall not be less than 20 AH. Every if the calculated AH requirement is less than 20 AH, the battery must still be rated at 20 AH.
- D. The charger shall have sufficient capacity to restore a depleted battery to 80% full capacity in less than 8 hours.
- E. Only the tripping coil and the closing coil shall be connected to the battery unit. Other load such as filament lamps shall be taken from a separate rectifier or from an AC source through a step down transformer.
- F. The charger and battery unit shall be suitably accommodated in a steel cabinet. The cabinet shall be suitable for floor mounting. The charger and battery compartments shall be accessible from the front of the cabinet by means of hinged doors.

## **2.29 A.C/D.C Control PANEL**

- A. For the switchboard with motor charged spring closing mechanism, motor raised circuit breaker mechanisms or lighting circuit, a main A.C. panel shall be provided for the control of all the A.C circuits.
- B. The panel shall be suitably rated for the size of the switchboard.
- C. The panel shall be an ON-OFF switch with fuse protection with suitable terminals for an incoming supply lead and outgoing bus wires to the switchboard.
- D. The A.C control panel may be accommodated in the existing cabinet if this is possible.
- E. For each switchboard a main AC panel with suitable rating MCBs and terminals for an incoming supply lead and outgoing bus wires to the switchboard shall be provided.
- F. The AC control panel may be accommodated in the same cabinet as the controls for the battery charger. All outgoing circuits e.g. DC control circuits, motor charging circuit, etc. shall be protected by miniature circuit breakers. A spare outgoing AC sub-circuit controlled by MCB shall be incorporated in the battery charger unit.
- G. The function of each MCB shall be clearly indicated and the labeling shall be riveted to the enclosure. A spare outgoing DC circuit shall be provided at each battery charger unit and the labeling of its function to be carried out by the Contractor.

## **2.30 CONNECTING CABLES**

- A. Connecting cables between the switchboard and battery unit, and between the switchboard and AC control panel shall be neatly run on cable trays supplied by the Contractors.
- B. The connecting cables between the switchboard and battery unit shall be at least 4 mm in size and shall be run in a ring configuration. Physically, the cables for entry and exit of the same loop should not be the same. All wiring and termination of connecting cables shall be carried out by the Contractor. Conductors used for AC and DC circuits shall not be mixed in the same multi-conductor cable.

### **2.31 CONTRACTORS STAFF**

- A. The contractor shall provide properly qualified installation and commissioning personnel and a sufficient number of properly qualified erectors to carry out the work. The erection commissioning personnel and erector shall be subject to Engineer's approval. The contractor shall, upon the request of the Engineer, remove any erection and commissioning personnel or erector who, in the Engineer's opinion, is incompetent or has been conducting himself improperly and shall replace the commissioning personnel or erector so removed with another acceptable to the Engineer.
- B. The erection and commissioning personnel shall represent the contractor on the site and directions given to him shall be deemed to be given to the contractor. It is the contractor's responsibility to provide efficient and continuous supervision of the work at site.

## **3 EARTHING INSTALLATION**

### **3.01 GENERAL**

- A. A complete earthing system comprising cables, conduit tapes, earth electrodes and earth connections necessary elective and permanent bonding to earth the non-current carrying metal work of all the switchgear and ancillary apparatus under this Contract shall be supplied, erected and connected under this section of the Specification

### **3.02 CODE OF PRACTICE**

- A. The earthing of the whole installation shall comply with the current standard - Earthing, issued by the British Standards and the Wiring of Electrical Equipment of Buildings BS7671 and BS7430 respectively.

### **3.03 INSTALLATION**

- A. The main switchboard shall be earthed to the earthing termination by means of a stranded copper. PVC insulated earthing conductor drawn in a 75 mm diameter underground cable duct. The installation of the main earthing shall be of green colour.
- B. Earthing tapes shall be of copper and shall be run in approved positions and fixed in approved manner using FURSE No. 44 general saddles of appropriate size for securing tapes at intervals not exceeding 1 meter. Tapes shall be supplied in continuous unbroken lengths, as far as practicable, to avoid unnecessary jointing. Mating surfaces of all tapes at joints, etc. shall be tinned, riveted and soldered. Joints in exposed sections shall be protected against corrosion and ingress of moisture by the application of at least two coats of approved anticorrosion paint.
- C. Each connection of all sections of the installation shall be electrically continuous throughout.
- D. Connections to electrical apparatus shall be made by a bolted connection in a visible and accessible position. Consideration shall be given so that dissimilar and incompatible metals are not directly in contact but have a high conductivity non reacting barrier between them.
- E. The earthing system includes for measuring, marking off, cutting, fitting, erection, testing, supply of necessary tools and materials for fixing, jointing, etc. including consumable stores.

### **3.04 EARTHING POINTS**

- A. Earthing points shall be provided according to specification Section 30.

### **3.05 EARTH LEADS**

- A. The minimum size of the earth leads shall comply with those specified in the current edition of the

- "Institution of Electrical Engineers Regulations for the Electrical Equipment Building", unless otherwise specified in this Specification and Standards BS7430.
- B. Aluminium conductors are not permitted for the purpose of this Contract. All earth leads shall be copper conductors of the appropriate cross-section.

### **3.06 EARTHING PIT**

- A. Earthing pit shall be provided according to relevant specification section.

### **3.07 EARTH VALUE**

- A. The Tender Price shall be deemed to include all necessary equipment, instrument, materials, labor, transportation etc. in connection with the system of earthing points and interconnections thereof to obtain the required earth resistance value of less than one ohm.

### **3.08 TEST RECORD**

- A. The results of all testing of earthing electrodes shall be recorded together with the dates of the tests and shall be kept by the contractor for inspection whenever required by the Engineer.
- B. The record shall be handed over upon completion of the Contract.

### **3.09 EVIDENCE OF SUPPLY RECORD**

- A. The switchgear supplier shall produce evidence of sound supply record with the Local Authority or other major developments in Tripoli, Libya for the past five years.

## **4 PROTECTIVE SYSTEMS**

### **4.01 TYPE**

- A. The protective systems to be provided with the switchgear shall be as follows:
  1. Feed
    - a. Pilot wire-Solkor R.
    - b. IDMTL over current and earth fault.
  2. Transformer panels
    - a. IDMTL over current and balanced earth Fault.
    - b. Winding and oil temperature.

### **4.02 SETTING AND PERFORMANCE**

- A. The pilot wire protective system shall operate in conjunction with similar equipment at the remote end of the feeder via pilot cable. The pilot cables used will be 1 x 10 pairs, 1.5 mm<sup>2</sup>, copper conductor, polyethylene insulated, copper tape screened, polyethylene over sheathed, steel wire tape armoured and PVC outer sheathed.

## **5 SWITCHROOM AUXILIARY ITEMS**

- A. The Contractor shall supply, deliver and install the following ancillary items:
  1. Framed single line diagram.
  2. First aid chart.
  3. Approved rubber mat extending to the full length of the switchboard.
  4. Key cabinet to accommodate keys and sub-station logbook.
  5. A4-size logbook.
  6. Danger signage on all equipment, sub-station doors etc.
  7. Operating tool board.

## **6 SCHEDULE OF TESTS FOR MV SWITCHGEARS**

Certified copies of the type test reports of the same type and make of switchgears as that supplied under this Contract shall be submitted.

## 6.01 TYPE TESTS

- A. The following Type or Tests shall be made on the switchgears
1. No Load Operations Before Short Circuit Tests  
Closing and opening operations shall be made on one circuit breaker of each type in accordance with IEC 56.4. Electrical opening and closing devices shall be energised at voltages specified in IEC 56.4.
  2. Basic Short-circuit Test Duties  
Short circuit closing and opening tests consisting the following test duties shall be made on one circuit breaker of each type in accordance with IEC 56.4:
    - a. Test-duty No. 1: O-3 min. CO-3 min.-CO at 10% rated short-circuit breaking current with a DC component of less than 20% of the AC component and transient and power frequency recovery voltages as specified in of IEC 56.4.
    - b. Test-duty No. 2: O-3 min. CO-3 min.-CO at 30% rated short-circuit breaking current with a DC component of less than 20% of the AC component and transient and power frequency recovery voltages as specified in IEC 56.4.
    - c. Test-duty No. 3: O-3 min. CO-3 min.-CO at 6090 rated short-circuit breaking current with a DC component of less than 20% of the AC component and transient and power frequency recovery voltage as specified in IEC 56.4.
    - d. Test-duty No. 4: O-3 min. CO-3 min.-CO at 100% of the rated. short-circuit breaking current with a DC of less than 20% of the AC component and taking into account IEC 56.4 and with transient and power frequency recovery voltages as specified in IEC 56.4
    - e. Test-duty No. 5: O- min. CO-3 min.-CO at 100% rated short-circuit Breaking current with a DC component equal to the appropriate value specified in 56.2 and a transient and power frequency recovery voltage as specified in IEC 56.4 and IEC 56.2.
  3. Critical Current Tests
    - a. Where circuit breakers have a critical current of less than 10% of the rated short- circuit breaking current critical current tests in accordance with IEC 56.4 shall be made.
  4. Small Inductive Current Breaking Tests
    - a. Small inductive current breaking tests shall be made on one circuit breaker of each type to demonstrate that the circuit breakers are capable of breaking small inductive currents up to rated value without excessive over voltages.
  5. Cable Charging. Current Breaking Tests
    - a. Cable charging Current Breaking tests shall be made on one circuit breaker of each type in accordance with IEC 56.4 to demonstrate that the circuit breakers are capable of breaking cable charging up to rated value without excessive over voltages. The test duties shall be those specified in IEC 56.4 and as follows:

Test-duty No	Supply Circuit IEC 56.4	Test current as percentage of the rated cable charging breaking current
1	1	20 to 40
2	1	100 to 110
3	2	20 to 40
4	2	100 to 110

6. Short Time Current Tests
  - a. One unit of each primary component with a rated short-time current (i.e. circuit breaker, disconnecting isolators, earthing switches, busbars, current transformers, cable sealing ends) shall be short-time current tested at its rated short-time current for its rated duration of short-circuit in accordance with the appropriate IEC or BS.
7. Peak Short-circuit Current Tests On Isolating Devices And Earthing Switches
  - a. One isolating device and one earthing switch of each type shall be subjected to a test to prove its capability of carrying the rated peak short-circuit current in accordance with IEC 129.
8. Short-circuit Making Tests On Earthing Switches
  - a. One earthing switch of each type shall be subjected to a test to prove its rated short-circuit making current in accordance with IEC 129.
9. Voltage Division Test
  - a. Voltage division across the different units of a multiple break circuit breaker shall be determined under short circuit conditions. The method of measurement of the division of power frequency recovery and transient recovery voltages across the individual breaks shall be in accordance with IEC
10. Mechanical Tests
  - a. One circuit breaker of each type shall be subjected to the mechanical test specified in IEC 56.4. The test shall consist of 1000 operating cycles without voltage or current in the primary circuit.
  - b. Mechanical tests on isolating devices and earthing switches shall be made on one unit of each in accordance with IEC 129.
11. Temperature Rise And mV Drop Test
  - a. Temperature Rise and mV Drop Tests shall be made in accordance with the appropriate standards and as follows:
 

1) Circuit breakers	:	IEC 564
2) Disconnecting isolators and earthing switches	:	IEC129
3) Busbars	:	IEC 56.4
4) Current transformers	:	BS 3938
5) Voltage transformers	:	BS 3941
6) Cable Sealing, Ends where applicable	:	IEC 56.4
12. Impulse Withstand Voltage Tests
  - a. At least one unit of each type of primary component be tested at the rated impulse withstand voltage in accordance with the method specified in IEC 56.4 and IEC 60.
13. Power Frequency Withstand Voltage Tests
  - a. At least one unit of each type of primary component shall be tested for one minute at the rated power frequency withstand voltage in accordance with IEC 56. IEC 129 and IEC60.
14. Tests On Current And Voltage Transformers
  - a. Current and voltage transformer shall be fully tested to BS 3935 and 3941 respectively.
15. Tests On Protective Equipment
  - a. All protective systems and relays shall be fully performed tested to BS 3950 and BS 142.
16. Tests On Relays
  - a. All relays shall be type tested to BS 142. 17.
17. Test On Instruments
  - a. Instruments shall be type tested to BS 89.18.
18. Test On Motors
  - a. One motor of each type shall be type tested in accordance with BS 2613, BS 170 and BS 3739 where appropriate.
19. Test On Motor Starters And Control Gear
  - a. Motor starters and control gear shall be type tested to BS 775.
20. Test On Secondary Wires And Control Cables
  - a. Secondary wires and control cables shall be type tested BS 6231.

21. Power Frequency Withstand Voltage Tests
  - a. All primary components of the switchgear except the voltage transformer shall be tested for one minute at the rated power frequency withstand voltage in accordance with IEC 56.4 and IEC 60. This test shall be made with the various components of the switch-ear assembled and ready for dispatch.
22. Millivolt Drop Test
  - Millivolt drop test shall be carried out on all contacts and terminals of primary components for comparison with millivolt drop type test stated in.
23. Mechanical Operating Tests
  - a. All circuit breakers shall be subjected to the mechanical operating tests specified in BS 56.4. All isolating devices and earthing switches shall be subjected to the mechanical operating tests specified in IEC 129.
24. Test On Current and Voltage Transformers The following tests shall be carried out Current Transformers
  - a. Power frequency withstand voltage test on secondary winding in accordance with BS 3938.
  - b. Over-voltage interturm tests in accordance with BS 3938.
  - c. Verification of Terminal markings shall be made in accordance BS 3938.
25. Voltage Transformers
  - a. Tests to determine voltage and phase errors in accordance with BS 3941.
26. Test On Relays
  - a. Each relay shall be routine tested in accordance with BS 142.
27. Test On Instruments
  - a. Each instrument shall be routine tested in accordance with BS 89.
28. Tests On Motors
  - a. Each motor shall be routine tested in accordance with BS 2613
29. Test On Motor Starters And Control gear
  - a. Each apparatus shall be routine tested in accordance with BS 775.
30. Tests On Secondary Wires Control Cables And Circuits
  - a. All wires and cables shall be routine tested to BS 6231 shall be made on the continuity and correctness of all wiring before any item is dispatched from the factor.
31. Test On Interlocks
  - a. Each system of interlocks shall be checked as installed in service to prove that it will prevent any dangerous or undesirable operation of the main plant items.

## 6.02 SAMPLES TEST

- A. The following sample tests shall be made on the switchgear materials.
  1. Tests On Solid Insulators
    - 6.02.1.1.1 Samples of solid insulators for the switchgear shall be selected for tests to prove compliance with requirements in their electrical and mechanical properties. 2. Galvanizing Tests
      - a. Samples selected by the Engineer of all galvanized materials shall be subjected to the galvanizing tests of BS 443 or BS 729 whichever is applicable.
    3. Tests On Seals
      - a. Samples of seals used for the switchgear enclosure shall be tested for their no deteriorating properties.

## 6.03 QUALITY CONTROL TESTS

- A. The Contractor shall establish a quality assurance scheme during the manufacture of the switchgear to ensure that the quality of the product leaving the factory is high and all defects in manufacture are eliminated. This scheme shall be additional to the Routine and Sample Tests specified.
- B. The scheme shall cover the assurance of the quality of materials. methods of welding, casting, molding, forging etc., fabrication and assembly and the final testing and inspection of the finished product.
- C. The Contractor shall include the cost of the requirement for witness at manufacturer for Factory Acceptance Test (FAT) not limited to Quality Control Tests, Routine and sample tests specified for the Engineer and Employer representative – 2 persons 3 day (excluding transport time) for tests at USA

embassy rate.

#### **6.04 SITE TESTS AUTHORISED TESTING ENGINEERING**

- A. The following tests shall be made on site during erection and completion of switchgear
1. Site Stage Tests
    - a. Tests on Current-Carrying & Earthing Connections
      - 1) All primary conductors and conductors used for the earthing system shall be tested to ensure full clamping pressure is applied to all contact surface and that all bolted connections are tightly secured with lock washers. Flexible connections shall be tested to ensure that sufficient slack is available for expansion.
    - b. Tests On Secondary Wiring And Circuits
      - 1) All wiring shall be checked against wiring diagrams provided by the Contractor and approved by the Engineer. Tests shall be made to ensure the continuity of each wire.
    - c. Operation Tests
      - 1) The operation of trip and closing devices, Mechanism Motors, etc. shall be checked.
    - d. Battery Tests
      - 1) Battery units shall be checked and tested for correct output voltage and proper functioning of equipment.
    - e. AC Control Panel Tests
      - 1) The AC control panel for motors, lighting etc. shall be checked for proper operation.

#### **2. Commissioning Tests**

- a. After the erection of the switchgear and its auxiliary items have been completed. the following commissioning tests shall be made:
  - 1) Operation Tests  
The circuit breakers, isolating devices and earthing switches shall be operated electrically and manually where appropriate.
  - 2) Power Frequency Voltage withstand Tests  
The completed switchgear shall be subjected to a power frequency voltage withstand test of the specified voltage for one minute in accordance with the test method specified in IEC 56. IEC 129 and IEC 60.
  - 3) Primary Current Injection Tests On Protective Systems  
All protective systems shall be tested for correct current transformer ratio, polarity and relay operation by the primary current injection method.
  - 4) Secondary Current Injection Tests on Relays  
Relays shall be tested for accuracy and compliance with BS 142 requirements by the secondary current injection method.
  - 5) Secondary Wiring Tests  
The insulation of the secondary wires and circuits shall be checked with an insulation tester.
3. Relay Operation And Tripping Tests
  - a. All relays shall be operated to assure the correct tripping of circuit breakers. 1) Test On Interlocks  
The correct operation of the interlocks shall be checked. The Contractor shall conduct all the tests required by the Engineer and the relevant Authorities. Where the tests are to be carried out by the Local Authority the Contractor shall make all necessary arrangement to conduct the tests and any costs to be incurred shall be deemed to have been included in the Contract.

#### **7. LABELLING**

- A. All switchgear panels shall be appropriately labeled to indicate the circuit they serve. The Contractor shall submit these labels to the Engineer for approval.
- B. Labels to identify the circuits shall be fitted both at the front and back of the switchgear panel and on doors or other detachable panels and circuit breakers
- C. Labels shall be of white plastic, engraved with black letters and/or figures or vice versa and be of an approved size, and attached to the equipment with self-tapping screws. Use of adhesive is not acceptable.

**\*\* END OF SECTION\*\***

## **MEDIUM VOLTAGE CABLES**

### **1. GENERAL**

### **2. SCOPE OF WORK**

This section specifies the engineering, supply and installation of MV power cables, manufactured to the latest revision of IEC 502 and appropriate BS/EN.

The indicative routing of the major MV cables are shown on the Drawings. The Contractor shall be responsible for co-ordination with Local Authority, to determine the exact routes and quantities of the MV cable installation. The MV cable installation shall comply with Local Authority's requirement.

The Works shall include the supply and installation of all cable glands, cable lugs, racks, hangers, suitable fire rated cable enclosure if applicable, clamps, cable clips, cable brackets, cable ladders, etc. and the supply of all necessary labors, equipment and materials for laying, termination of power cable.

### **3. STANDARDS**

The complete cable shall be engineered to manufacturer data and constructed in accordance with the latest revision of the following standards and the appropriate BS/IEC:

IEC 228	:	Conductors of insulated cables
IEC 502	:	Extruded solid dielectric insulated power cables for rated voltages from 1kV up to 30kV
IEC 540	:	Test methods for insulation and sheaths of electric cables and cords (electromeric and phermoplastic compounds)
BS 5468	:	Cross-linked polyethylene insulation of electric cables.

The engineering of the cable to manufacturer data shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this Specification and Drawings, whichever is the more stringent and approval to the Engineer.

In the adoption of standards and requirements, the Contractor shall take the following precedence: Engineer's decision;

Local codes of practice;

Drawings; Specifications;

International standards and requirements.

### **4. SUBMISSION**

All technical submissions shall be approved by the Engineers prior to the respective stages of construction.

As a minimum requirement, the submission shall include the following:

Shop drawings of the complete cable routes (including the cable ladder, tray / pipes and cable support system, etc). Cable routes as shown on the Drawings are for general guidance only; no variation will be entertained for cable route subject to adjustment of route and site co-ordination.

Equipment submission and sample submission; Cable termination details for cable manufacturer;

Cable test reports for routine test, type test, and site acceptance test;

Testing and commissioning procedure of MV cables;

Builders work Requirement.

### **CLIMATIC CONDITION**

The cables will be used in Lahore re sub-soil salty water exists in depths varying from three feet to eight feet. The climatic and atmospheric condition is given below:-

Peak ambient air temperature	48°C Mean
maximum temperature during 24 hours	35°C Minimum
temperature-----	1°C
Maximum sun temperature on exposed horizontal surface	52 °C
Maximum relative humidity.	60% at dry-bulb temperature of 47°C Average
annual rainfall.	1000mm.
Altitude	_____m above sea-level
Location	Gujranwala

## **5. PRODUCT**

### **INSULATED CONDUCTORS**

The conductor shall be EC grade aluminum as per IEC60228 class 2 stranded conductors.

Conductor Shield – The stranded conductor shall be shielded with an extruded semi conducting layer before insulating

Insulation: - The insulation shall be cross linked polyethylene. The average thickness of the insulation shall be 4.5mm, which should not be less than 3.95 mm at any one point.

### **SHIELDING**

The cables core shall be shielded in accordance with the shielding recommendation of IEC 60502 (2005) or applicable publication.

Shielding shall consist of layer of semi conducting XLPE material extruded or semi conducting material coated directly over the insulation and a rubberize semi conducting tape applied over with an overlap of 15% (width of the tape).

The semi conducting insulation shield shall be covered by a bare copper shielding tape applied with an overlap of 15% (width of the tape).

Phase identification shall be obtained by using either colored Tapes (Red Yellow, Blue) which shall be applied over semi-conductor tape longitudinally or numerically 1,2,3 printed on semi-conducting tape in Red, Yellow, Blue colors.

The insulation shield shall be easy to strip from the insulation and individual conductors of multi conductor cables shall be easy to separate for termination purpose.

**ASSEMBLY**

Three insulated cores shall then be laid with jute or synthetic fiber filters and bound with a cable tape binder.

The cable tape binder shall then be covered with a PVC Jacket. PVC compound should be compatible with the conductor operating temperature of 90°C. PVC Jacket should have the following nominal radial thickness, subject to a required tolerance of 20% + 2mm.

**ARMOUR**

Armoring shall be provided with steel wire. The thickness of each wire shall be 3.15mm for sizes 300mm<sup>2</sup> applied helically over the PVC bedding, covering the surface of the bedding. Steel wires shall be in accordance with requirements laid out in BSS 6346:69.

**OVERALL JACKET**

The entire cable assembly shall then be covered with a PVC outer jacket suitable for the operating temperature of the cable. Nominal radial thickness shall be as given below and subject to a required tolerance of 20% + 0.2mm.

**PACKING**

The cables shall be supplied wound in lengths, as given in below on non-returnable drums which shall be strong enough to withstand transport from the factory and handling on site when laying the cables. Covering, strong enough to withstand the handling shall be put around the circumference of the drum to protect the cable from damage. Relevant brief particulars of the cables shall be painted on the side of the drums as well the identification —Property of SBPl.

**6. EXECUTION**

**LAYING & TERMINATION OF MV CABLES**

**GENERAL**

In general, the installation of cables shall be carried out in accordance with the latest GEPCO Specifications, manufacturer’s recommendations and IEE Regulations. The bending radius (as a multiple of the overall cable diameter, d<sub>0</sub>) shall not be less than

600/ 1000 V PVC cable	12d <sub>0</sub>
6350/ 11000 V XLPE cable	15d <sub>0</sub>

Even during handling, pulling, and installation. A total maximum of 5% of the cable length shall be provided as slack (at termination positions, in draw-pits, etc).

Cables shall generally be laid parallel to roads and footpaths, within the appropriate services reservations. During excavation, laying, and backfilling, the adjacent and intersecting service pipes and runs shall not be damaged or disturbed.

Cable drums shall be carried on suitable trailers and unloaded near point of use. Any rolling shall only be in the direction of the arrow marked on the drum. If hoisting equipment is not available, ramp boards (max 1:4) with a winch or a coil of rope around the drum shall be used. The cable shall be paid out by jacking/propping the drum on an axle/spindle, and a braking plank installed below. Care shall be taken to see that the manufacturers recommended pulling tension is not exceeded. Cable rollers shall be installed at maximum 2m spacing (1.2m for heavy cables) and at bends. A cable stocking or pulling eye shall be attached to the leading edge of the cable for pulling purposes. Cables shall not be laid if the temperature is below 0 °Centigrade.

Power cables shall be installed in cable ducts, directly buried, or in under floor cable trenches, as required.

The following methods shall be employed for laying cables: Paying out from a trailer

Laying by hand

Laying by motor-driven rollers

### Pulling by winches

If cable is to be carried by hand (un-supported by rollers) men shall stand 4 to 6 m apart along the route. Flaking of cables (—figure-eight method) may be employed, taking care to prevent infringement of the minimum bending radius requirement.

For directly buried cable, excavation shall be carried out in accordance with BS6031, and shall be kept free of water and protected against damage or collapse. Before cables are laid, the bottom of the trench shall be graded evenly, cleared of loose stones, and then covered for the full width of the trench with 75mm thick fine riddled-soil/sieved-sand bedding (in compacted 50mm layers). After cables are laid, a 50mm thick sand cover shall be laid over the cable, with 50mm thick protective brick/tiles provided along the entire length. The first layer of backfill shall be placed manually and compacted by hand punning until a thickness of 150 mm over the cover tile is reached. Additional layer shall be laid in 150mm increments and may be compacted mechanically.

When cable trenches are opened all cables shall be laid as quickly as possible. The engineer's approval shall be obtained before a trench is backfilled, but generally backfilling shall be commenced within 24 hours of cable laying and the work completed speedily.

Multi-core cables in pipe and duct shall be pulled after the entire raceway system has been completed, dried out, and cleared of all obstructions, using a wooden mandrel (300mm length, dia. 10mm less than pipe dia) to ensure correct alignment.

After installation of cables in underground ducts and pipes, the cable shall be supported any from the bottom end of the pipe and the pipe and the pipe-ends shall be properly plugged and sealed to prevent ingress of water or vermin.

On completion of laying, terminating and jointing of the cables and CPC, a plan (1:500) shall be prepared, containing the following details:

Type of cables, X-sectional area of conductors, rated voltage. Year of manufacture, month and year of laying

Actual laid lengths between centers of the joints and between them and the sealing ends. Exact locations and depths of cables and joints in relation to fixed points.

The electrical values of the completed installation shall be measured and recorded:

Insulation resistance between conductors and between conductors and earth/armour. Conductor resistance, using a suitable measuring bridge of all cores.

Capacitance, between conductors and between conductors and earth/ armour.

Markers of approved design/inscription shall be installed to indicate the location of all joint boxes at every point where a cable enters a building, sub-station, plinth or feeder pillar and will be provided all along the cable route at regular intervals of 30m when a straight run occurs or when the route changes direction. The XLPE cables will terminate with approved stress cone in panels.

Cable markers shall be made of concrete, 600mm square by 100mm thick with impressed characters. They shall be made of grade 20 concrete, with 10mm aggregate. The wording shall be —HT CABLE|, —LT CABLE| or —COMMUNICATION CABLE| as appropriate, together with circuit details, as instructed by the Engineer; in addition, the word —JOINT| shall be added where appropriate.

### **11-kV Power Cable Terminations**

The terminations covered are of pre-moulded cold, heat shrinkable and slip on type for indoor and outdoor use, suitable for rapid and easy installation and for maintaining safety of the persons and the equipment. The terminations shall be suitable for operation at the ambient temperature of 50°C. The relative humidity may range up to 100%. The termination kits shall be suitable for a three-phase 11kV distribution system of the following characteristics:

Nominal System Voltage	11 kV
System Highest Voltage	12 kV
Frequency	50 Hz
Maximum short circuit rating	25 kV

Indoor termination shall be made in pad mounted steel enclosures and switchgear panels where dust and severe condensation is liable to occur.

The termination kits shall conform to GEPCO specifications. **11kV**

### **Power Cable Splices**

The joint and termination kits shall be suitable for cable of following description: Single

#### Core Cable

This conductor is of aluminum, covered by a semi-conducting layer approximately 0.25 mm thick.

The conductor insulation is made of cross-linked polyethylene of 4.5 mm thickness applied over semi-conducting layer.

#### A semi-conducting tape

Layer approximately 0.51 mm thick is applied over the insulation.

A tinned annealed copper foil shielding tape of thickness 0.127 mm is applied helically to the surface of the insulation with an overlap of about 50 percent of the tape width.

An overall polyvinyl chloride sheath of 2mm thickness is applied over the core.

#### Three Core Cable

This construction of the individual cores of three-core cable shall be the same as for single core cable stated in clause a (i) above except that the overall sheath shall not be applied.

A suitable binding tape shall be applied helically over the laid up cores with a suitable overlap.

The cable shall be covered with an inner jacket made of polyvinyl chloride compound of 2 mm thickness.

A bedding tape of approximately 1mm thickness made of rubberized cotton or jute shall be applied over the inner PVC jacket.

Steel tape armour of 0.75 mm thickness shall be applied over the bedding. The armour shall consist either of two layers of galvanized steel tape or a single layer of interlocked galvanized steel tape.

Overall PVC sheath of approximately 2.8 mm thickness shall be applied over the armour.

The kits supplied for terminations, tee and straight joints shall be suitable for continuous operation at an ambient temperature of maximum 50 °C and for a conductor operating temperature of 90 °C.

Terminations shall be made in pad mounted steel enclosure where severe condensation is liable to occur. Tee and straight joints shall be suitable for direct burial underground or

Installation in ducts. The duct and soil conditions vary from dry to wet. Highly corrosive salts are encountered in soil.

The splices and terminations shall be suitable for operation at ambient temperature of 50oC maximum and suitable for three phase underground 11kV distribution system of the following characteristics:

Nominal System Voltage	11 kV
System Highest Voltage	12 kV
Frequency	50 Hz
Maximum short circuit rating	25 kV

The material kits shall be according to GEPCO'S latest specifications (amended to-date) Termination Kits

A protective covering of suitable materials having anti-track and erosion-resistant properties for use as an external covering of insulated cores for indoor and outdoor use shall be provided. Where required, sealants may be used to effect seals on joints.

A tube or pre-moulded cone of suitable material having properties to provide electric stress control over insulated cores of the terminations of indoor and outdoor use shall be provided.

Suitable tubing for enclosing and sealing prepared lug for indoor and outdoor terminations shall be provided. The tube shall have anti-track and erosion resistant properties.

The trifurcated tube of suitable material for sealing a prepared crotch (for three core cables) for indoor and outdoor terminations shall be provided. It shall have excellent Water proof and erosion resistant properties.

Rain sheds of suitable material shall be provided for application over prepared outdoor terminations. The material shall have excellent anti-tracking and erosion resistant properties.

The internal surface of the tubular part shall be coated with suitable adhesive compound or provided with adhesive tape for proper fixing of the shed.

Indoor termination shall be provided with Lugs. Outdoor termination shall be provided with Sleeves and Connectors.

All Bolts, Nuts and Spring Washers used in connectors shall be of steel and electrolytically galvanized. The thickness of coating shall be such as to withstand two, one minute's dips in a Copper Sulphate solution.

A suitable copper flexible earthing strap of one meter in length shall be provided for soldering with the metallic shield of the cable. Alternate earthing devices can also be offered for which technical details will be provided.

#### **Cable Jointing**

Earth joint and termination kit shall contain all materials in adequate amounts necessary to made to splice or termination as per drawings listed above. The approximate quantity of materials to make terminations splices and tee joints. Each splice and termination kit shall contain the following materials.

GEPCO'S specifications: High voltage splicing tapes.

Pressure sensitive tape (Adhesive tapes) or Glass tape with epoxy resin compound and a brush for applying the compound over the joint.

Semi-conducting tapes. Tinned coppers mesh tape. Grounding strap.

Jumper wire or strap. Cotton tape for binding.

Compression connectors, sleeves or tee joints or lugs as may be the case. Jointing solder 50: 50.

Soldering flux. Insulation putty. Cleaning fluid. Abrasive cloth.

Cleaning cloth.

The outer coverings of splices and terminations shall be completely non-hygroscopic, moisture and track resistant. This may be achieved by the application of epoxy resin compound over the protective tape. All connectors shall be filled with inhibiting compound and ends covered with rubber plastic caps. The caps shall fit over the ends tightly to prevent leakage of the compound.

The tape shall consist of an un-vulcanized or partially vulcanized polyethylene base insulating compound with or without synthetic resins and shall be self bonding, self fusing, Ozone and Cornea resistant. The tape shall be suitable for use with cross linked polyethylene, butyl rubber and PVC insulation or a continuous operating temperature of 90 °C.

The characteristics of the insulating tape shall be as follows:

Tensile strength min at break	17.5 kg/sq cm	Elongation 500 %
Dielectric strength min	2 KV/mm	
Volume resistively	1015 ohm-cm	
Ozone resistance	No effect when exposed to 0.04% Ozone by volume for 3 hours.	

The tape shall meet the fusion and thickness tests specified in relevant clause of the specification.

The tape shall be wound in rolls with a separator between layers. The separator shall be parchment paper or glazed sheet which shall be interposed between adjacent layers and shall cover the outside of the tape.

The dimensions of the tape shall be as under: Width	20 mm
Thickness minimum .....	0.5 mm
Length per roll	10 meters.

The average thickness shall not vary from the nominal thickness more than 0.075 mm and the average length in any roll shall not be more than 5% from the nominal specified.

Pressure sensitive tapes shall be suitable for providing protective covering over the cable joints and shall be resistant to heat, ozone and moisture. The tape shall be made of plasticized polyvinylchloride compound or synthetic rubber coated on one side with pressure sensitive adhesives. The tapes shall be suitable for a minimum continuous operating temperature of 70°C. The tape shall be free from sulphur.

The instruction for installation of cable termination kits and cable jointing as contained in GEPCO specification mentioned above may be followed.

#### **AUTHORITY INCOMING CABLES**

The Contractor shall render all assistance to the Local Authority during the laying of the incoming cables.

The Contractor shall provide all termination kits, coordinate with Local Authority and terminate the incoming power and pilot cables at the incoming MV switchboard side.

The Contractor shall provide cable supports for all incoming cables.

## **SCHEDULE OF TEST FOR MV CABLES**

### **FACTORY TESTS**

Each type of cable specified shall be fully type tested according to IEC 502 and the appropriate British Standards. The types and sizes of cables required are shown on the Drawings.

Should the Engineer require it, the Contractor shall submit reports issued by a national or international testing authority on type test that have been successfully performed on the cable for his approval.

The type test shall include the following test: Partial discharge test;  
Bending test, plus partial discharge test;

Tan d measurement as a function of the voltage and capacitance measurement; Tan d measurement as a function of the temperature;  
Heating cycle test plus partial discharge test;

Impulse withstand test, followed by a power frequency voltage test; Medium-voltage alternating current test;

Type test (non-electrical) as stipulated in IEC 502, Table VI.

Cable routine test shall be conducted at factory in accordance with IEC 502 for the following tests:  
Measurement of the electrical resistance of conductors.

Partial discharge test. 4-hour MV test.

### **SITE ACCEPTANCE TEST**

The Contractor shall supply all necessary testing equipment for site testing. When required, this testing equipment shall be calibrated at the expense of the Contractor at a recognized national laboratory.

The Contractor shall engage an Authorized Medium Voltage Testing Engineer who is recognized by Local Authority to perform all site tests.

In addition to Local Authority's requirements and those recommended by the manufacturer, the following tests shall be carried out:

Continuity test, Earth test, Polarity test,  
Insulation resistance test,

DC high voltage test. The test voltage shall be in accordance with Local Authority's requirements and Engineer's approval.

**\*\* END OF SECTION\*\***

## **LOW VOLTAGE SWITCH BOARDS / DISTRIBUTION BOARDS**

### **1. GENERAL**

#### **1.1 Purpose**

This section together with its appending document covers the minimum requirement for the design, construction and performance of factory built assemblies of LV switchboard.

#### **1.2 Scope of Work**

The work under this scope consists of supplying, installation, testing, connecting and commissioning of all material and services of the complete switchboard as specified herein and/ or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

#### **1.3 Standards**

Switchboards shall comply with Section —General Specifications, Clause 3.

Particular reference shall be made to:

IEC 80000	Quantities and Units.
IEC 60051	Direct setting electrical measuring instruments.
IEC 60073	Color for indicator lights and push buttons.
IEC 61095	Electromechanical contactors for household and similar purposes.
IEC 61869	Instrument Transformers.
IEC 61869-2	Additional requirements for current transformers.
IEC 61869-3	Additional requirements for inductive voltage transformers.
IEC 60269	Low-voltage fuses.
IEC 60439	Low Voltage switch gear and control gear Assemblies.
IEC 60947	LV Switch gear and Control gear – All Parts (Circuit Breakers, Contactors, Motor Starters, etc.)
IEC 60529	Degree of protection provided by enclosures.
IEC 60617	Graphic symbols for diagrams.
BS 951	Electrical Earthing - Clamps for Earthing & Bonding.
BS EN 62305	Lightning Protection Standard.
BS EN 13601	Copper and copper alloys -Copper rod, bar and wire for general electrical purposes.
BS 2874	Nuts, Bolts, Washers and Rivets for use on copper.
BS 6346	PVC Insulated Cables.
BS 7430	Code of practice for protective earthing of Electrical installations

Any other standard referred to in above standards or these specifications. **1.4**

**Installation and Service Conditions**

For general site conditions refer to Section - E- 1, Clause 4.

Switchboard shall be installed indoor. The equipment shall be capable of operation under the prevailing ambient conditions without any deleterious effect of any kind. Switchboard shall be suitable for continuous operation at full load rating under combined variation of both voltage and frequency as stated in Section - E-1, Clause 5.1.

Transient voltage depression down to 80% of rated voltage shall not affect the performance of the equipment and dip voltage must be within permissible limit.

**2.MAIN ELECTRICAL CHARACTERISTICS**

**2.1 Power Supply System**

Main characteristics of power supply system applicable to all switchboards are:

- Voltage 400 V  $\pm$  10%
- Phase 3 f, 4 Wire.
- Frequency 50 Hz.  $\pm$  2 Hz.
- Neutral system solidly grounded.
- Peak asymmetrical SCC To be specified by the bidders.
- RMS symmetrical SCC To be specified by he bidders

Main characteristics of auxiliary supply

system are:

- Control / Command system 24 VDC.
- Space heater system 230 VAC.

**2.2 Ratings**

The equipment shall be capable of carrying the specified current on a continuous basis of 24 hours / day, without exceeding the permitted temperature.

The current ratings of all equipment must be guaranteed at the specified design temperature. Equipment shall be fully rated and constructed for withstanding, making and breaking the specified short circuit duty.Pins of auxiliary circuits shall be sized for a rated circuit of 10A Minimum.

**3.GENERAL REQUIREMENTS 3.1**

**Concept**

The Switchboard shall be of standard, prefabricated metal clad cubicle(s), floor mounting type, totally enclosed, dead front, dust tight and vermin proof requiring front access only. It shall complete in all respects with material and accessories, factory assembled, tested and finished all according to the specifications and to normal requirements. For indoor installations the international classification shall be IP42.

The Switchboard with all components and accessories shall be suitable for front operation only and shall:

- have a rated service short service breaking capacity, Ics at 400 VAC, conforming to IEC 60947-2 unless

otherwise stated on the drawings.

- be provided with adequate clearance from live parts so that flash over cannot be caused by switching, vermin, pests, etc.
- have all components rated for insulation class 600-volt minimum.
- be designed for flush mounting of all instruments on the front side.
- have all incoming or outgoing connections from the top or bottom as required. Have the components mounted so as to facilitate ease of maintenance from the front. Have common lamp test facility for all lamps.
- have wiring diagram on the inside of door of the switchboard. Be labeled with nameplate on the front side of door.
- have arrangements for extension of switchboard in future.

### **3.2 Accessibility**

Switchboard shall preferably be arranged for bottom cable entries. Adequate space must be provided for cable entries and termination. It shall be possible to work easily and safely on cable of a main or control outgoing circuit in OFF position with the remainder of the board alive.

Adequate system shall be provided for installation and clamping of cables inside the cable compartment. Position of terminals and cables shall allow use of clamp ammeter.

Power and Control cable termination shall avoid obstruction to other cable termination and provide easy access for terminating cables. Cable supports shall be provided to avoid undue strain on cable termination. Easily accessible locations shall be reserved in the compartment for measuring transformers.

### **3.3 Heaters**

Space heaters shall be provided for prevention of moisture in each cubicle. Heaters shall be wired together and shall be automatically controlled to avoid over heating the equipment. Heater shall be suitable for operation on 230 VAC supply from an external source (to be provide in main Distribution Board)

### **3.4 Name plates**

On the front side, a name plate shall be provided at the top to indicate the name of manufacturer, system voltage and frequency and the current carrying capacity of switchboard.

Each breaker shall have a circuit identification label fitted below the breaker aperture or as suitable.

Drawing indicating the branch circuit names, breaker elements, cable sizes and connecting services shall be placed in a clear plastic pocket provided at the back of the front access.

Labels described shall have block letters 7 mm high on a white back ground, to be made from traffolite and be fixed with screws.

Each incoming and outgoing circuit shall also be labeled with name plate 75 mm x 15 mm, as described above on the front side of door.

## **4. MECHANICAL DESIGN**

### **4.1 General Construction**

The switchboard shall be fabricated, welded; grinded, finished with angle iron framework and clad with 14 SWG MS sheet, to form a rigid, free standing, flush mounting fronted assembly.

It shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories. Each compartment shall be fully partitioned from its neighbor both horizontally and vertically, allowing safe cable routing / termination without shutting the switchboard down.

All live parts within cubicles, compartments or modules, which have to be accessible during normal maintenance operations, shall be adequately protected and / or barred to ensure protection of works and to avoid accidental contact. Barriers may be rigid, transparent, insulating material fitted with warning labels.

The doors shall be provided with hinges on the left-hand side and locking handles on the right hand side for fastening the door. The front assembly shall be fastened to the enclosure by means of self locating fasteners for quick and easy fixing.

All holes, cutouts shall be tool or jib manufactured and free from burrs and rough edges. All structural components shall be of standardized design to provide complete uniformity and interchangeability of common parts. Removable gland plates shall be provided at top and / or bottom as required.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels with galvanized steel clamps and brass cable clamps respectively for unarmoured and armoured cables shall be provided.

The cabling inside the Switchboard shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.

All metal work of the switchboard shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of colour RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

#### **4.2 Bus Bars**

Bus bars and droppers supported on non - hygroscopic material are to be high conductivity electrolytic tinned copper, completely isolated and mechanically braced and rated to withstand the specified short circuit currents for one second duration.

Bus bars and droppers shall be housed in a separate compartment and shall be clearly marked with their respective colors. Bus bars shall be provided for three phases, neutral and multi - terminal earth. The temperature rise shall not exceed 50 degree centigrade at rated current. Neutral bus assembly shall consist of outgoing screw terminals with one terminal for every MCCB / MCB.

Neutral Bus bar should be of same ampere rating as phase bar.

Removable metal covers on the bus bar chamber shall be provided with suitably sized labels at regular intervals, fixed with self tapping screws and warning of live metal work.

All bus connectors shall be tinned plated connections and joints. Horizontal bus bars shall be of the same current rating throughout their length.

#### **4.3 Earthing**

A copper earth bar of suitable section for the specified fault level shall extend the entire length of the Switchboard. Provisions shall be made for possible future extensions at both ends.

Earthing facilities shall be provided on each incoming and outgoing unit to permit earthing of the connections.

All metallic non-current carrying parts of the Switchboard shall be bonded together and connected to the Switchboard's earth bar.

Each circuit wiring shall be green / yellow colour. Earthing mass continuity between withdrawable parts and fixed frame shall be correctly ensured whatever the withdrawable part position.

Provision shall be made adjacent to cable termination for earthing cable armour to the earth bus bar.

Earthing switch shall be provided wherever mandatory as per rules and regulations / codes and standards and shall be manually operated. An interlocking system shall provide the following locking and safety functions:

- Impossibility of closing the earth switch if the switching device is closed.
- Visual check of earthing switch positions to be possible.
- Possibility of locking the earthing switch operating handle in open and closed position.
- The earthing of the bus bar shall be done manually by the operator without provision of general earthing system.

## **5. DISTRIBUTION BOARDS**

The enclosure of the LV Distribution Board shall be fabricated from electro-galvanized / zinc coated sheet steel.

The LV Distribution Board shall be fabricated with 16 SWG sheet steel recess mounting. All components shall be installed on a common component mounting plate made of 14 SWG sheet steel inside the enclosure and protected from the front with screwed sheet steel front plate. The door and dead front covers shall be made of 14 SWG sheet steel. The door shall be fully gasket with hinges on the left hand side and locking handle on the right hand side for fastening the door. The locking handle should be detachable. The dead / front assembly shall be fastened to the enclosure by means of self - locating fasteners for quick and easy fixing.

The distribution board 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 Distribution Boards.

An earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of Distribution Boards at two points. Flexible copper strip shall be provided for earthing of the door of Distribution Board.

Neutral bus assembly shall consist of outgoing screw terminals with one terminal for each MCB. All holes, cutouts, etc., shall be tool or jib manufactured and free from burrs and rough edges. Removable gland plates shall be provided at both the top and / or bottom, as required.

The cabling inside the distribution board shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.

All metal work of the distribution board shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of color RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

## **6. COMPONENTS**

The switchboards shall be provided with all components as specified or shown on the Drawings and as necessary for the satisfactory operation of the Switchboard and of the electrical system. Typical specifications are given here under:

### **6.1 Moulded Case Circuit Breaker**

These shall be three pole 400 / 500 volts rating shown on the drawings. The breakers shall have both time delay over current and instantaneous short circuit protection.

The MCCBs shall be installed such that their switching levers are accessible through the dead front plate for operation. Circuit numbers / designation on all circuits shall be conspicuously marked to facilitate connection and maintenance.

The breaker shall have quick make - quick break toggle mechanism with positive 'ON', 'OFF' and intermediate

' Tripped ' positions.

Trip mechanism shall be trip free on overload or short circuit ensuring that the breaker will not close / remain close even if the close command is given while the circuit breaker has tripped due to short circuit or continuing overload.

### **6.2 Miniature Circuit Breaker (MCB)**

The MCBs with current rating from 3 to 100 Amps. shall be conforming to BS EN 60-898 or IEC 60947-2. The circuit breakers shall be suitable for DIN-rail mounting, maintenance-free and fully tropicalized.

The MCBs shall be designed for horizontal or vertical mounting, or reverse feeding, without any adverse effect on electrical performance.

The operating mechanism shall be quick make, quick break type, trip free, with all poles opening and closing simultaneously (except for the neutral pole, which if required shall be of the advance- closing and late-opening type). The operating toggle shall clearly indicate the ON and OFF/TRIP positions.

The individual operating mechanism of each pole of a multiple MCB shall be directly linked within the MCB casing and not by the operating handle.

Each pole of the MCBs shall be provided with bimetallic thermal element for overload protection and a magnetic element for short circuit protection.

### **6.3 Residual Current Circuit Breakers (RCCB)**

RCCBs shall be four pole, current operated type with tripping current of 0.3A and tripping time not more than 0.1 seconds.

### **6.4 Load Break Switch and Contractor**

Load Break Switches and contractors shall be of AC3 type for motor loads. Air circuit breakers above 630A shall be housed in separate cubicles. Aluminium plate shall be provided for cable entry to ACBs / MCCBs cubicles of 630A and above rating.

## **7. POWER FACTOR IMPROVEMENT PLANT**

The power factor improvement plant shall be used for improving the power factor of the system. The plant shall be automatic-cum-manual.

The power factor improvement plant shall be aligned with main LT switch board and it shall be a part of that LT switchboard as shown on the drawing. The capacitors shall be suitable for three phases, 415 volts 50 Hz system and shall be self cooled, designed for indoor use in tropical climate for maximum ambient temperature of 45 degrees centigrade and relative humidity 90%. The capacitors shall be in the form of banks divided for 12 stages, 6 stages and 4 stages. Each capacitor bank unit shall be 25, 50 and 100 kVAR. The total kVAR capacity shall be as indicated on the drawings. Each capacitor unit shall be complete with discharge resistors and internal fuses and shall be connected with control panel with proper size of single core PVC insulated cables.

The panels shall be supplied complete with a set of 3-phase, full capacity, isolated tinned copper bus bars, interconnections, risers, designation labels, cable sockets, holding down bolts, wiring with cleats and ferrules, earthing sockets and studs, etc. Each control panel shall comprise.

1 No. Multi stage power factor correction relay for automatic/manual control.

1 No. 3-phase, 4 wire, 415 volts, unbalanced load power factor indicator.  
Auto-off-Manual selector switch

Current transformer with 5A secondary current, having suitable output burden and accuracy.

Instrument protection fuses.

Following equipment shall be provided for every 250 KVAR capacitor bank:

1 No. 630 amps, triple pole 415 volts air break contractor with auxiliary contacts (2 N.0+2 NC)  
Contractor shall be suitable for AC 3 duty.

1 Set of 2 Nos 630 Amps H RC back-up fuses with base and carrier. 1 Set  
of ON and OFF push buttons.

1 No. Red lamp for —Onl indication of the contractor.

### **7.1 Requirement of Capacitor Banks**

According to IEC-83 1 -1 and 831-2.

Fully insulated, terminals to be shielded by a cover.

Dielectric: Plastic poly-propylene, impregnated. Electrodes:

Aluminium coating vacuum metalized.

Safety features: Self healing, Over pressure tear-off fuse.

Withstand switching operations safely.

Maximum in rush current 200 times rated current.

Loading capacity: 1.1 times rated voltage. 1.3 times rated current at delta max.

Overloading capacity 1.5 times rated output at delta max.

Acceptable tolerances - 5/+ 10% of rated output at rated frequency. Static life  
expectancy > 100,000 operating hours.

Test Specifications: Terminal versus terminal with an AC voltage 2.15 times rated voltage for 10seconds  
duration. Terminals to casing with an AC voltage of 3 KV for 10 seconds duration.

## **8.PARTICULAR COMPONENT REQUIREMENTS**

### **8.1 Current Transformers**

Current transformers shall comply with the requirements of IEC 60185 (or equivalent).

Current Transformers shall be polyester resin insulated, ring type, air cooled having transformation ratio as  
indicated on the drawings. The current Transformers shall be of suitable burden having accuracy class 1.0.  
The Current Transformers shall have rated secondary current 5A / IA as required.

Current Transformers shall mechanically and thermally withstand the specified short circuit capacity. Test  
terminal blocks shall be provided for current Transformer secondary circuits having short circuiting provisions  
to allow portable apparatus to be connected.

### **8.2 Voltage Transformers**

Voltage transformers shall comply with the requirements of IEC 60186 (or equivalent) and shall be of the  
same accuracy class as Current Transformers.

Voltage Transformers shall be equipped with primary fuses with an interrupting capacity of the incoming  
circuit breakers. Test terminal block shall be provided for each Voltage Transformer system.

### **8.3 Ammeters and Voltmeters**

Indicating instruments shall be semi-flush Switchboard type, moving Iron, spring controlled with standard scale having white background and black graduations and markings. The front dimensions shall be 144 x 144 mm for instruments on incoming side and 96 x 96 mm on all outgoing circuits.

Indicating instruments shall be 1.0 class percent of full scale basic accuracy class in accordance with IEC 60051.

The ammeter shall be suitable for connection to 5 Amp. Secondary of Current Transformer or directly through shunt as shown on the drawings. The instruments shall have measuring range indicated on the drawings. A red mark shall be provided at the working voltage on the scale of all voltmeters.

### **8.4 Selector Switches**

Ammeter and voltmeter selector switches shall be complete with front plate, grip handle, R-Y-B and OFF position for ammeter and RY-YB-BR-RN and OFF positions for voltmeters.

The selector switches for controls shall be rotary cam type and shall be provided complete with knob and front plate, showing all positions as required.

### **8.5 Push Buttons**

The push buttons shall be momentary make / break contact type (normally open / normally close) and suitable for flush mounting. The push button for ON and OFF switching shall be red and green respectively.

### **8.6 HRC Fuses**

HRC Fuses shall be provided complete with fuse bases, fuse, etc. The fuses shall have a fusing factor as specified for class QI in accordance with BS 88.

### **8.7 Pilot Lamps**

Switchboard shall be provided with phase indicating pilot lamps. The lamps shall be rated for 250 volts supply and suitable for flush mounting. The front of the lamps shall have colored rosettes for identification of phases.

### **8.8 Line up Terminals**

Line up terminals wherever provided for Control or Power circuits shall be suitable for voltage and size of conductors as indicated on drawings. The Lineup terminals for controls shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

### **8.9 Secondary Wiring**

All wiring shall be copper conductor, thermoplastic insulated, at least 1.5 sq. mm flexible, neatly arranged and clipped in groups.

Each conductor and its termination are to be identified and marked with numbered ferrules. All live terminals are to be shrouded.

Secondary wiring for Current Transformers shall be carried out with not less than 2.5 sq. mm. Terminals shall be specially marked to avoid opening of the circuit by accident.

## **9. INSTALLATION**

The LV Switchboard shall be installed at location shown on the drawing. The Contractor shall ensure coordination with civil works for providing any openings, holes, etc. to avoid any breakage to completed works. In case the provisions in civil works for the installation of electrical equipment are not made or made incorrect the same shall be rectified by the Contractor at his own cost and to the satisfaction of the Engineer. The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material with the approval of Engineer.

All installation material for physically erecting the Switchboard, such as bolts, nuts, washers, supporting steel, etc., shall be provided and installed by the Contractor. The Switchboard shall be installed upright and in level and shall be firmly and rigidly bolted to the floor and concrete supports.

The switchboard shall be completely erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided

by the manufacturer. Any safety locking provided by the manufacturer for safe transportation shall be released only after the switchboard is erected in position.

The incoming and outgoing cables shall be connected as recommended by cable manufacturer. The cable armour shall be connected effectively to ground.

The Switchboard body shall be connected to earth as per instructions given in section "Earthing" of these specifications. The Switchboard shall be tested and commissioned in the presence of the Engineer. The tests to be carried out shall be tested before energizing as per instructions contained in the article " Testing " of General Specifications of Electrical Works, section E-1 of these specifications.

**\*\* END OF SECTION\*\***

## LOW VOLTAGE CABLES AND WIRES

### 1. SCOPE OF WORK

The work under this scope consists of supplying, installation, testing, connecting and commissioning of all material and services of low voltage cables and wires and the accessories as specified herein or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The LV cables and wires with accessories shall also comply with the General Specifications for Electrical Works, Section E- I and with other relevant provisions of the Tender document.

### 2. GENERAL

All multicore and single core wires for light circuits, socket outlets and circuits operating upto 250 volts shall be 300 / 500 volts grade. All single core sheathed cables shall be of 450 / 750 volt grade. Power cables for main feeders, main to submain feeders, power equipment, etc., armoured or unarmoured shall be of 600 / 1000 volts grade. Armouring of cables shall be done with appropriate size galvanized steel wire as per codes.

The conductors shall be stranded or solid, high conductivity, soft annealed copper. Conductor of single core cables shall be circular, whereas of multicore cables may be circular or shaped according to standard practices and codes. The PVC insulation shall be extruded with a PVC compound having good flexibility, resistance to aging and ability to withstand the ambient temperatures as given in General Specifications for Electrical Works, Section E-1 of these specifications. Cable should be capable of running 125% of full load current without any damage.

### 3. STANDARDS

LV Cables and Wires shall comply with Section – E -1, Clause 3. Particular reference shall be made to:

- |                  |  |
|------------------|--|
| • BS 6004 / 6346 | PVC insulated cables for lighting and power. |
| • BS 6746        | PVC insulation for electrical cables.        |
| • BS 6360        | Copper conductors                            |
| • BS 6500        | Insulated flexible cords.                    |

Any other standard referred to in above standards or these specifications.

### 4. MATERIAL

#### 4.1 General

The power, lighting and control cables shall be furnished and installed in accordance with the routes and requirements shown on the drawings.

All cables shall have phase identification colours on insulation of each core. The colour code for three phase circuits shall be red, yellow and blue for phase conductors and black for neutral conductor. Where insulated earth conductor is installed, it shall have green colour insulation.

Single phase circuits shall have insulation of red colour for phase / line, black colour for neutral and green colour for earth conductor.

All DC circuits shall have insulation of red colour for positive, black colour for negative and green for earth conductor.

The ends of each length of multicore armoured or unarmoured cables shall be properly marked for clockwise and anti clock-wise sequence of core colours.

#### 4.2 Cables for Conduit Wiring

All cables / wiring in concealed or surface mounted PVC or steel conduits shall be single core PVC

insulated of specified grade and size, unless specifically shown on the drawings or given in BOQ.

#### **4.3 Cables on Surface / Concrete Trenches**

Cables for distribution system to be installed on surface, in cable ducts, in concrete trenches or on trays shall be single or multicore PVC insulated and PVC sheathed of specified voltage grade and size, unless specifically shown on the drawings or given in BOQ.

#### **4.4 Underground Installation**

Cables for laying directly underground shall be PVC insulated, PVC sheathed and armoured with galvanized steel wire. Cables fully installed in underground ducts / pipes and mechanically protected from end to end shall be PVC insulated and PVC sheathed unless specifically shown on the drawings or given in BOQ.

#### **4.5 Cable Accessories**

All cable accessories shall be provided for the complete cabling and wiring system without any additional cost unless specifically mentioned in BOQ. These shall include but not limited to the items such as saddles, clamps, fixing channels, connectors, cable joints (where necessary and approved by the Engineer), clips, lugs, tapes, solder, identification tags, bushes, glands, etc.

### **5. INSTALLATION**

#### **5.1 General**

When the laying is effectuated by others, the contractor shall test the cable characteristics insulation and continuity, at all phases of these and communicate them in a report to the Engineer, as per recommendations of the standards according to which the cable is manufactured.

The cables shall be spaced by categories along their entire length as well as upon penetration into buildings and in their interiors, according to their following rated voltages:

- 30 cm at least between a cable carrying 1 KV - 30KV and other cables.
- 20 cm at least between a cable carrying voltages between 50V - 500V, and any power or control
- 10 cm at least between a cable carrying voltages lower than 50V and telephone or these possible being grouped.
- All installation material, labor, tools and accessories for cable installation shall be furnished by the Contractor. The cable and accessories shall be installed as described in accordance with these specifications, drawings and manufacturer's instructions.

#### **5.2 Conduit Wiring**

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 filling rate inside the conduits shall not exceed 50 %. Cables directly embedded in the masonry are not accepted.

The wires shall be pulled in conduit with care, preferably without the use of any lubricant. Where necessary and if approved by the Engineer, the cable manufacturer's recommended lubricant may be used. Where several wires are to be installed in the same conduit, they shall be pulled together along with the earth conductor. All wires of same circuit shall be run in one conduit.

The wires shall not be bent to a radius less than 10 times the overall diameter of the wire, or more if otherwise recommended by the manufacturer.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in wires shall not be allowed. The use of connectors shall only be allowed at locations where looping-in is rendered difficult. The consent of the Engineer shall be required for using connectors. The connector shall be of suitable rating having porcelain body with sunk-in screw terminals. 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.

#### **5.3 Cables on Surface / Trenches**

All cables for installation on surface of wall, column, ceiling, trenches, etc., shall be fixed to the surface by means of galvanized steel clips, secured to a steel channel using suitable stud plate, nuts and washers.

The erection of cables and position of support shall be agreed by the Engineer on site, having taken into consideration the accessibility of all such routes. These shall be so arranged that cable crossing one another be minimized if cannot be avoided.

Cables shall be fixed throughout their length by means of approved saddles, clips, etc., at every 600 mm vertically and 900 mm horizontally.

Cables and equipment fixed to a building fabric, i.e., brickwork, concrete, etc., shall be fixed by means of appropriate fixing devices, i.e., Raw bolts, Hilti fixing devices, etc., or alternatively by means of suitable fixing devices cast at site, e.g., concrete inserts.

Contractor shall be responsible for all drilling of steel work, brick work and masonry where necessary for fixing clamps and brackets for supports.

Cables shall not be pulled into conduit until the conduit system has been completed, cleared and free from obstruction and sharp edges.

It shall be ensured that conduit system is clear before cable is drawn in. cables shall be put into conduits in such a manner that there will be no cuts or abrasions in the cable insulation, protective braid and jackets. There shall be no link in the conductors.

Distance of saddles shall be used for installation of cables in defined condition of the surface of wall etc.

Grease or other injurious lubricants shall not be used in pulling cables. The use of talc or non injurious lubricants is permissible, if desirable.

The number of wires installed in any conduit shall be such that the resulting space factor does not exceed 50 %. Spliced wires shall not be pulled through conduits.

All conduit wiring shall be carried out in the loop - in principle from outlet box to outlet box and in no circumstances shall joints be used except in fixed base connection blocks housed in outlet boxes.

The vertical clearance between two adjacent cables at any point is 50 mm minimum. Common mounting, channels are to be furnished for cable along the same route. The Contractor can offer alternate cable fixing arrangement, which shall be approved by the Engineer before commencement of installation.

The wall crossings where the outdoor cables penetrate in the building shall be carefully obstructed by means of polyurethane foam. The Contractor shall be fully responsible for the perfect tightness of these cable penetrations.

#### **5.4 Underground Cables**

The Contractor shall plan and take special care to prevent any damage to existing underground facilities such as underground piping, cables, foundations, etc. The Contractor shall notify the Engineer of any obstruction encountered and shall provide protective support or removal of such obstructions as instructed by the Engineer. Excavation adjacent to existing facilities, such as foundations manholes, ducts, underground pipelines and paving shall be braced and / or shored properly to protect those facilities during excavation and construction.

Sufficient slack shall be left in cables for this purpose that cut lengths of cables shall allow about 3% more in the measured lengths between terminations.

Cables, whether installed underground or in concrete trenches, shall not be bent to a radius less than 10 times the diameter of the cable or as recommended by the cable manufacturer, whichever is higher.

All cables shall be marked at least at each end, switch gear and equipment termination, where cable enter

or leave underground cable trenches or channels, where cable rises from one level to another, at 30M intervals with predetermined identification numbers, by means of proprietary non-deteriorating type, PVC, heat shrinkable, strap-on type or equivalent, for the identification of cable and circuit. These shall be indelibly marked with cable number and securely fixed to the cable. Where conductors are left to be terminated by another party or left to be connected later, they shall be identified. The earth continuity conductor shall be laid in the trench with the cables.

Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables, shall be plugged water tight by means of polyurethane foam / bituminized Hessian or equivalent method as approved by the Engineer.

## **5.5 Cable Termination and Joints**

Cables shall be terminated in a safe, neat and approved manner at the associated equipment, included that erected by others.

Compression type connectors (lugs) shall be of the correct size and approved type for the conductors concerned. Compression tools shall be supplied for specific use and shall be maintained in good order. After compression the conductor and terminal shall form a solid mass ensuring good conducting properties and mechanical strength. The compression jointing system used throughout the installation must be approved by the Owner or his representative before use.

The Contractor shall be responsible for all drilling and if necessary, tapping entries where these have not been provided by others.

When preparing cables prior to fitting glands, the gland manufacturer's instructions for cable preparation shall be observed. In all cases where armoured cables are used, care shall be taken to ensure that the lay of the armour is maintained after the gland is completely fitted.

Termination and joints shall be suitably insulated for the voltage of the circuits in which they are used.

Every compression joint shall be of a type, which has been the subject of a test certificate as described in BS 4579.

Cable ends, which are not terminated immediately after cutting, shall be sealed effectively to prevent ingress of moisture and shall be protected from damage until termination.

For all cables above 6 sq. mm in section, if a substantial mechanical clamp is not provided a compression type lug or socket shall be provided. At all equipment, cable shall be installed and terminated so that no strain is imposed on the cable or gland and due allowance made to counter the effect of vibration. At all termination an ample length of 'tail' shall be left.

Where joints in cable conductors and bare conductors are required, they shall be mechanically and electrically sound and they shall be accessible for inspection. Joints in non-flexible cables shall be made either by soldering or by means of mechanical clamps or compression type socket, which shall securely retain all the wires of the conductors.

Any joint in flexible cable shall be made by means of cable coupler. Cable couplers and connectors shall be mechanically and electrically sound and shrouded in metal, which can be earthed. Where the apparatus to be connected require earthing every cable coupler shall have adequate provision for maintaining earth continuity.

Cables of AC circuits, installed in PVC or steel conduit shall always be so bunched that the cables of all phases and the neutral conductor (if any) are contained in the same circuit. The outdoor apparatus shall normally be connected by means of cables with conduit termination down to about 30 cm below ground level or concrete foundation. The conduit shall be firmly secured down to their penetration into the trench or channel.

**\*\* END OF SECTION\*\***

## **CONDUITS AND PIPES**

### **1. SCOPE OF WORK**

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete Conduits and Pipes as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The Conduit and Pipes with accessories shall also comply with the General Specifications for Electrical Works, Section E- I and with other relevant provisions of the Tender document.

### **2. GENERAL**

The extent of works shown on the drawing does not indicate the exact position of conduit and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services drawings, as per site requirements and as directed by the Engineer.

The quality and material for the accessories of conduits and pipes such as sockets, elbows, bushings, bends, inspection / pull boxes, round boxes, etc., necessary for the completion shall be similar to that of conduit or pipes. All the accessories shall be supplied by the Contractor without any extra cost and deemed to have been included in the price of conduits / pipes.

### **3. STANDARDS**

Pipes and Conduits shall comply with Section - E-1, Clause 3. Particular reference shall be made to:

BS 31	Steel Conduit and accessories
BS 1378	Galvanized Iron Pipes and accessories.
BS 3595	PVC Pipes and accessories.
BS 4607	PVC Conduits and accessories.

Any other standard referred to in above standards or these specifications.

### **4. MATERIAL**

#### **4.1 PVC Conduits, Pipes and Accessories**

The PVC conduits and accessories for lighting and power circuits shall be furnished by the Contractor as shown in the drawings or given in BOQ. The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where conduit changes direction. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of sharp 90 degree bends and tees will not be allowed for concealed wiring.

The round PVC junction boxes for ceiling light or fan 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. Round junction boxes shall be provided with one piece bakelite cover plate fixed to the box by means of galvanized screws.

The PVC pipe shall be rigid and shall be minimum D-Class (working pressure - 12 Kg / cm), unless otherwise stated on Drawings or Bill of Quantities. Where pipe changes direction, manufactured smooth bends shall be used. For jointing of pipe, all precautions and procedures recommended by manufacturer shall be followed.

#### **4.2 Steel Conduit and Accessories**

All conduits shall be of heavy gauge 16 SWG steel, manufactured and tested in accordance with latest relevant standards.

The conduit shall be protected by two base coats of red oxide anti-rust paint and finished in first quality black enamel paint. The coating shall be of heavy enamel, which shall not flake or crack during installation and handling. Each conduit length shall be furnished with threaded ends and a threaded coupling at one end. Soft metal bushes shall be provided at conduit termination to prevent damage to cable during pulling operation.

Junction boxes shall be 100 mm square, having minimum depths of 38 mm or 65 mm as required for accommodating the number of wires. The junction box shall be 16 SWG sheet steel provided with anti-rust paint and finished in heavy black enamel paint. The cast Iron outlet boxes for light points shall be round having 50 mm diameter and 63 mm depth. The above dimensions are given as minimum only, and the exact size shall be determined by the Contractor keeping in view the ease of Installation and maintenance. All outlet boxes and junction boxes shall be provided with one piece bakelite cover plate of suitable design.

#### **4.3 Galvanized Iron Pipes and Accessories**

The G.I. pipes shall be galvanized from inside and outside by hot dip galvanizing method. The pipes shall be free from stains, burrs or any other defect. The accessories for G.I. pipes shall be galvanized from inside and outside. The conduit shall be NPT threaded, with at least 5 complete threads and assembled with TEFLON tape.

#### **4.4 Inspection Boxes / Pull Boxes**

The rectangular inspection boxes or pull boxes shall be of 16 SWG heavy gauge, sheet steel having nipples welded to box at entry holes to receive PVC conduit with force fit. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum length of inspection box shall not be less than six times the cable manufacturer's recommended bending radius of the cable. All concealed type pull boxes shall have a white plastic sheet of appropriate size fixed to the box by means of galvanized screws.

#### **4.5 Adaptable Boxes**

Adaptable boxes shall be made of 16 SWG sheet steel box, painted and finished to the same quality as the light Distribution Board. The boxes shall be 50 mm in depth for conduits up to 25 mm diameter, 63 mm in depth for conduits up to 40 mm diameter and 87 mm in depth for conduits up to 50 mm in diameter. For conduits more than 50 mm in diameter, the minimum depth shall be two times the diameter.

#### **4.6 Conduit / Pipe Accessories**

Bushes, plugs, glands, etc., shall be of brass and all male bushes shall be of long thread pattern. Covers for boxes shall be screw fixed and finished as the boxes. Gaskets shall be fitted only when finish is galvanized unless otherwise specified.

#### **4.7 Cable Trunking**

Where required, wiring shall be run in hot-dipped galvanized (after fabrication) sheet steel cable trunking of the specified gauge complete with all fittings and accessories, manufactured and installed in accordance with BS 4678/NEMA. The trunking shall be constructed with return flanges. Trunking covers shall be secured by anchored turn-buttons and locking bars and minimum length of individual sections shall be 2.44-m. The trunking shall be suspended / supported from the structure at maximum 1.5-m intervals with straps and hangers fabricated from minimum 6-mm dia HDGF bars, or supported by angle-iron brackets.

Conduit drips from the trunking shall also be supported with hangers. Factory made connectors shall be used at joints.

Junctions (tee and 4-way) in multi-compartment trunking shall be double depth to avoid reduction in cabling space. Cable in vertical runs shall be supported by pin racks, prongs or bridging pieces. Fire barriers shall be provided at each floor level. Allowance for expansion shall be incorporated.

Bonding links shall be provided at each joint and secured by screws, nuts and shockproof washers. The bonding links shall make contact with the metal of the trunking or fitting, and continuity shall not depend on contact through the screws, nor on removal on site paint finish from ferrous metal.

## **5. INSTALLATION**

### **5.1 PVC Conduits - Concealed**

The conduit shall be installed concealed in roof, wall, column, etc.

At all joints and bends, PVC jointing solution as manufactured by Pakistan PVC Limited or approved equivalent must be used to strengthen and to seal the joint.

Manufactured smooth bends shall be used. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of 90 degree bends and tees will not be allowed.

The conduit shall have a minimum of 38 mm cover of concrete. In the reinforced cement concrete (RCC) work, the conduit shall be laid before pouring of concrete. Under no circumstances shall chases be made in the RCC structure for concealing conduit and accessories, after pouring of concrete. The concrete shall be supported on top of bottom reinforcement of slab and shall be firmly secured by tying to the reinforcing steel in order to avoid being disturbed during pouring of concrete.

All outlet boxes to be firmly supported and installed such that they finish flush with the soffit of slab of beam.

Where conduits have to be concealed in cement concrete (CC) work after concreting, or in block masonry, chases shall be made with appropriate tools and shall not be made deeper than required.

The conduit shall then be fixed firmly in the recess and covered with cement concrete mixture to have to at least 32 mm cover before plastering. The work of curing in the cement concrete work or block masonry work shall be coordinated with the civil work. The Contractor shall obtain approval from Engineer for the route, to suit the site conditions before starting chasing and cutting.

The termination of conduits at or near the Switchboard / Distribution Board is shown diagrammatically on the drawing. The exact final locations of the termination shall be coordinated with the Switchboard / Distribution Board to be installed. Any extension of conduit near the Switchboard / Distribution Board to suit the site condition shall be made without any extra cost. 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 concrete, 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.

The entire conduit system shall be installed and tested before wiring is carried out. Any obstruction found shall be cleared by use of cutting mandrel or other approved device and the conduit shall be cleaned out before the installation of cable.

Pull boxes / Adaptable boxes shall be provided in conduit runs wherever required to facilitate pulling operation. The drawings are diagrammatic and do not indicate the position and spacing of pull boxes or adaptable boxes. However, these shall meet the following requirements:

- Pull boxes.

For straight runs the spacing shall not be more than 30 meters.

For runs with one 90 degree bend, the spacing shall not be more than 15 meters.

- Adaptable boxes.

For conduits up to 25 mm diameter, the boxes shall be 50 mm in depth. For

conduits up to 40 mm diameter, the boxes shall be 63 mm in depth. For conduits up to 50 mm diameter, the boxes shall be 87 mm in depth.

Wherever the conduit lengths cross the expansion joint either along the column or slab, suitable arrangement shall be provided so that when the conduit lengths in the expansion joint are stressed, the conduit neither develops any cracks nor breaks down.

Bending, offsetting and similar operations shall be performed through the help of proper bending tool to give a perfect bend of required angle without Desha ping of conduit to the least.

## **5.2 Steel and G.I Conduit**

The minimum size of conduit shall be 20 mm.

The use of solid or inspection elbows, bends or tees will not be permitted and 120 degree bends shall be limited to one between any two drawn-in boxes.

Conduit coupling joint shall not be used where conduit enter spout entry boxes. Conduit running, joints shall not be used where conduit enter conduit boxes or spout entry boxes.

Equipment that is required to be removed for maintenance shall be provided with conduit unions in all conduits that enter such equipment. The use of conduit nipples shall be avoided as far as practicable.

All conduits shall be cut square and reamed at the end. All conduit ends and the inside of conduits shall be clean and free from burrs.

Where bushed spouts or tapped holes are not provided at conduit termination, the conduit shall be terminated in a flanged socket and a smooth bore brass hexagon bush, with a lead washer fitted between the flanged socket and the equipment or box.

All exposed threads and parts where the galvanizing has become damaged shall be thoroughly cleaned and painted with galvanized paint. the exposed conduit ends shall be capped to protect threads from being damaged before installing cables.

Repair painting shall take place before any making good on site or buildings is carried out. The entire conduit system shall be checked for continuity. Any observation found shall be removed without damaging the installation.

The conduit system shall be installed empty with an 16 SWG steel wire drawn through the conduits for pulling of cables. Joints in underground conduits shall be avoided or reduced to the absolute minimum.

Where adjustable dies are used they shall be so adjusted that threads cut with them shall be the same depths as machine made threads.

The use of manufactured bends shall be avoided and instead smooth bends shall be provided by using approved type of bending tools.

Flexible steel conduits shall be installed at all points locations where flexible connection is required, as directed by the Engineer. The flexible conduits when used, shall be protected by external PVC sheath, resistant to oil damages.

G.I. pipes for underground installation shall be given bituminous paint coating and wrapped with suitable paper or cloth before installation.

## **5.3 Fixing of Conduits and Fittings**

Conduits in process units and on steel work with "U" bolt type fixings.

Conduits in buildings shall be fixed with galvanized distance saddles. Where a number of conduits follow a single route they may be fixed to mild steel brackets.

Conduits shall be supported on both vertical and horizontal runs as follows:

- Conduits size 20 mm and 25 mm maximum spacing of fixing 1000 mm.
- Conduit sizes larger than 25 mm spacing of fixing 1500 mm.

All conduit boxes that support fittings shall be securely fixed. All conduits shall be fixed 150 mm before and after every right angle or off set. All conduit fittings and equipment shall be fixed true and line able.

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
20 mm (3/4")	Not less than 130 mm.
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.

Underground conduit stud-up or kick pipe through concrete envelope shall be extended a minimum of 150 mm above grade and adequately braced to prevent shifting during concrete pouring work. The concrete envelope shall extend at least 76 mm above grade.

Under floor conduit installation shall be at a minimum depth of 120 mm from finished floor level. The G.I. pipes / conduits shall be installed at a minimum depth of 1000 mm measured from the top of size to the finished road level.

#### 5.4 Location of Conduits and Fittings

Before conduits are installed, confirmation shall be obtained that the conduit may be installed in that position.

Particular attention shall be given to the location of conduits to prevent the infringement of headroom and access ways.

Conduits shall be located to avoid obstructions, furnaces, hot lines and other places of high temperature.

Conduit shall not be located than 150 mm (6") where it runs parallel to or crosses hot surfaces. Underground conduit runs shall be kept to minimum in both number and length. Conduits shall not be recessed in fair brick work.

Draw boxes shall be so positioned to enable the cables to be drawn in easily. The boxes shall not be located in the comers or other such locations and shall be positioned to avoid tight bends, bending and cable kinks.

Conduits shall not generally be installed having a greater length 12,000 mm (40 feet) between draw-in boxes.

Conduit entries shall wherever possible be located in the bottom of boxes and equipment etc.

**\*\* END OF SECTION\*\***

## **BUSWAY SYSTEM**

### **1. GENERAL**

#### **1.01 SCOPE OF WORK**

- i) The scope of work shall cover the supply, design, manufacture, testing in the factory, packing, insurance, delivery to site, unloading, installation, testing and commissioning of all components with all the necessary accessories in accordance with this technical specification.
- ii) Installation will be by electrical contractor as per manufacturer recommendations.

#### **1.02 STANDARDS**

The bus bar shall comply with the following standards:

- a) IEC 61439 – 6
- b) IEC 60331 – Fire Resistance
- c) IEC 62271 : 200 : 2003
- d) IEC 60529 – 2 : 2001

#### **1.03 SHOP DRAWINGS/ SUBMITTAL**

- i) Submit installation & shop drawings and as built drawings. The busbar installer shall be fully responsible for coordination with site conditions and with MEP contractors executing other works at site to ensure the proper installation of the busbar without disruption to existing works. All shop drawings submitted to consultant will bear the signature and company seal of the MEP contractors and switchgear suppliers and be duly coordinated.
- ii) Shop drawings shall include components, supports and dimensioned system layouts in plan and section. All congested areas to have detailed blowups and sections.
- iii) General arrangement of bus duct runs shall be as shown on the drawings. Shop drawings shall show in detail the exact routing of all duct through the building, relative to the building column lines, structural floor slabs, walls, and switchboard interface details.
- iv) Submit test results for voltage drop with shop drawings for each rating of duct.
- v) Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.
- vi) Indoor feeder and plug-in busbar trunking shall be approved for hanger spacing of up to 2 meters for horizontally mounted run and 4.88 meters for vertically mounted runs. Outdoor feeder busbar trunking shall be approved for spacing of up to 1.5 meters for horizontally or vertically mounted runs.
- vii) All vertical runs with Tap-off's to be shown in continuous building / architectural sections to be provided by the engineer and should detail the Tap-off unit arrangement.
- viii) Submit complete voltage drop calculation complying with voltage drop schedule.

### **2. PRODUCT**

#### **2.01 BUSBAR RISING MAINS**

- i) Consist of bus bars in extruded aluminum housing with openings for duct plug-in units, and shall be complete with all hangers, cable tap boxes, elbows, flanges, bus extensions, end closures, fire barriers, bus plugs and accessories required for the complete installation and as shown on the drawings.

- ii) The bus duct shall be sandwich type construction and designed to operate on a 380 volt, 3 phase, neutral, and earth 5 wire, 50 Hz with neutral size same as phase size and shall be sized as shown on the drawings. The bus duct shall be designed and manufactured to comply with IEC 61439-6, BS 159 & 5486.
- iii) Be rated for 45 °C ambient at rated current, with voltage drop at unity power factor as per schedule below. The load shall be assumed to be concentrated at the end.
- iv) Be braced to withstanding without damage or distortion the stresses due to short circuit currents of 50kA for 1 second RMS symmetrical and shall be ASTA certified.
- v) Be capable of having any length removed without disturbing the adjacent sections.
- vi) Have its enclosure designed and, installed to ensure a low impedance ground return path along its entire length. Bus plugs and tap boxes shall be positively earthed to the bus duct enclosure.
- vii) The busbar trunking housing shall be constructed of code gauge steel and aluminum to reduce hysteresis and eddy current losses and shall be provided with a suitable protective finish of ANSI 49 grey epoxy paint.
- viii) All bus bars shall be fully insulated through its entire length.
- ix) Have a manufacturer guarantee for bus bar plating against peeling or flaking due to temperature or moisture.
- x) Be true sandwich construction with Class B 130°C insulation materials consisting of two layer of head formed polyester film or epoxy powder coat materials around each bus bar.
- xi) Have minimum enclosure protection to IP-54, and fully splash proof.
- xii) Provide flanges where duct passes through walls or floors and fire barriers where required by Code. Provide moisture barriers for walls between areas of high temperature or humidity differentials.
- xiii) The bus bars shall be tinplated or silver plated at all contact surfaces to assure low surface to surface contact resistance.
- xiv) The temperature rise at any point of bus bar shall not exceed 55°C rise above the ambient temperature of 45 °C when operating at full load current.
- xv) All busbar fitting and accessories shall be manufactured by the same manufacturer.
- xvi) The ampere ratings, approximate footage, fitting, plug-in units etc. are shown on the plan. The electrical contractor shall be responsible for routing the busbar trunking to coordinate with the other trades. Final field measurements shall be made by the contractor prior to release to the busbar trunking for fabrication by the manufacturer.
- xvii) The busbar trunking housing shall be totally enclosed non-ventilated for protection against mechanical damage and dust accumulation. And can endure 1000 hour salt spray testing.
- xviii) The temperature rise at any enclosure of the busbar trunking shall not exceed 55 °C rise above ambient temperature when operation at rated load current.
- xix) On plug-in busbar trunking there shall be three dead fronts, hinged cover type plug-in openings on each side.
- xx) All openings shall be usable simultaneously.
- xxi) Busbar trunking shall be installed so that plugs are side mounted to permit practical use of all plug-in openings.

- xxii) It shall be possible to inspect the plug-in opening and busbars prior to the installation of the plug-in units.
- xxiii) Provide expansion joints wherever they exist in building structure or at horizontal lengths exceeding 20m.
- xxiv) Busbars shall be of hard drawn silver-plated high conducting copper of 99.9% purity or Aluminium with silver / tin fused coating. They shall be designed for an operating voltage of 1500 volts and a withstand voltage of 10,000 volts.

## **2.02 TAP-OFF BOXES**

- i) Be equipped with steel spring reinforced contact jaws. Plugs shall be designed to ground to the casing before connection of the jaws.
- ii) Be designed so they cannot be inserted or removed in the closed position.
- iii) Be complete with current limiting circuit breakers as indicated in the drawing.
- iv) Have isolator interrupting ratings of 50 kA for 1 second RMS symmetrical amperes.
- v) Covers which have 'releasable' type interlocks to prevent the cover from being opened when the switch is in the 'ON' position.
- vi) Be equipped with internal barriers to prevent accidental contact of fish tape and conductors with live parts on the line side of the protective device.

## **2.03 JOINT**

- i) The busbar trunking joint shall be of the one-bolt type which utilizes a high strength steel bolt(s) and Belleville washers to maintain proper pressure over a large contact surface area.

## **2.04 BUS TIE DUCT**

- i) Bus tie duct shall be fabricated as per BS 5486 standard from copper bus-bar of required size.
- ii) Low voltage Bus Tie Duct system shall be air-insulated, non segregated construction and to be designed to meet the required voltage, ampere and fault level ratings.
- iii) The bus bar shall be braced to provide a dynamic short-circuit strength of 2.5 times the rms fault level of the main LV panel.
- iv) Copper Bus bars are sized in accordance with the specified ratings to operate within IEC temperature rise limits. Joints shall be tin-plated.
- v) Provision for the Bus expansion furnished as required by the configuration and length of each system.
- vi) Flexible connections shall be provided at the transformer end to absorb the vibrations with heat shrink insulation sleeves along with insulation tape over the bolted section.
- vii) Adequate high grade non-hygroscopic bus supports are furnished to suit the electrical and mechanical requirements specified for each installation.
- viii) Enclosure up to 4000A rating shall be made of sheet steel with minimum 1.6 mm, while above 4000A (up to 6000A), thickness of sheet need to be confirmed to the Design. The enclosure should be of self-ventilation design.

## **3. EXECUTION**

(By others supplier to ensure complete shop drawing coordination support and ensure any materials required as called for in section 3.01 below to be provided in project)

### **3.01 INSTALLATION**

- i) Support bus duct on vertical runs at each floor level. Adjust supports to ensure the weight of the duct is carried by the supports as per manufacturer's recommendation. Install expansion joints at the spacing

recommended by the manufacturer, with a maximum of 20m.

- ii) On horizontal runs support the duct from hangers on 1000mm centers or as per manufacturer's recommendation. Provide expansion joints at all locations where the duct crosses a building expansion joint and at the spacing recommended by the manufacturer.
- iii) Secure all connections with bolts and cup washers, tightened by a torque wrench and as recommended by the manufacturer.
- iv) Install and connect ducts so phase rotation is the same throughout the building.
- v) Cover the bus duct with a weatherproof heavy-duty plastic envelope. Do not remove until the building is clean and the bus ready to be meggered and energized.
- vi) Ensure that all bus duct terminations mate properly with the associated equipment.
- vii) Provide curb around interior floor penetrations.
- viii) Tighten the joint bolts to the required torque in accordance with manufacturer's recommendations.
- ix) Meggar the bus ducts in presence of the engineer and re-torque the joint bolts as recommended by the manufacturer.
- x) Fire barriers shall be included as an integral part of each feeder bus bar trunking length and fitting and shall be positioned when it passes through fire insulating ceilings and walls. These fire barriers shall be effective not only within the interior of the bus ducts, but also in the space between the bus duct and the protective sleeves of the ceiling and shall prevent fire, smoke and hot gases.
- xi) The bus duct trunking system shall be assembled under license to the manufacturer.

### **3.02 CERTIFICATION**

- i) The busbar should pass type testing on full range of each rating which is carried by international well-known lab accredited by IEC i.e. KEMA etc.

The busbar passes seismic tests with actual physical product and being certified complying with the seismic zone 2B.

**\*\* END OF SECTION\*\***

## **WIRING ACCESSORIES**

### **1. SCOPE OF WORK**

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete switches, switch sockets, etc., and miscellaneous items as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The wiring accessories shall also comply with the General Specifications for Electrical Works, Section – E - I and with other relevant provisions of the Tender document.

### **2. GENERAL**

The locations of the wiring accessories such as sockets, switches etc. are tentatively shown on the drawings. The Contractor shall ensure exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer. The Contractor shall be responsible for proper functioning of wiring accessories after installation and Commissioning.

### **3. STANDARDS**

Wiring accessories and miscellaneous items shall comply with Section - E-1, Clause 3. Particular reference shall be made to:

- BS 67                                      Ceiling roses.
- BS 1363:1984                          13A fused plugs and unswitched socket outlets
- BS 116                                    Two and three terminal ceiling roses.
- BS 2135                                  Capacitors for radio interference suppression
- BS 3676                                  Switch for domestic and similar purposes.
- BS 4934                                  Safety requirements for electric fans and regulators.
- BS 5060                                  Performance of circulating fans and their regulators.

Any other standard referred to in above standards or these specifications.

### **4. MATERIAL**

#### **4.1 Switches**

Switches for controlling light and fan points shall be single pole, rated for 10 Amp, 250 VAC. The body of switches shall be made of poly carbonate / urea with white face plate suitable for flush mounting on sheet steel outlet box. The switches shall be gang type having silver tipped contacts and operate with snap action.

For locations where switches and fan speed regulators are installed together, single switches shall be grouped and fixed on 3 mm thick plastic sheet screwed to a sheet steel box of appropriate dimensions. The fixing of plates on outlet boxes shall be means of flat head counter sunk galvanized screws with the head of the screw finish flush with the surface of the plate. Except for switches controlling light points, all single switches for fans, sockets, etc., shall have identification symbols on the operating levers.

Two way switches shall be used to control lights from two different locations as shown on the drawings.

#### **4.2 Switch Socket Outlets**

Switch socket units shall be of flat pin type and conform to BS 1363, 13A for fused plugs and socket outlets. 2 and 3 Pin rated for 5 Amps. or 2 Pin rated for 5 Amps. Supply as specified in the bill of quantities.

3 Pin 5 Amps. Sockets shall be moulded type having white plastic face plate, suitable for mounting on a sheet steel box of appropriate dimensions. Switch sockets shall have shrouded live contacts such that the earth pin is engaged to socket earth before making with the live contacts. Where specified, the switch socket unit shall have spring loaded dust tight cover for mechanical protection.

#### **4.3 Sheet Steel Boxes**

The outlet boxes for installation of switches, fan speed regulators and socket outlets shall be 16 SWG sheet steel having appropriate dimensions. The boxes shall have suitable knockouts or welded nipples for receiving the conduits. An earth terminal shall be provided for connecting at least three earth wires of 4 sq. mm. The outlet boxes shall be given two coats of anti-rust red oxide and one coat of enamel before installation. The boxes shall be suitable for mounting flush with the surface of wall or on the surface of wall as may be required. The boxes shall not be less than 75 mm x 75 mm (3" x 3"). All boxes shall be water tight where installed in the vicinity of liquids.

#### **4.4 Ceiling Rose**

The ceiling rose shall be suitable for 5 Amps, 250V AC. It shall have white plastic moulded base plate, copper or brass terminals for connecting at least two wires of 2.5 sq. mm size. The ceiling rose shall have a cover with cable inlet hole for multicore PVC insulated and PVC sheathed cable.

#### **4.5 Fans**

##### **4.5.1 Bracket Type**

The bracket type fans shall be suitable for mounting on the wall and suitable for operation semi-horizontally. These shall operate satisfactorily on 250 volts, single phase, 50 Hz, A.C. supply with + 10 % tolerance.

The sweep of the fan shall be as given in BOQ/drawings.

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed regulator, starting, radio interference, silent operation and temperature rise are concerned. For testing, BS 848 as amended shall be complied with.

##### **4.5.2 Exhaust Fan**

The exhaust fans shall be three blade types, mounted on the steel/plastic structure of its own, which will be fixed to the structure by means of suitable grouted foundation bolts. The fan shall be suitable for operation on 250 VAC with + 10 % tolerance.

The sweep of the fan shall be as given in Schedule of Quantities/drawings. Fans shall be direct driven and supplied complete with electric motor, back draft dampers and anti-vermin screen. The bearings shall be ball, roller or sleeve type of permanently lubricated and sealed type. Wheels shall be heavily and rigidly constructed and accurately balanced both statically and dynamically and free from objectionable vibration or noises.

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed, speed regulator starting, radio interference silent operation and temperature rise is concerned. For testing BS 848 as amended 1 960 shall be complied with.

**\*\* END OF SECTION\*\***

## **INTERIOR LIGHTING FIXTURES**

### **1. SCOPE OF WORK**

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete light fixtures as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and positions of light fixtures.

The light fixtures with accessories shall also comply with the General Specifications for Electrical Works, Section - E-1 and with other relevant provisions of the Tender document.

### **2. GENERAL**

The description of light fixtures in given Bill of Quantities, and stated on the drawings, and relevant material are described in this section. The determination of quality is based on certified photo-metric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.

The Contractor shall submit two samples of each and every light fixture specified and obtain approval of the Owner before purchasing. The quality and finishes of 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.

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.

### **3. STANDARDS**

Lighting fixtures shall comply with Section E-1, Clause 3.

Particular reference shall be made to:

-	IEC 81	Tubular fluorescent lamps.
-	IEC 82	Ballast for tubular fluorescent lamps.
-	IEC 155	Starters for fluorescent lamps.
-	IEC 400	Lamp holders and starters holders for fluorescent lamps.
-	IEC 566	Capacitors for use in TL, HP Mercury and LP sodium vapour.
-	IEC 598	Luminaries.
-	BS 3677	Discharge lamp circuits.

Any other standard referred to in above standards or these specifications.

### **4. MATERIAL**

#### **4.1 Fluorescent Light Fixtures**

The fluorescent light fixtures shall have lamps and ballast of proper rating as shown on the drawings. Each lamp shall be provided with independent ballast.

The fluorescent lamps shall be tubular, 1224 / 610 mm long, for 40 / 20 watts respectively as specified. The fluorescent colour shall be warm white characteristics with an average output of 3350 lumens (+5%) for 36 watts and 1350 lumens (+5%) for 18 watts after 1 00 burning hours. The ballast shall be polyester filled type, totally enclosed and suitable to operate up to 250 VAC. The power loss shall not be more than 9 / 6 watts for 40 / 36 watts ballast. A wiring, diagram, wattage, voltage and current figures shall be printed on the body of the ballast.

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. All light fixtures shall be provided with power factor improvement capacitor to give a minimum power factor of 0.90.

The body of the fluorescent light fixtures shall be minimum 22 SWG sheet steel, derusted, degreased, finished in heat resistant paint, stove enameled. Appropriate size bushed wire entry holes, fixing holes and earth terminals shall be provided. Connectors suitable for connecting 2.5 sq. mm cable connectors shall be provided for supply connections. An earth terminal for connection to 14 SWG copper conductor shall be provided.

The light fixtures shall be furnished with perspex diffusing panels " 040 opal acrylic (minimum sheet thickness 3 mm), 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 polystyrene louvers shall be white Egg Crate or as approved. 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.

#### **4.2 Incandescent Light Fixtures**

The incandescent light fixture shall be as stated on drawings and bill of quantities. The light fixture shall be finished in standard colors unless otherwise stated on drawings or directed by Engineer. All incandescent light fixtures shall be of international standard and quality. The type of fixtures with manufacturer catalog 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 photo-metric curves to show that the fixture proposed are of the same type, construction and quality.

The lamps for incandescent light fixtures shall be GLS lamps and shall be supplied and installed according to the wattage as indicated on drawings.

Weather proof bulk head incandescent light fixture shall comprise of cast aluminum body and gasketed clear glass cover secured to the body by means of galvanized nuts / screws to give a weather proof and water tight fit. A wire guard shall be provided for protection of front glass against mechanical injury. The gasket shall be weather resistance type. A G.I. wire guard shall be provided on the glass cover. The lamp holder shall be of bi-pin brass having porcelain outer ring.

The glass shade of light fixtures shall be opal white or clear 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. The glass shall be opal white or clear as furnished by the manufacturer with the light fixture unless specified.

### **5. INSTALLATION**

#### **5.1 General**

The mounting heights of light fixtures are indicated on the drawings, and position of fixtures according to the mentioned scale.

The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position. All fixing accessories such as ceiling rose, flexible cord, lamp holder, suspension rod; pipe or chain with suitable canopy, etc., shall be provided and installed.

The wiring between ceiling rose or terminal box and the fixture shall be carried out with 3 core 0.75 sq. mm and 1 sq. mm copper conductor, PVC / PVC cable respectively for circuits protected by 10 amps. and 15 / 20 amps. MCBs. The wiring inside light fixture body shall be done with heat resistant cables or PVC insulated cable in heat resistant sleeves as approved by the Engineer.

Glasses, shades, reflectors, diffuses, etc., must be in a clear condition after installation.

All light fixtures shall be earthed by an earth wire connected to the earth terminal in the fitting.

### **5.2 Fluorescent Light Fixtures**

The fluorescent light fixtures on the surface of ceiling shall be installed with the back of the body flush with the ceiling surface, and in a manner so as to facilitate wiring. Nylon plugs and galvanized steel bolts or screws shall be used for fixing the light fixture to the ceiling. For light fixtures on installation on false ceiling, the installation method detail shall be coordinated with ceiling design and submitted for approval of Engineer. Care shall be taken to prevent the weight of the fixture from being transferred to the false ceiling.

Pendent light fixtures shall have two holes in the top of each casing by a 1/4" diameter galvanized pipe or any other standard method as approved by the Engineer. Wiring from ceiling rose to the fixture shall be installed through the pipe. Proper arrangements such as long threads with check nuts, etc. for minor adjustment in the mounting heights of the fixtures shall also be provided.

### **5.3 Incandescent Light Fixtures**

The incandescent light fixture shall be installed on the surface of ceiling or wall by means of nylon plugs and galvanized steel screws, such that their back finish flush with the surface for exposed conduits and flush with outlet box for concealed conduit system. Wherever convenient, screws for fixing light fixtures shall be screwed into the holes of the outlet box. The light on false ceiling shall be installed in a manner as described for fluorescent light fixture.

### **5.4 Outdoor Lighting**

For illumination around buildings during dark hours, light fittings in various arrangements shall be provided in accordance with these specifications. The items not shown on drawings or called for, but which are necessary for a complete working system as required, these shall also be provided and deemed to have been considered as such.

In case, the specified materials and equipment are not used, the Contractor shall then essentially use the standard products of a manufacturer, regularly engaged in the manufacturer of the product and shall meet the requirement of the specifications.

**\*\* END OF SECTION\*\***

## **EXTERIOR LIGHTING FIXTURES**

### **1. SCOPE OF WORK**

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete light fixtures as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and positions of light fixtures.

The light fixtures with accessories shall also comply with the General Specifications for Electrical Works, Section 1 and with other relevant provisions of the Tender document.

### **2. GENERAL**

The description of light fixtures in given Bill of Quantities, and stated on the drawings, and relevant material are 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 two samples of each and every light fixture specified and obtain approval of the Owner before purchasing. The quality and finishes of 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.

All fixtures shall be finished in standard color 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.

### **3. STANDARDS**

Lighting fixtures shall comply with Section 1 Clause 3

Particular reference shall be made to:

- IEC 566                                      Capacitors for use in TL, HP Mercury and LP sodium vapor.
- IEC 598                                      Luminaires.
- BS 3677                                      Discharge lamp circuits.

Any other standard referred to in above standards or these specifications.

### **4. MATERIAL**

#### **4.1 Street Light Fixtures**

The street light fixtures shall be according to the BOQ. The fixture shall consist of weather proof, IP- 66 rated light weight pressure die-cast aluminum housing, grey stove enameled outside and colored by a molded acrylic cover.

The fitting shall contain a tray carrying all electrical gear. This tray is made of white stove enameled aluminum sheet. The fixture shall have porcelain lamp holder and capacitor.

The ballast shall be polyester resin filled, totally enclosed and shall have leak proof body. The voltage of the lamp and ballast, and a wiring diagram and other relevant data shall be printed on the body of ballast.

The ballast shall be provided with insulated wires. The voltage of the lamp and type of fixture shall be as specified in Bill of Quantities. Light pole of required sizes as mentioned in the BOQ shall be in and out galvanized with all accessories like base plate, nut, anchor bolts, washer (all accessories shall be galvanized) with grey paint over two coats shall be installed as per BOQ.

The Luminaries shall be dust and jet proof, corrosion resistant and resistant to exhaust gases and cleaning detergents.

The single lamp Luminaries shall be designed to house high-pressure sodium lamps. The complete assembly shall provide the required light distribution pattern.

The Luminaries shall be made of pressure aluminum and silicon alloy. The exterior shall be totally smooth. The copper content shall be less 0.05% to prevent inter-crystalline corrosion.

The mirror reflects shall be of either the high-grade anodized aluminum (99.9%) type, or a white lacquered reflector type, rigidly fixed to the body and easily replaceable.

The control gear shall be within the fixture. The lamp and control gear shall be mounted in two different and isolated compartments.

Each luminaries optical compartment or unit shall be protected by a high impact resistant clear glass protector and shall be dust-and watertight to the recommendation of IEC publication No. 144 or approved equal. The protector shall be smooth to reduce to a minimum dirt accumulation and have and maintain a coefficient of transmission of the order of 88% or better.

The front glass shall be provided with corrosion resistant hinges and quick closing devices for easy access for lamp replacement.

The lamp socket shall be made of high-grade porcelain and be provided with a locking system to prevent loosening of the lamp.

The Luminaries shall also be suitable for ceiling mounting under the bridge by means of suitable brackets and clamps.

The materials chosen shall be able to withstand without damage or ageing alteration in their structural or physical properties the server local environmental conditions in addition to the heat emitted by the lamp.

A suitable terminal block shall be provided to allow connection of the internal wiring and supply cables. Provision shall be made to facilitate maintenance, and easy disconnection and quick replacement of individual components.

The exposed metallic parts of the luminaries shall be factory finished, store enameled with a suitable corrosion resistant paint capable of resisting the heat emitted by the lamp during continuous operation.

The high pressures sodium lamp shall be designed to achieve a long life. The lamps shall have a clear finish and shall have a bayonet-mounting base.

A complement of new lamps of the correct wattage, shapes and rating shall be provided with the luminaries.

## **5. MEASUREMENT AND PAYMENT**

### **5.1 Measurement**

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

## **5.2 Payment**

The quantities measured as provided above shall be paid for at the unit prices bid for the several pay items appearing in the Bill of Quantities which payment and prices shall be full compensation for furnishing, preparing, fabricating, transporting, placing and erecting all material for the complete structure; for all labor, equipment, tool and all other items necessary for the completion of work. Such payment shall constitute full payment for completed structure and no allowance will be made for false work and other incidental expenses. No separate payment shall be made for work involved within the scope of this section unless specifically stated in the Bill of Quantities or herein.

**\*\* END OF SECTION\*\***

## LIGHTING POLES & ACCESSORIES

### 1. GENERAL

This section together with its appending document covers the minimum requirement for the design, construction and performance of factory built assemblies of lighting pole.

### 2. SCOPE OF WORK

The work under this scope consists of manufacturing / supplying, installation, testing of all material and services of the complete lighting pole as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The lighting pole with accessories shall also comply with the General Specifications for Electrical Works, Section 1 and with other relevant provisions of the Tender document.

### 3. CONSTRUCTION REQUIREMENT

Lighting poles sizes and dimensions shall be as mentioned in the BOQ and as per the drawing. The poles shall be round conical in shape cross section continuously tapered and longitudinally welded. The welding shall be complying with BS 5135; no circumferential weld shall be accepted. The pole shaft shall be fabricated from high strength structural steel, hot dipped galvanized as per BS 729 / ISO 1416 / 91121. The steel used for fabrication shall be minimum yield strength of 3600 kg per sq cm.

Epoxy paint ultra built liner should be applying over the proper galvanizing for extra protection.

The manufacturer shall provide written guarantee that the galvanizing treatment shall be adequate for 15 years of service.

Scratches, marks, dents or other damages to poles and fittings will be the cause of rejection. Any marks or stains resulting from wrapping materials shall be removed.

### 4. IDENTIFICATION OF POLE

For each piece of pole, identification label shall be fitted in front side. The label should mention the height of pole, year of manufacturing and company name. The label shall have block letter 7mm high, black on white background of trifoliolate and fixed with screws.

### 5. CABLE CONNECTION BOX

- Electrical Class: Class-II
- Protection: IP- 44
- Cable connection box with 4 Amps fuse for controlling of lighting fixtures.
- Fitted with line-neutral circuit including 4 Amp 10x38 Gg curve fuse.
- The box shall be suitable up to 4 core 35 sq mm cable.

### 6. MEASUREMENT AND PAYMENT

#### 6.1 Measurement

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

## **6.2 Payment**

The quantities measured as provided above shall be paid for at the unit prices bid for the several pay items appearing in the Bill of Quantities which payment and prices shall be full compensation for furnishing, preparing, fabricating, transporting, placing and erecting all material for the complete structure; for all labor, equipment, tool and all other items necessary for the completion of work. Such payment shall constitute full payment for completed structure and no allowance will be made for false work and other incidental expenses. No separate payment shall be made for work involved within the scope of this section unless specifically stated in the Bill of Quantities or herein.

**\*\* END OF SECTION\*\***

## **EARTHING SYSTEM**

### **PART 1 – GENERAL**

#### **1.01 WORK DESCRIPTION**

- A. This section specifies the engineering, supply, installation, testing, commissioning and setting to work of the complete earthing network for individual earthing systems, circuit protective conductors and bonding conductors. A complete earthing network comprising cables, copper tapes, electrodes and earth bondings of all relevant necessary non-current carrying metal shall be supplied, erected and connected as required.
- B. The system shall be a common earthing system as described in the Specification and as shown on the Drawings. Individual earthing systems shall be provided as follows prior to any according to drawing. Earth main MV/LV/Generator Electrical Earthing shall have 2 connection to the earthing system:
  - 1. MV Electrical Earthing
  - 2. LV Electrical Earthing;
  - 3. Generator Earthing;
  - 4. ELV Earthing;
  - 5. Data Earthing;
  - 6. Local Authority's Earthing;
- C. Sufficient numbers of electrodes interconnect by stainless tape to form earthing mat so that the overall earth resistance shall be less than 1 ohm for each individual earthing mat.
- D. The number of earth electrodes of the earthing mat is indicated on the drawings as minimum. The Contractor shall test the resistivity of soil at site. Exact number of earth electrodes shall be determined by the Contractor to achieve the earth resistance value subject to Engineer approval. The complete earthing installation include earthplate, earth mat detail to achieve the earth resistance value shall be included in the Contract.
- E. The Contractor shall inform the Engineer or his representative before driving stainless steel earthing rods into the ground so that he may supervise the operation. Driving shall be carried out only in the presence of the Engineer or the representative and all rods shall be submitted for the examination before use.

#### **1.02 STANDARDS**

- A. Complete earthing system shall be engineering and constructed in accordance with the latest revision of the following standards and the appropriate BS/IEC:
  - 1. BS7671 : Electrical Installation
  - 2. BS7430 : Earthing
  - 3. BS6651 : Lightning Protection System
  - 4. BS 7430 : Earthing.
  - 5. IEC 61024-1-2 : Lightning Protection System
- B. The detail of the Earthing System shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this Specification and Drawings, whichever is the more stringent and acceptable to the Engineer.

- C. In the adoption of standards and requirements, the Contractor shall take the following precedence:
  1. Engineer's decision;
  2. Local codes of practice;
  3. Drawings;
  4. Specification
  5. International standards and requirements.

### **1.03 SUBMISSION**

- A. All technical submissions shall be approved by the Engineer prior to the respective stages of construction.
- B. As minimum requirement, the submission shall include the following:
  1. Equipment Schedule, including all manufacturer's data;
  2. Shop Drawings and Sample Submission;
  3. Builder's work requirements;
  4. Testing procedures and report format for testing of the earth electrodes and/or earth strips;
  5. Soil resisting test report with calculation report for the details of the earthing system detail including quantity and layout of earth electrodes and/or earth strips to achieve the required earth resistance. The report shall be endorsed by the Contractor's Installation Engineer who supervise and endorse the installation upon completion;
  6. Proposed details of earthing system including quantity and layout of the earth electrodes and/or earth strips according to the calculation result.

### **2.01 General**

- A. Common earth mats of resistivity of less than one (1) ohm shall be constructed below the lowest floor structure prior to any ground work construction. The stainless steel earth mats shall comprise the complete earth electrodes, earth strips/grids, earth inspection chambers, earth leads, main earth terminals, earth test link boxes at ground level, etc. Under these circumstances, each individual earthing system shall have earth leads connecting its main earth terminal directly to an earth electrode underground as specified.
- B. In the case where drilling is required to take the earth rods or stainless steel tapes below ground level, a specified earth resistance enhancement compound shall be added into the bored holes and a mixture at 60% bentonite and 40% of gypsum to 125% of water mixed to give a thick slurry. It shall be grouted into the holes prior to inserting of rods or tapes, and be allowed to solidify. The hiring of machine drilling equipment and the grouting as described above shall be provided by the Contractor.
- C. The earthing system shall be formed as shown on relevant drawings.
- D. All stainless copper tape clips, holdfasts, clamps, earth rod clamps, etc. shall be supplied by the same manufacturer of the stainless steel tapes and rods.
- E. All earthing products/accessories shall be of Local Authority's approved type.
- F. The mating surface of all tapes at joints etc shall be cleaned before clamping and all joints shall be rivetted, joint with proper connector or exothermic welded. All connectors to electrical apparatus shall be made by a bolted connection in a visible and accessible position
- G. Copper tapes shall be secured with appropriate size stainless saddles at intervals not exceeding 600 mm and the tapes shall be supplied in long unbroken lengths to avoid unnecessary jointing.

### **2.02 EARTH ELECTRODE**

Various types of earth electrodes shall be utilized as specified:

- a) 3m length 19-29 mm dia copper rod 99% purity.
- b) Tinned copper plate, 600mm×600mm×3.2mm, 99% purity buried at least 300mm below permanent water level at 8.0mm below ground level, whichever is less. A mixture of charcoal and salt (3:1) shall be used as packing 300mm around the earth plate.
- c) Chemically activated grounding electrodes, commercially known as CEE (Chemically Enhanced Earthing).

#### 1). Earth Electrode Rods

- A. Earth electrode rods shall be 19-20 mm diameter extensible copper clad stainless steel type with internal screw and socket joints, driving head and connection clamp.
- B. Stainless steel rods shall have tensile strength of approximately 600 N/m<sup>2</sup>.
- C. Couplings for each section of the rod shall be of same material of the rod, threaded to fit the rod sections. Driving studs shall be used when driving the electrode into the ground. Earth values shall be measured and recorded before coupling and driving in the next section. Additional earth rods shall be driven in if necessary to attain the required effective earth values.
- D. Clamping of the earth leads to the earth rod shall be made by earth clamp. The clamps shall be capable of providing a high pressure contact between the earth rod and the earth leads to achieve a low contact resistance.
- E. When two or more electrodes are driven to form a group, the heads of the electrodes in the group shall be bonded to each other by means of a 25 mm x 3mm stainless steel tape, laid at a depth of at least 600 mm in soil.

#### 2). Earth Electrode Tinned copper plate

- A. Tinned copper plate, 600mmx600mmx3.2mm, 99% purity buried at least 300mm below permanent water level at 8.0mm below ground level, whichever is less. A mixture of charcoal and salt (3:1) shall be used as packing 300mm around the earth plate.

#### 3). Chemically Enhanced Earthing

- A. Chemically Enhanced Earth 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.
- B. To install the CEE, 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.
- C. Remove all of the tapes covering the absorption and electrolyte holes.
- D. 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.
- E. Tamp the earth in place, leaving space to reach the connections and to install the well access assembly.

- F. Make the connection to the ECC copper electrode.
- G. 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 is 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.

All earth electrode penetrations through basement water proofing membranes shall be provided with manufacturer's recommended water seal insert sleeve approved by Engineer. The installation of the water seal insert sleeve shall be under the supervision and endorsed by the manufacturer's representative to ensure the installation comply with the manufacturer installation detail.

### **2.03 EARTH INSPECTION CHAMBER**

- A. Earth electrode shall be fitted with a heavy-duty precast concrete inspection chamber/pit complete with heavy-duty cover as specified on drawings.
- B. For earth electrodes located outside or on the apron of the building, earth inspection chambers shall extend to a depth of not less than 300 mm below finished ground level and kept free of soil. For earth electrodes located inside building, earth electrodes shall be buried not less than 100 mm below the floor slab structure. Each earth electrode shall be clearly marked. SAFETY ELECTRICAL EARTH CONNECTION – DO NOT REMOVE.
- C. The chamber and cover shall be heavy duty detail to consider the traffic load at the location of installation. The cover shall be recessed cover to receive the Architectural floor finish at the location of installation.

### **2.04 EARTH LEAD**

- A. Earth leads, also commonly known as earth conductors, shall be used for the final connection between the earth electrodes and the main earth terminals.

### **2.05 EARTH STRIP**

- A. Earth strips/grids shall be of bare Copper tapes of 25 mm x 3 mm as specified.
- B. Earth strips shall be rivetted or joint with proper connector to earth electrodes underground below the floor slab structure, and shall be buried not less than 300 mm below the floor slab structure.
- C. In order to minimise the mutual inductance between strips, earth strips shall be positioned at a distance not less than 6m apart unless otherwise specified or as as necessitated by site restrictions.

### **2.06 MAIN EARTH TERMINAL**

- A. Main earth terminals shall be provided for the termination of each earthing system. 50mm x 6 mm tinned HDHC copper earth bars of not less than 1000 mm / as indicated on drawing / BoQ (larger size shall prevail) length shall be installed in the respective plant rooms / switch rooms at a height of 300 mm above finished floor level. The insulators shall be the approved type. Interconnection between plant rooms / switch rooms and connection to earth electrodes shall be minimum 2 direct connection and as per the Drawings and/or as required to complete the installation.

- B. Suitable earthing terminals shall be provided in all the equipment housings, switchgear enclosures, relayed and instrument casings and all other electrical metalwork for bonding to earth.

The earth connections for all sections of the installation shall be electrically continuous throughout back to the corresponding main earth terminals.

## **2.07 CONNECTIONS**

- A. Joints in the earth bars, copper tapes and earth mats shall be exothermatically or butt weld or brazed such that the resistance of the section containing the joint shall not exceed that of an equivalent length at unjointed conductor. Any joint so made may be required to be tested to prove compliance with the requirement.
- B. The contact faces of all protect conductors shall be cleaned and tinned before connections are made.
- C. No drilling of the earth bar shall be permitted except in terminations.

## **PART 3 – EARTH BONDING**

### **3.01 CIRCUIT PROTECTIVE CONDUCTOR**

- A. Circuit protective conductor (cpc) is a system of conductors joining together all exposed conductive parts and connecting them to the main earth terminal.
- B. The purpose of circuit protective conductor is to provide a path for earth fault circuit so that the protective device will operate to remove dangerous potential differences during a fault condition.
- C. The circuit protective conductors shall take the form of separate cable with a sheath in green/yellow colour or copper tape of minimum size 25mm x 3mm.
- D. All exposed non-current carrying metal parts of light fittings, switchgears, motors, enclosures, etc. shall be effectively earthed by circuit protective conductors for earth continuity protection.
- E. For equipment where an earth terminal is provided, the earth continuity wire shall be firmly clamped. Where no earth terminal is provided, the exposed metal part shall be cleaned of paint and surface rust before welding the earth continuity lead.
- F. The sizing of principal protective conductors shall be in accordance with to the current edition of BS 7671 and BS 7430.
- G. The external earth terminal on the outside of the end panel of any switchboard shall be connected to the main earth bar provided in two independent points.
- H. Circuit protective conductors shall be provided in electrical and mechanical rooms and along the routes for the bonding of all exposed conductive parts and extraneous conductive parts. A suitably sized earth terminal shall be provided at each zone of the building for this purpose.
- I. All exposed conductive parts shall be effectively connected in an approved manner to the principal protective conductors. The circuit protective conductors shall be single core copper cables or high conductivity annealed copper tapes specified. Unless otherwise specified, the minimum cross-sectional area of the circuit protective conductors shall be selected in accordance with BS 7671.
- J. Neutral earthing (N.E) shall be done with PVC insulated cables connecting the

neutral bar of the LT panel to the substation earth bar.

### **3.02 MAIN EQUIPOTENTIAL BONDING CONDUCTOR**

- A. This is referred to the conductor for the equipotential earth bondings of the metalwork of other services such as gas and water to the earthing system. This bonding of service pipes shall be made as close as possible to their point of entry to a building.
- B. All extraneous conductive parts of the following services shall be connected to the main earth terminal by means of main equipotential bonding conductors:
  - 1. Main water pipes;
  - 2. Main gas pipes;
  - 3. Other service pipes and ducting;
  - 4. Risers of central heating and air conditioning system;
  - 5. Exposed metallic parts of the building structure and as required by the Engineer;
  - 6. Breeching inlets;
  - 7. Fuel inlets.
- C. The earthing system shall be bonded to the rebars of the building foundation and UG water tank, with approved rebar clamps/welding of already laid steel reinforcement bars within the structural concrete around the entire periphery of the basement retaining wall to form a continuous loop with clamps to vertical rebar at column positions.
- D. The metalwork of public gas and water service shall not be used as a sole protective earth electrode.
- E. Main equipotential bonding conductors shall have cross-sectional areas not less than half of the cross sectional area of the earth conductor of the installation, subject to a minimum of 6 mm<sup>2</sup> for copper cables. A conductor size beyond 25mm<sup>2</sup> for copper cables, theoretically, is considered not necessary.
- F. Location of all incoming pipes and ductings shown on the Drawings are indicative only and are to be coordinated on site.

### **3.03 SUPPLEMENTARY EQUIPOTENTIAL BONDING CONDUCTOR**

- A. This is referred to the conductor for the equipotential earth bonding of the metalwork which is not associated with the electrical installation but which may provide a conducting path giving rise to shock.
- B. All extraneous conductive parts of the following shall be connected to the earthing system by means of supplementary equipotential bonding conductors:
  - 1. Metal tanks;
  - 2. All metallic cat-walks, platforms, handrails, staircases, ladders within 2m reach of pipes, tanks, cable trays cable ladders, trunking etc which have equipotential bonding.
  - 3. Any metallic cat-walks, platforms, handrails, staircases, ladders etc with attached electrical cabling or fittings;
  - 4. Metallic door frames/doors controlled by electromechanical locking mechanism with an operating voltage or supply voltage exceeding 50V.
  - 5. Metallic support to electrically operated equipment without direct electrical contact with the equipment;
  - 6. Electrically operated roller shutters;
  - 7. Metallic wall cladding containing, or immediately adjacent to, electrical socket outlet or other sources of electricity;
  - 8. Cable ladder, tray and trunking
  - 9. Raised floor system;
  - 10. Electrical facilities in toilets and shower rooms;

11. Exposed metallic parts of building structure, including roof trusses. (If roof trusses connect to lightning conductor earth, no further equipotential bonding is required).

C. The requirement does not apply in the following instances:

Steel reinforced concrete poles in which the steel reinforcement is not accessible;

Exposed conductor parts which owing to their reduced dimensions or their disposition cannot be gripped or cannot be contacted by a major surface of the human body, provided that connection of these parts to the protective conductor cannot readily be made or cannot be reliably maintained. This item applies to small isolated metal parts such as bolts, rivets, nameplates and cable clips. A major surface of the human body is considered to be 50mm x 50mm.

Fixing screws for non-metallic accessories provided that there is no appreciable risk of the screws coming into contact with live parts.

Short lengths of metal conduit for mechanical protection of cables having a non-metallic sheath.

D. Local supplementary bonding conductors shall be provided between simultaneously accessible (i.e. within 2m) exposed conductive parts of equipment, between exposed conductive parts and simultaneously accessible extraneous conductive parts, and between simultaneously accessible extraneous conductive parts. The bonding conductors shall be single core copper cables with oversheath in green/yellow colour.

E. Supplementary bonding, conductors shall be sized in accordance with BS7671 which can be summarized as follows:

1. For conductors connecting two exposed conductive parts, the conductor sizes shall not be less than the smaller protective conductor connected to the exposed conductive parts, subject to a minimum of 4 mm<sup>2</sup> if the cables are not mechanically protected;
2. For conductors connecting exposed conductive parts to extraneous conductive parts, the conductor sizes shall not be less than half that of the protective conductor connected to the exposed conductor parts, subject to a minimum of 4 mm<sup>2</sup> if the cables are not mechanically protected;
3. For conductors connecting two extraneous conductive parts, the conductor sizes shall not be less than 4 mm<sup>2</sup>, or even 2.5 mm<sup>2</sup> if mechanically protected, for copper conductors.

F. All equipment equipotential bondings in area other than plant rooms and within false ceiling shall be concealed. Any remedial work required due to bad connection, open circuit, etc. shall be borne by the Contractor;

G. All earth conductors and earth terminals shall be manufactured to carry the maximum short circuit current at the point of the installation.

### **3.04 CLEAN EARTHING SYSTEM**

Clean earthing system must be provided for Telecommunication System, Data Communication etc. as per system's requirements and connected to a separate earth pit. The low current panels shall be connected to separate dedicated clean earthing system.

## **PART 4 – EXECUTION**

### **4.01 INSTALLATION**

- i) The whole of the earthing and bonding shall be installed and tested in accordance with the requirements of the IEE Wiring Regulations, LESCO'S requirement and this specification.

- ii) Attention is drawn to the use of circuit protective conductors in addition to metallic conduit/trunking.
- iii) All enclosures, equipment, exposed conductive parts, extraneous conductive parts, and metallic trunking, metallic conduits, metallic cable trays and other metalwork other than any live part, forming protection to or part of the electrical installation, including apparatus and appliances, shall be effectively bonded to earth.
- iv) Protective conductors shall be provided in the form of copper tape to all vertical electrical rising bus bars. The size of this tape shall be in accordance with the IEE Wiring Regulations.
- v) All bonding and protective conductors, where fixed to bolted connections, shall be terminated on compression type lugs made with an automatic purpose-made machine.
- vi) Provide an earth bar 450mm long on 10mm spacers on the wall of each electrical room, and connect to the enclosure and ground buses of all equipment in the room.
- vii) Run a No. 120mm<sup>2</sup> sheathed copper cables from the main 600V switchboard ground bus to the main water pipe and connect to the upstream side of the water meter.
- viii) Bond water main with proprietary purpose made bonding clamps. Scrape and sand the water main to remove all rust, paint or scale at the location where the connection is to be made.
- ix) Remove non-conductive coatings from threads or other contact surfaces to ensure good electrical continuity.
- x) Provide a separate insulated ground conductor in every conduit, in every system, to all devices and fixtures.
- xi) Protect all exposed earthing conductors from mechanical damage.

Soldered joints are not permitted.

#### **4.02 TESTING AND COMMISSIONING**

##### **4.02.01 GENERAL**

- i) The complete installation shall be tested and inspected to ensure that it complies with the requirements of this Specification, the IEE Wiring Regulations, and British Standards. The tests shall be carried out in accordance with the IEE Wiring Regulations.
- ii) The inspection and tests shall be carried out in the same sequence as set out in the IEE Wiring Regulations and in such time as to allow any remedial work to be completed prior to Practical Completion. Tests shall also include any part of the existing installation related to the new work.
- iii) Tests shall be carried out strictly in accordance with a programme to be agreed prior to
- iv) All instruments necessary for inspection and testing shall be supplied and shall be properly calibrated and operated by personnel skilled in their use.
- v) Allowance shall be made for disconnection or similar operations to satisfy the requirements for testing, etc., and the reinstatement of the installation.

**4.02.02 CERTIFICATES AND SCHEDULES**

- i) All values called for under the IEE Wiring Regulations shall be recorded and three copies of the Inspection Certificate described in the IEE Wiring Regulations shall be submitted. The installation shall not be considered as completed unless inspection Certificates have been submitted.

**\*\* END OF SECTION\*\***

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F  
CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH  
MAZAR KEAMARI KARACHI**

**SUMMARY OF COST**

**BLOCK E AND F**

<b>S.No</b>	<b>Description</b>	<b>Amount</b>
1	Civil Works	
2	Plumbing Works	
3	Electrical Works	
	<b>Total Amount</b>	

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY SHAREEF COMPLEX BEHIND PIR  
GAYEB SHAH MAZAR KEAMARI KARACHI**

**SUMMARY OF COST**

**BLOCK E**

<b>S.No</b>	<b>Description</b>	<b>Schedule Items</b>	<b>Premium on Schedule Items</b>	<b>Amount of Premium</b>	<b>Non-Schedule Items</b>	<b>Total</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7=3+5+6</b>
1	Civil Works	25,578,970	____%			
2	Plumbing Works	2,350,692	____%			
3	Electrical Works	5,204,201	____%			
	<b>Total Amount</b>					

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY SHAREEF COMPLEX  
BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI**

**BILL OF QUANTITIES BLOCK E**

**PAK PWD SCHEDULE 2022**

S.No	Reference	Description	Unit	Quantity	Rate	Amount
1	3/102	Felling trees of any height, girth exceeding 6 inches to one foot (152 mm to 305 mm), cutting into portable pieces, taking out their entire roots and filling hollows with earth complete with dressing, consolidating and watering the filling including stacking the serviceable materials and disposal of useless materials as directed, lead upto 10 chains (305 Rm), cost of earth included.	Each	4.00	623.75	2,495
		<b>DISMANTLING WORKS</b>				
2	3/123	Dismantling stone masonry in lime or cement mortar in foundation, plinth and ground floor including stacking salvaged material (serviceable) and disposing surplus stuff as directed within three chains (91.5 m)	100 Cft	1645.46	4787.50	78,777
2a	17/123	Extra for 1st floor	100 Cft	237.60	755.00	1,794
2b	18/123	Extra for every additional floor above 1st floor	100 Cft	1223.06	681.25	8,332
3	11/123	Dismantling cement concrete block masonry work in lime or cement mortar in foundation, basement, plinth and ground floor including stacking salvaged material (serviceable) and disposing of surplus material as directed with in three chains (91.5 m).	100 Cft	776.60	3006.25	23,347
4	15/123	Dismantling R.C.C. including separating reinforcement from concrete in foundation, basement, plinth and ground floor including stacking at site and disposing of unserviceable material within three chains (91.5 m)	100 Cft	2878.79	8456.25	243,438
4a	19/123	Extra for first Floor	101 Cft	105.25	968.28	1,019
4b	20/123	Extra for every additional floor above first floor on item No. 15.	100 Cft	2719.54	838.44	22,802
5	45/123	Taking out door and window frames with or without hold fasts in ground floor including cutting walls, stacking salvaged material (serviceable) and disposing of unservice-able material as directed within three chains (91.5 m).	Each	229.00	584.38	133,823
5a	53/123	Extra for first floor above ground floor on item Nos. 45 and 46.	Each	77.00	40.63	3,129
5b	2x53/123	Extra for second floor above ground floor on item Nos. 45 and 46.	Each	79.00	81.26	6,420
6	47/123	Taking out carefully shutters of doors and windows in ground floor and stacking as directed within three chains (91.5 m).	Each	229.00	346.88	79,436
6a	54/123	Extra for first floor above ground floor on item Nos. 47 and 48.	Each	77.00	28.75	2,214
6b	2x54/123	Extra for second floor above ground floor on item Nos. 47 and 48.	Each	79.00	57.50	4,543

7	40/123	Dismantling cement tiled floor, dado or skirting in basement, plinth and ground floor including base mortar and stacking salvaged material (serviceable) and disposing of surplus stuff as directed within three chains (91.5 m)....	100 Sft	12446.37	2605.63	324,306
7a	44/123	Extra for first floor above ground floor on item Nos. 39 to 40.	100 Sft	4100.11	292.50	11,993
7b	2x44/123	Extra for second floor above ground floor on item Nos. 39 to 40.	100 Sft	4100.11	585.00	23,986
8	64/123	Dismantling rain water pipe including clamps and specials and stacking serviceable material, disposal of unserviceable material as directed within three chains (91.5 m).	100 Rft	160.00	1459.38	2,335
<b>MASONARY WORKS</b>						
9	18/113	Providing and laying coursed rubble masonry first sort in cement mortar 1 :6 in superstructure including scaffolding, curing etc. complete in ground floor.	100 Cft	1645.46	42977.55	707,179
9a	30/113	Extra for 1st floor	100 Cft	237.60	4221.94	10,031
9b	31/113	Extra for every additional floor above 1st floor	100 Cft	1223.06	3020.19	36,939
10	34/100	Providing and laying 1:3:6 cement concrete solid block masonry more than 6 inches (152 mm) thick using graded screened bajri 3/4 inch (19 mm) and down gauge set in lime cement mortar 1:1:6 including scaffolding, raking out joints and curing etc. complete in ground floor superstructure.	100 Cft	223.85	30086.14	67,348
10a	70/110	Extra for work other than in arches in first floor over item Nos. 33 to 65 and 67 to 69	100 Cft	94.05	1857.18	1,747
10b	71/110	Extra for work other than in arches in every additional floor above first floor over item Nos. 33 to 65 and 67 to 69 ...	100 Cft	94.05	1853.50	1,743
<b>FLOORING</b>						
11	181/117	Providing and laying light colour, glazed/non skid vitrified porcelean tiles (Polished) exceeding 3600 Sqcm each, (Pak made) on walls and floors, in any floor, laid with dry bond (stile bond) over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per direction of the Engineer incharge.	100 Sft	10385.42	49798.24	5,171,758
12	40/118	Providing and fixing 1/4 inches or 6.4 mm (approx.) thick approved Pakistani make white glazed tiles upto 1.50sq feet size in dado and skirting in ground floor, over 1/2 inch (13 mm) thick base of cement mortar 1:3 setting of tiles in slurry of grey cement over mortar base including filling the joints and washing the tile with white cement slurry curing and cleaning etc. complete .	100 Sft	3704.25	27722.10	1,026,896
12a	49/118	Extra for 1st floor	100 Sft	1234.75	762.50	9,415
12b	50/118	Extra for every additional floor above 1st floor	100 Sft	1234.75	572.50	7,069

13	43/117	Providing and laying floor of 3/4 inches (19 mm) thick Granite stone Pakistani Original more than 36 sq. inches upto 72 Sq. inches (232 Sq.cm. upto 464 sq. cm.) size fine dressed on the surface without winding in ground floor over 1 inch (25 mm) lime mortar 1:2 (one lime, two sand) setting the marble tiles with grey cement slurry including curing rubbing and polishing etc. complete, including the cost of mortar.	100 Sft	30.25	57793.50	17,483
13a	77/117	Extra for stairs/steps (tread, risers and mid stair landings)	100 Sft	30.25	937.50	284
14	33/117	Providing and laying floor of 3/4 inch (19 mm) thick white marble tiles upto 36 Sq. inch (232 sq.cm) size fine dressed on the surface without windings in ground floor and laid over 1 inch (25 mm) thick lime mortar 1:2 (one lime, two sand) setting the tiles with grey cement slurry over lime mortar, jointing & washing the tiles with white cement slurry including curing, rubbing and polishing etc. complete, including the cost of mortar.	100 Sft	866.80	26556.00	230,187
14a	76/117	Extra for laying of any description in cement mortar instead of lime mortar 1:2	100 Sft	866.80	215.50	1,868
14b	79/117	Extra for first floor	100 Sft	2.00	736.25	15
14c	80/117	Extra for additional above first floor (2nd floor)	100 Sft	96.80	593.75	575
		<b>SURFACE RENDERING</b>				
15	28/125	Plastering 1/2" (13 mm) thick in patches in cement and sand mortar 1:4 including curing and scraping old damaged portion in regular shape and removal of rubbish from the site etc. complete as per direction of Engineer-in-Charge in ground floor.	100 Sft	25215.30	5291.84	1,334,353
15a	53/125	Extra for patch plaster and finishing of any description in basement, mezzanine and first floor on item No. 28 to 49.	100 Sft	8405.10	380.00	31,939
15b	54/125	Extra for patch plaster and finishing of any description in every additional floor above first floor on item No. 28 to 49..	100 Sft	8405.10	237.50	19,962
		<b>CARPENTARY AND JOINERY</b>				
16	53/121	Providing and fixing with C.P. brass screws main door handle type yale lock (Italy make) of approved design, cutting wood etc., to required size, with two operating keys, as per direction of the engineer-in-Charge.	Nos	55.00	15899.38	874,466
		<b>PAINTING AND AVRISHING</b>				
17	167/125	Repainting two coats with plastic emulsion paint of (ICI) Dulux make and shade to walls and ceiling including cleaning, and sand papering the surface as directed by the Engineer-in-charge in any floor.	100 Sft	41871.50	2578.13	1,079,502
18	160/125	Distempering three renewal coats with vinyl distemper (Paintex ICI Dulux) of approved make and shade to walls and ceiling etc., including scraping cleaning the old surface in any floor .	100 Sft	11693.14	2681.25	313,522
19	154/122	Painting with wood preservative paint (solignum or equivalent) of any approved proprietary brand two coats complete at any height in any floor .	100 Sft	3956.00	3383.75	133,861

20	158/122	Painting iron work with enamel paint of approved make and shade two coats over and including the cost of one coat of priming complete at any height in any floor.	100 Sft	1489.00	5819.10	86,646
		<b>REINFORCED AND PLAIN CEMENT CONCRETE WORKS</b>				
21	50/114	Providing and laying reinforced cement concrete using screened graded bajri 3/4 inch (19 mm) and down gauge having a minimum works cube crushing strength of 2250 lbs. per sq inch (15.52 N/mm <sup>2</sup> ) at 28 days with a mix not leaner than 1:2:4 in straight stairs and landing of required section including form work and its removal, compacting and curing etc. complete but excluding the cost of reinforcement, in basement plinth and ground floor.	100 Cft	852.13	57317.53	488,421
21a	92/114	Extra for lift for 1st floor	%Cft	323.68	2811.46	9,100
21b	93/114	Extra for lift for 2nd floor	%Cft	184.59	2210.59	4,080
22	56/114	Providing and faying reinforced cement concrete using screened graded bajri 3/4 inch (19 mm) and down gauge having a minimum works cube crushing strength of 2250 lbs. per sq inch (15.52 N/mm <sup>2</sup> ) at 28 days with a mix not leaner than 1:2:4 in ordinary slab 5 inches (127 mm) to 6 inches (152 mm) thick Including form work and its removal compacting and curing etc. complete but excluding the cost of reinforcement, in basement plinth and ground floor	100 Cft	2992.06	45074.27	1,348,651
22a	93/114	Extra for every additional floor above 1st floor	100 Cft	2992.06	2210.59	66,142
		<b>REINFORCEMENT WORKS</b>				
23	166/114	Providing and laying hard grade ribbed deformed (minimum yield point 60,000 psi) reinforcement bars with & including the cost of straightening, cutting, bending, binding, wastage, and such overlaps as are not shown in the drawings, placing in position on cement concrete 1:2:4 precast or m.s. chairs, tying with binding wire, cost of chairs and wires etc. in all kinds of RCC work in foundation, basement, plinth and ground floor of building including septic tanks and under ground tanks and in projections for future extension .	Cwt	411.99	14349.00	5,911,701
23a	174/114	Extra for lift for 1st floor	Cwt	34.69	225.63	7,827
23b	175/114	Extra for lift for 2nd floor	Cwt	340.45	225.63	76,816

<b>IRON WORKS</b>						
24	202/124	providing & fixing 2" dia stainless steel pipe (18 gauge) railing along with 4 Nos 3/4" dia parallel pipe having S/S pipe vertical post 2" dia at 3 ft c/c average spacing and 4" dia vertical post at start turning and end point including cost of labour, welding charges fitting & fixing in marble floor and wall etc complete as per direction of the Engineer Incharge.	Sft	462.00	2234.38	1,032,284
25	139/124	Providing and installing cast iron spiral stair case with central post, hand rail and braces at required intervals etc. complete but excluding the cost of cement work in base and foundation 6 ft. (1.82 m) dia .	P.Kg	3745.82	311.64	1,167,349
26	32/119	Providing and fixing iron grills with required section of flat iron as per approved design including welding all sides of the section at the junction and fixing with sunk iron screws, painting two coats of red oxide paint etc. complete as required in any floor in masonry or concrete.	P.Kg	3028.31	290.89	880,905
<b>MISCELLANEOUS</b>						
27	207/124	Providing & fixing ward robe 24" deep consisting 19 mm thick laminated sheet on bottom, top sides partition shelves & shutters etc and 4 mm thick pressed on back side, 2-1/2" x1-1/4" best quality deodar wood frame and all open edges filled 3/4" molding PVC gola complete i/c the cost of glue iron nails screws, heavy type piano hinges, 1/2" handle, catcher, locks etc, complete as per direction of engineer incharge.	P.Sft	445.50	1289.74	574,579
28	192/124	P/F kitchen cabinet wall mounted of 3/4" thick laminated board with best quality deodar wood frame and beading 1/8" thick hard board backing required section in approved pattern etc. fixed on wall with rawal plugs, screws i/c cost of glue, nuts, piano hinges, handles and painting or polishing etc. as drawing complete all as respect.	P.Sft	653.40	1363.25	890,748
29	204/124	Fabrication and fixing of the Fiber shed consisting of 5-Ply fiber sheet and 2"x2" M.S. Box pipe 16 gauge main frame beams and central bracing 2"x2" at 24" c/c diagonal and 2"x2" support upto 2 feet c/c over 4" dia M.S. pipe 16 gauge 10-14 feet high i/c the cost of excavation, with pcc 1:2:4 and rcc with steel and MS steel plate 1/2" thick in foundation, size 2'x2' cutting fitting, welding painting etc. complete as per direction of engineer incharge.	Sft	720.00	1075.00	774,000
30	65/124	Providing and fixing 4" (100 mm) dia polyvinyl chloride rain water (PVC) down pipe with mild steel clamps, bolts and nuts fixed in cement concrete 1;2:4 etc. complete ...	Rft	160.00	718.67	114,987
31	2/125	Repairs to cracks to reinforced cement concrete work by grouting with cement gun with cement mortar 1:2 including cutting the chase of required size, finishing, curing including removal of rubbish etc. from site complete as directed by the Engineer-in-Charge, in ground floor.	100 Rft	600.00	5695.94	34,176
31a	7/125	Extra in first floor	100 Rft	200.00	380.00	760
31b	8/125	Extra for every additional floor above first floor	100 Rft	200.00	285.00	570

32	18/125	Brushing and cleaning with solution of caustic soda the surface of snow-crete, colour crete, sandtex, stone masonry, brick masonry including removal of rubbish etc. from the site as per direction of the Engineer-in-Charge in all floors .	100 Sft	10357.50	549.38	56,902
			<b>TOTAL SCHEDULE ITEMS</b>			<b>25,578,970</b>
<b>NON SCHEDULE ITEMS</b>						
1	NSI	Providing and laying reinforced cement concrete with aluminum powder at 2% by weight of cement using screened graded bajri 3/4 inch (19 mm) and down gauge having a minimum works cube crushing strength of 2250 lbs. per sq inch (15.52 N/mm <sup>2</sup> ) at 28 days with a mix not leaner than 1:2:4 in column footing of required shape including form work and its removal, compacting and curing etc. complete but excluding the cost of reinforcement, in foundation basement and plinth.	100 Cft	26.40		
2	NSI	Providing and laying Grey stone, on walls, laid with dry bond over a base of 3/4" thick cement mortar (1:2) including jointing to tiles with joint filler of approved quality as per direction of the Engineer incharge.	Sft	1711.68		
3	NSI	Providing and fixing best quality deodar wood in door shutters solid wood 1-3/4" thick and deodar door frames of 7" x 2" complete in all respect as per design and as per instructions of engineer incharge.	sft	1945.00		
4	NSI	Supply and fixing UPVC Flush doors with 60mm wide frame 2-2.5mm wall thickness inclusive of all accessories and galvanized iron support i/c all accessories locks complete in all respect as approval by the Engineer Incharge	Sft	441.00		
5	NSI	Supply and fixing UPVC Flush windows with 60mm wide and 6mm thick glass frame 2-2.5mm wall thickness inclusive of all accessories and galvanized iron support i/c all accessories locks complete in all respect as approval by the Engineer Incharge	Sft	1739.65		
6	NSI	Providing and laying floor of 3/4 inch (19 mm) thick badal marble tiles upto 2' x 2' size fine dressed on the surface without windings on roof laid over 1 inch (25 mm) thick lime mortar 1:2 (one cement, two sand) setting the tiles with grey cement slurry over lime mortar, jointing & washing the tiles with white cement slurry including curing, rubbing and polishing etc. complete, including the cost of mortar.	P.Sft	5018.33		
			<b>TOTAL NON SCHEDULE ITEMS</b>			

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY SHAREEF COMPLEX  
BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI**

**BILL OF QUANTITIES PLUMBING WORKS**

**BLOCK E**

<b>S.No</b>	<b>Description</b>	<b>Qty</b>	<b>Unit</b>	<b>Rate</b>	<b>Amount</b>
1	Providing and fixing Pakistani make best available quality European style white glazed earthenware wash down W.C.Pan complete with and including the cost of a plastic seat (PVC cover and huffers a galls. (13.6 litres) white glazed earthenware low level flushing cistern with siphon fittings, 1-1/2 inches (40mm) dia white porcelain enamelled flush bend, 3/4 inch (20mm) dia, G.I. warning pipe carried outside and bent vertically downwards and making requisite number of holes in walls, plinth and floor for pipe connections and making good in cement concrete 1:2:4.. ITEM NO 6/301	6	Each	13420.00	80,520
2	Providing and fixing best quality squatting type white glazed earthenware W.C Pan, Pakistani (of not less than 18 Inches clear opening as measured between flushing rims) complete with and including the cost of 13.6 litre best quality low level plastic flushing cistern with internal fittings complete, P.V.C. flushing pipe suitable for squatting type with extra bends and length with fittings, 4 inches (100mm) dia white glazed earthenware trap and making requisite number of holes in walls, plinth & floor for pipe connection and making good in cement concrete 1:2:4. ITEM NO 2/301	6	Each	11227.50	67,365
3	Providing and fixing 25 inches x 18 inches (635 mm x 457 mm) lavatory basin with Pedestal in white glazed earthenware (Pakistani) complete with and including the cost of Brass oxidized bolts kit built into wall /2 Inch (15 mm) dia. Chrome plated mixer 1-1/4" Inches (32mm) rubber plug and chrome plated brass chain, 1-1/4 inches (32 mm) dia brass waste of approved pattern, 1-1/4 inches (32 mm) dia. Malleable iron or C.P. brass traps malleable iron or brass unions and making requisite number or holes in walls plinth and floor for pipe connections and making god in cement concrete 1:2:4. item no 8/301+ ITEM NO 10/301	12	Each	12262.50	147,150
4	Extra over item No.8 and 9 for providing single hole chromium plated mixer tap 1/2 inch (15 mm) dia English or approved foreign make).. ITEM NO 14/301	12	Each	1298.55	15,583
5	Providing 1/2 inch (15 mm) dia plastic connection complete with a 1/2 inch (15 mm) dia brass stop cock two brass nuts and lining jointed to plastic pipe. ITEM NO 17/301	12	Each	824.50	9,894
6	Providing and fixing approved quality C.P. brass toilet paper holder. ITEM NO 3/302	12	Each	854.40	10,253
7	Providing and fixing 24 inches x 18 inches (510 mm x 457 mm) looking mirror of Imported glass 5 mm thick fixing with CP clamps and screws ITEM NO 5/302	12	Each	2173.98	26,088
8	Providing and fixing glass shelf 25 inches x 5 inches 8 (610 mm x 127 mm) brackets and guard rail complete. ITEM NO 7/302	12	Each	758.24	9,099
9	Providing and fixing Royal bath room accessories of set of 6 pieces consist of one towel rod with bracket, one tooth brush holder with glass and cover, one double hook one NOTowel ring etc complete of approved quality as per direction of Engineer in-charge. ITEM NO 12 /302	12	Each	10405.25	124,863
10	Providing & fixing chromium plated Muslim bib-cock with out Muslim Shower of approved quality. ITEM NO 13/302	12	Each	3381.75	40,581

<b>SANITARY DRAINAGE</b>					
11	Providing and fixing un platized polyvinyl chloride pipe (P.V.C) "D" class and specials etc. including cutting and fitting complete with and including the cust of cutting trench upto 1-1/2 feet deep refilling, watering, ramming, and disposal of surplus earth within one chain and after cleaning the pipe and cartage within 10 miles (16,09 km.) (working pressure 12 kg/cm <sup>2</sup> ) ITEM NO 21/306				
a	Do. Do. 6 inches (150 mm) diapipe.	400	Rft	716.62	286,648
b	Do Do. 4 inches (100 mm) dia pipe...	300	Rft	600.01	180,003
c	Do Do. 3 inches (80 mm) die pipe..	300	Rft	503.47	151,041
<b>EXTERNAL DRAINAGE</b>					
12	Providing and fixing un platized polyvinyl chloride pipe (P.V.C) "D" class and specials etc. including cutting and fitting complete with and including the cost of cutting trench upto 1-1/2 feet deep refilling, watering, ramming, and disposal of surplus earth within one chain and after cleaning the pipe and cartage within 10 miles (16.09 km.) (working pressure 12 kg/cm <sup>2</sup> ) ITEM NO 21/306				
a	Do. Do. 6 inches (150 mm) diapipe.	400	Rft	716.62	286,648
13	Excavation in all kinds of soil, murum, hard, average or soft including lift up to 5 feet (1.52 m) and lead up to one chain (30.48 m). ITEM NO 5/313.	1200	%Cft	4387.08	52,645
14	Filling and disposal of earth.. ITEM NO 28/313	1278.5	%Cft	1095.00	14,000
15	Making connection with the existing manhole including the cost of cutting holes in walls, making them good in cement concrete 1:2:4 and making the required channel etc., complete.... ITEM NO 13 /316	4	Pair	828.24	3,313
16	Cutting holes in walls 9 incnes and 8 inches (229 mm and 203mm) thick and making them good in cement concrete 1;2;4... ITEM NO 11 /316	30	Each	866.50	25,995
17	Providing & fixing C.I Cover & Frame 18" dia (460 21 mm) weight 1 cwt 3 Qtr (88.90 ) Deduct from rate if other Cover is used. ITEM NO 26/315	2	Each	25630.00	51,260
18	Providing G.I. pipes, specials and clamps etc.,including fixing cutting and fitting complete with and including the cost of breaking through walls and roof, making good etc., painting 2 coats after cleaning the pipe etc.; with white zinc paint with pigment to match the colour of the bulding and testing with water to a pressure head of 200 feet (61 M) and cartages within 10 miles (16.09 km.) (ILLM), 1/2 inch (15mm) dia item no 1/305	0	Rft	202.94	0
b	Do. Do. 1 inch (25 mm) dia..	500	Rft	366.46	183,230
c	Do. Do. 1-1/2inch (40mm) dia..	400	Rft	534.17	213,668
d	Do. Do, 2inch (50 mm) dia..	300	Rft	718.54	215,562
19	Providing and fixing dia ball valve (with PVC Ball) made to B.S.S. 1212. ITEM NO 16/307				
b	Do.Do 1 incn (25 m.m) dia..Do (18/307)	10	Each	703.70	7,037
c	Do. Do. 1-1/2 inches (40 mm) dia Do. (20/307)	10	Each	871.60	8,716
d	Do. Do. 2 inches (50 mm) dia Do. (21/307)	10	Each	1084.10	10,841
<b>PLUMBING WORK (SCHEDULE ITEM)</b>				<b>Rs=</b>	<b>2,350,692</b>

**NON SCHEDULE ITEMS**

S#	Description	Unit	Rate	Amount
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1	Providing and fixing approved quality double bowl stainless steel Kitchen sink size 800x 470 x200mm Pak made (Atlas) or equivalent complete fixed in alcaloid Mercle counter Top fixed over RCC slob 3" thick cost of slab and marble top is not included in this rate including " dia CP sink mixer with three knobs and CP brass chain 1-1/4" CP waste malleable iron or brass unions and making requisite number of holes in walls, plinth and floor for pipe connections and making good in cement concrete 1:2:4	3	Each		
2	Providing and fixing CP double bib cock 1/2" dia. meter 90 degree regular type Master Make or equivalent with crystal plastic knob all complete in approved make with all accessories as per specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12	Each		
3	Providing and fixing CP Brass single bib cock 90 degree reglur type with crystal plastic knob all complete in approved Master make or equivalent with all accessories as per sperified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12	Each		
4	Providing and fixing CP Brass regular T-Stop cock 1/2" dia meter with crystal plastic knob Master Make or equivalent all complete in approved make with all accessories as par specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12	Each		
5	Proving & Fixing Toilet shower with flexible platic pipe and CP thraded nut etc complete Master make or equivalent complete.	12	Each		
6	Providing and fixing CP Brass common single hole mixer with U Type long neck (cold ) Master make or equivalent in crverai niastic knch approved make complete with all accessories as per specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 ( Master or Equivalent)	12	Each		
7	Providing and fixing CP Brass wall sink mixer with U Type long neck (cold & hot) with two knob plastic crystal knob Master make or equivalent crystal plastic knob approved make complete with all accessories as per specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12	Each		
8	Providing & fixing Floor Drain Grating 6"x6"( 150mm x150mm) Stain less Steel heavy Type 10mm thick, Master Make /Super Asia or equivalent complete as per direction.	36	Each		
9	Providing & fixing floor trap Grating 3" dia(75mm) Stain less Steel heavy Type 10mm thick. Master Make /super Asia or equivalent complete as per direction.	15	Each		
10	Providing and fixing UPVC P-Trap confirming to ASTM D-2466 Schedule 40, cost of jointing solvent, cutting and fitting etc. including the cost of 3/8 thier Stall, isab sel grating with 1-1/2" dia hole complete as per specification...				
c	2" Dia	15	Each		
11	Providing and fixing UPVC Floor Vent Cowel for Soil Waste pipe confirming to ASTM D-2466 Schedule 40, cost of jointing solvent, cutting and fitting using PVC Clamp etc and cartage complete.				
a	4" Dia	5	Each		
b	3" Dia	5	Each		
12	Providing and fixing UPVC Clean Out confirming to ASTM D-2466 Schedule 40, with 3/8" thick Stain less steel or brass cover including cost of jointing solvent, cutting and fitting etc and complete. cartage				
a	4" Dia	5	Each		
b	3" Dia	5	Each		

13	5 Supply, install and commission PP-R COLD & HOT Water pipes SDR 6 (PN 20) piping system including cutting & breaking wall etc & making good complete in all respects with all fittings & special & accessories as per drawings and specifications				
a	3/4Inch Diameter	200	Rft		
b	1 inch Diameter	500	Rft		
d	1 1/2 inch Diameter	400	Rft		
e	2 inch Diameter	200	Rft		
14	Supply, install and commission Gate Valves with accessories as per drawings & specifications.				
a	1/2 Inch Diameter	5	Each		
b	2 inch Diameter	5	Each		
c	2 1/2 inch Diameter	5	Each		
15	Supply, install and commission Check Valves with accessories as per drawings & specifications.				
a	1 1/2 inch Diameter	2	Each		
b	2 inch Diameter	2	Each		
16	Providing and fixing Glass fiber reinforced polymer GFRP water tank with a capacity of 3000 Gallons, thickness of 5mm, pressure rating of 0.5-1.5 bar, temperature range -20 to 80 degree centigrade, resistant to water, chemicals and UV rays and specifications as per manufacturer or as approved by engineer with all necessary accessories required for fixing or proper working complete in all respect.	2	Each		
<b>SUB HEAD -II PLUMBING (NON -SCHEDULE ITEMS)</b>				<b>Rs =</b>	

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY SHAREEF COMPLEX  
BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI**

**BILL OF QUANTITIES BLOCK E**

**ELECTRICAL WORKS**

**BASED ON PAK. P.W.D SCHEDULE OF RATES 2022.**

S.NO	DESCRIPTION OF WORK	QTY	RATE	UNIT	AMOUNT
	<b><u>Point Wiring:-</u></b>				
<b>2-3-01</b>	Wiring for light, fan, point with (3/.029) PVC insulated wire in 20mm (3/4") dia PVC conduit recessed in the wall,column and roof including 1mm <sup>2</sup> single core PVC insulated wire as ECC as required.				
a)	Ground Floor	65	2836	Point	184,340
b)	Ist Floor	50	2836	Point	141,800
c)	2nd Floor	50	2836	Point	141,800
<b>2-5-03</b>	Wiring for plug point with (3/.029) PVC insulated wire in 20mm (3/4") dia PVC conduit recessed in the wall,column and roof including 1mm <sup>2</sup> single core PVC insulated wire as ECC as required.				
a)	Ground Floor	20	1528	Point	30,560
b)	First Floor	20	1528	Point	30,560
c)	2nd Floor	20	1528	Point	30,560
<b>2-35-02</b>	P/Laying (Main or Sub Main) Pvc insulated with size 2-7/.029 copper conductor in 20mm (3/4") dia PVC conduit recessed in the wall or column including 1.5mm <sup>2</sup> single core PVC wire as ECC as required (for pp & circuit wiring).				
a)	Ground Floor	250	449	P/Meter	112,250
b)	First Floor	250	449	P/Meter	112,250
c)	2nd Floor	250	449	P/Meter	112,250
<b>2-35-04</b>	P/Laying (Main or Sub Main) Pvc insulated with size 2-7/.044 (6mm <sup>2</sup> ) copper conductor in (1") dia PVC conduit recessed in the wall, column including 2.5mm <sup>2</sup> single core PVC wire as ECC as required (For Spilit AC Unit & Electric Gyser)				
a)	Ground Floor	150	805	P/Meter	120,750
b)	First Floor	150	805	P/Meter	120,750
c)	2nd Floor	150	805	P/Meter	120,750
	<b><u>DB'S Wiring:-</u></b>				
<b>2-37-04</b>	P/Laying for submain with 4x6sq-mm,PVC insulated wire 300/500 Volts grade,single core,stranded copper conductor with 25mm(1")dia uPVC conduit recessed in the wall,column and roof etc including 2.5sq-mm PVC insulated wire single core wire as ECC as required.(From Energy Meter to Flats DB)				
a)	Ground Floor	150	1700	P/Meter	255,000
b)	First Floor	175	1700	P/Meter	297,500
c)	2nd Floor	175	1700	P/Meter	297,500

S.NO	DESCRIPTION OF WORK	QTY	RATE	UNIT	AMOUNT
2-43-04	Wiring for sub-main with 4 core, 6mm <sup>2</sup> , Stranded copper conductor, PVC insulated & PVC sheathed circular/flat cable I/c 2.5mm <sup>2</sup> single core PVC insulated wire as ECC in 30mm (1¼") dia uPVC conduit fitted on surface as required.(From BusBar to Energy Meter)				
	Ground Floor	20	1443	P/Meter	28,860
	Ist Floor	100	1443	P/Meter	144,300
	2nd Floor	100	1443	P/Meter	144,300
2-43-05	Providing and laying 4 core 120mm-sq, PVC insulated & PVC sheathed,600/1000 volts grade with stranded copper conductor,armoured underground,L.T cable buried in the ground dully covered with sand and warning cable tiles as per Pak.P.W.D specification as required. (From Supply Point to BusBar)	60	22180	P/Meter	1,330,800
	<b>Accessories</b>				
2-64-03	Providing and fixing flush type, 6 Amps,2-pin socket/SP Piano Switch fixed on Plastic or Fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in wall and column including, connection as required.				
	Ground Floor	65	340	Each	22,100
	Ist Floor	50	340	Each	17,000
	2nd Floor	50	340	Each	17,000
2-64-05	Providing and fixing flush type, 6 Amps Piano Fan dimmer fixed on plastic or fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in wall and column including, connection as required.				
	a) Ground Floor	10	449	Each	4,490
	b) Ist Floor	10	449	Each	4,490
	c) 2nd Floor	10	449	Each	4,490
2-64-10	Providing and fixing flush type,15Amps 3-Pin switch and combine unit (power plug) fixed on plastic or fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in the wall and column including connection as required.				
	a) Ground Floor	4	898	Each	3,592
	b) Ist Floor	2	898	Each	1,796
	c) 2nd Floor	2	898	Each	1,796
2-64-07	Providing and fixing flush type,6/10Amps 3-Pin switch and socket combine unit(universal) fixed on plastic or fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in the wall and column including connection as required.				
	a) Ground Floor	16	766	Each	12,256
	b) Ist Floor	16	766	Each	12,256
	c) 2nd Floor	16	766	Each	12,256
	<b>Circuit breakers:-</b>				
2-71-01	Providing & fixing 6 to 32 Amps, SP MCCB fixed on existing board I/C inter connection as required.				

S.NO	DESCRIPTION OF WORK	QTY	RATE	UNIT	AMOUNT
a)	Ground Floor	17	870	Each	14,790
b)	Ist Floor	13	870	Each	11,310
c)	2nd Floor	13	870	Each	11,310
2-72-01	Providing and Fixing 20A DP Breaker for Ac and Gyscr as switch	18	2410	Each	43,380
.2-72-02	Providing & fixing 15 to 60 Amps, TP MCCB fixed on metal board recessed in the wall duly covered with fiber sheet, I/C inter connection as required.				
a)	Ground Floor(20 A TP)	2	9,481	Each	18,962
b)	Ist Floor(20 A TP)	2	9,481	Each	18,962
c)	2nd Floor(20 A TP)	2	9,481	Each	18,962
	<b><u>Distribution Boards:-</u></b>				
2-73-01	Providing & Fixing, testing,commissioning cubical type metal distribution board flush type with locking arrangement duly powder quoted paint including all fastening material including wiring with suitable gauge Pvc / Pvc wire complete in all respect (Pel, Libra, Rco, Karimi, Industrial Power Tech, Global Tech).	20	6006	Sft	120,120
2-75-01	Providing & fixing Pilot lamp set fitted on existing board I/c connection as required.	6	872	Set	5,232
	<b><u>Earthing:-</u></b>				
3-8-01	Providing and fixing Earthing set with 2'x2'x1/8" copper plate buried in the ground at a depth of 12 feet or less if water comes out from the ground level (salt & charcoal, or earthing chemical powder) etc. making the pit 12 feet deep by excavation of all type of soil (except soft or hard rock) including fixing of 2x8 SWG copper wire in 1/2" dia GI conduit complete in as respect as required.	2	54,979	Job	109,958
	<b><u>Exhaust Fan:-</u></b>				
2-84-03	Providing and fixing at site of work Exhaust fan 12"sweep,Plastic body Exhaust fan complete with blades,motor,etc fixed in existing hole inlcuding connection with 14/.0076" flexible wire complete as required .Pak,Royal,GFC				
a)	Ground Floor	6	4,672	Each	28,032
b)	First Floor	6	4,672	Each	28,032
c)	2nd Floor	6	4,672	Each	28,032
	<b><u>Ceiling Fan:-</u></b>				
106-03	Providing & Installing 140Cm (56") sweep ceiling fan with blades,canopy,standard length of down rod including connection with 14.0076" flexible wire complete as required.(without regulator).				
a)	Ground Floor	8	9,349	Each	74,792
b)	First Floor	8	9,439	Each	75,512
c)	2nd Floor	8	9,439	Each	75,512
	<b><u>Light Fitting And Fixture:-</u></b>				

S.NO	DESCRIPTION OF WORK	QTY	RATE	UNIT	AMOUNT
2-77-02 (c)	Providing,Installing,Testing and Commissioning of recessed / surface mounted project / professional series ceiling light / downlights including driver having warm / neutral white / cool white colour ,80-90 lm/watts efficiency, 0.9 or above power factor,20000-25000 hours life cycle, including connection, complete in all respect as approved by the Engineer Incharge				
a)	Ground Floor(Ceiling Light)	41	2,737	Each	112,217
b)	Ist Floor(Ceiling Light)	41	2,737	Each	112,217
c)	2nd Floor(Ceiling Light)	41	2,737	Each	112,217
	<b><u>ELECTRIC GEYSER</u></b>				
4-3-04	Providing,Installing,Testing and Commissioning of Instant Electric Geyser,complete in all respect,as approved by the Engineer Incharge 10 Litters	10	24,030	Each	240,300
	<b><u>CENTRIFUGAL PUMP</u></b>				
5-12-02	Providing and fixing centrifugal pumping set complete with AC 2HP 2850/2900 RPM 220V 50 HZz motor attached with centrifugal pump having suction & discharge 1 1/2" x1 1/2 " coupled on a common base plate as approved by engineer incharge as required.	1	43,557	Each	43,557
	<b><u>DONKEY PUMP</u></b>				
5-12-02	Providing and fixing reciprocating pump(Donkey Pump) 2HP having suction & discharge 1"x1" double belt complete with AC 220V Single Phase motor mounted on a frame.	1	30,393	Each	30,393
	<b>TOTAL COST OF SHEDULE ELECTRICAL ITEMS</b>				<b>5,204,201</b>
	<b><u>NON-SCHEDULE ITEMS</u></b>				
1	Providing and fixing LED bulkhead fitting Aluminum Body good quality complete in all respect or as approved by the E/I as required.	20		Each	
2	Providing and fixing Energy Analyzer good quality complete in all respect or as approved by the E/I as required.	1		Each	
3	Providing and fixing electric water cooler NAS GAS (DIX - NC-35) Fully stainless steel, Singer, make, including water connection, waste pipe connection and electric connection with existing points etc., complete with testing/commissioning, installed 4" above floor on 4 No purpose made concrete supports under four corners, 30 gallons capacity.	5		Each	
4	Providing and fixing water filter plant 3 stage with existing water cooler i/c connection complete in all respect.	5		Each	
	<b>TOTAL COST OF NONSHEDULE ELECTRICAL ITEMS</b>				

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY SHAREEF COMPLEX BEHIND PIR**

**SUMMARY OF COST**

**BLOCK F**

<b>S.No</b>	<b>Description</b>	<b>Schedule Items</b>	<b>Premium on Schedule Items</b>	<b>Amount of Premium</b>	<b>Non-Schedule Items</b>	<b>Total</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7=3+5+6</b>
1	Civil Works	27,251,607	___%			
2	Plumbing Works	2,276,600	___%			
3	Electrical Works	4,364,717	___%			
	<b>Total Amount</b>					

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY SHAREEF  
COMPLEX BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI**

**BILL OF QUANTITIES BLOCK F**

**PAK PWD SCHEDULE 2022**

S.No	Ref..	Description	Unit	Quantity	Rate	Amount
1	3/102	Felling trees of any height, girth exceeding 6 inches to one foot (152 mm to 305 mm), cutting into portable pieces, taking out their entire roots and filling hollows with earth complete with dressing, consolidating and watering the filling including stacking the serviceable materials and disposal of useless materials as directed, lead upto 10 chains (305 Rm), cost of earth included.	Each	4.00	623.75	2,495
		<b>DISMANTLING WORKS</b>				
2	3/123	Dismantling stone masonry in lime or cement mortar in foundation, plinth and ground floor including stacking salvaged material (serviceable) and disposing surplus stuff as directed within three chains (91.5 m)	100 Cft	1647.80	4787.50	78,888
2a	17/123	Extra for 1st floor	100 Cft	27.50	755.00	208
2b	18/123	Extra for every additional floor above 1st floor	100 Cft	1567.50	681.25	10,679
3	11/123	Dismantling cement concrete block masonry work in lime or cement mortar in foundation, basement, plinth and ground floor including stacking salvaged material (serviceable) and disposing of surplus material as directed with in three chains (91.5 m).	100 Cft	1667.19	3006.25	50,120
4	15/123	Dismantling R.C.C. including separating reinforcement from concrete in foundation, basement, plinth and ground floor including stacking at site and disposing of unserviceable material within three chains (91.5 m)	100 Cft	2722.36	8456.25	230,210
4a	19/123	Extra for first floor	100 Cft	96.09	968.28	930
4b	20/123	Extra for every additional floor above first floor on item No. 15.	100 Cft	2555.62	838.44	21,427
5	45/123	Taking out door and window frames with or without hold fasts in ground floor including cutting walls, stacking salvaged material (serviceable) and disposing of unservice-able material as directed within three chains (91.5 m).	Each	177.00	584.38	103,435
5a	53/123	Extra for first floor above ground floor on item Nos. 45 and 46.	Each	65.00	40.63	2,641
5b	2x53/123	Extra for second floor above ground floor on item Nos. 45 and 46.	Each	65.00	81.26	5,282

6	47/123	Taking out carefully shutters of doors and windows in ground floor and stacking as directed within three chains (91.5 m).	Each	177.00	346.88	61,398
6a	54/123	Extra for first floor above ground floor on item Nos. 47 and 48.	Each	58.00	28.75	1,668
6b	2x54/123	Extra for second floor above ground floor on item Nos. 47 and 48.	Each	58.00	57.50	3,335
7	40/123	Dismantling cement tiled floor, dado or skirting in basement, plinth and ground floor including base mortar and stacking salvaged material (serviceable) and disposing of surplus stuff as directed within three chains (91.5 m)....	100 Sft	10214.60	2605.63	266,155
7a	44/123	Extra for first floor above ground floor on item Nos. 39 to 40.	100 Sft	4135.18	292.50	12,095
7b	2x44/123	Extra for second floor above ground floor on item Nos. 39 to 40.	100 Sft	2547.33	585.00	14,902
8	64/123	Dismantling rain water pipe including clamps and specials and stacking serviceable material, disposal of unserviceable material as directed within three chains (91.5 m).	100 Rft	160.00	1459.38	2,335
		<b>MASONRY WORKS</b>				
9	18/113	Providing and laying coursed rubble masonry first sort in cement mortar 1 :6 in superstructure including scaffolding, curing etc. complete in ground floor.	100 Cft	1647.80	42977.55	708,184
9a	30/113	Extra for 1st floor	100 Cft	27.50	4221.94	1,161
9b	31/113	Extra for every additional floor above 1st floor	100 Cft	1567.50	3020.19	47,341
10	34/100	Providing and laying 1:3:6 cement concrete solid block masonry more than 6 inches (152 mm) thick using graded screened bajri 3/4 inch (19 mm) and down gauge set in lime cement mortar 1:1:6 including scaffolding, raking out joints and curing etc. complete in ground floor superstructure.	100 Cft	920.70	30086.14	277,003
10a	70/110	Extra for work other than in arches in first floor over item Nos. 33 to 65 and 67 to 69	100 Cft	400.95	1857.18	7,446
10b	71/110	Extra for work other than in arches in every additional floor above first floor over item Nos. 33 to 65 and 67 to 69 ...	100 Cft	400.95	1853.50	7,432
		<b>FLOORING</b>				
11	181/117	Providing and laying light colour, glazed/non skid vitrified porcelean tiles (Polished) exceeding 3600 Sqcm each, (Pak made) on walls and floors, in any floor, laid with dry bond (stile bond) over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per direction of the Engineer incharge.	100 Sft	15435.10	49798.24	7,686,407

12	40/118	Providing and fixing 1/4 inches or 6.4 mm (approx.) thick approved Pakistani make white glazed tiles upto 1.50sq feet size in dado and skirting in ground floor, over 1/2 inch (13 mm) thick base of cement mortar 1:3 setting of tiles in slurry of grey cement over mortar base including filling the joints and washing the tile with white cement slurry curing and cleaning etc. complete .	100 Sft	2594.08	27722.10	719,132
12a	49/118	Extra for 1st floor	100 Sft	791.18	762.50	6,033
12b	50/118	Extra for every additional floor above 1st floor	100 Sft	901.45	572.50	5,161
13	43/117	Providing and laying floor of 3/4 inches (19 mm) thick Granite stone Pakistani Original more than 36 sq. inches upto 72 Sq. inches (232 Sq.cm. upto 464 sq. cm.) size fine dressed on the surface without winding in ground floor over 1 inch (25 mm) lime mortar 1:2 (one lime, two sand) setting the marble tiles with grey cement slurry including curing rubbing and polishing etc. complete, including the cost of mortar.	100 Sft	27.50	57793.50	15,893
13a	76/117	Extra for laying of any description in cement mortar instead of lime mortar 1:2	100 Sft	27.50	215.50	59
13b	77/117	Extra for stairs/steps (tread, risers and mid stair landings)	100 Sft	27.50	7370.63	2,027
14	33/117	Providing and laying floor of 3/4 inch (19 mm) thick white marble tiles upto 36 Sq. inch (232 sq.cm) size fine dressed on the surface without windings in ground floor and laid over 1 inch (25 mm) thick lime mortar 1:2 (one lime, two sand) setting the tiles with grey cement slurry over lime mortar, jointing & washing the tiles with white cement slurry including curing, rubbing and polishing etc. complete, including the cost of mortar.	100 Sft	723.25	26556.00	192,066
14a	76/117	Extra for laying of any description in cement mortar instead of lime mortar 1:2	100 Sft	723.25	215.50	1,559
14b	79/117	Extra for first floor	100 Sft	300.58	736.25	2,213
14c	80/117	Extra for additional above first floor (2nd floor)	100 Sft	122.10	593.75	725
14d	77/117	Extra for stairs/steps (tread, risers and mid stair landings)	100 Sft	723.25	7370.63	53,308
		<b>SURFACE RENDERING</b>				
15	28/125	Plastering 1/2" (13 mm) thick in patches in cement and sand mortar 1:4 including curing and scraping old damaged portion in regular shape and removal of rubbish from the site etc. complete as per direction of Engineer-in-Charge in ground floor.	100 Sft	17334.90	5291.84	917,335
15a	53/125	Extra for patch plaster and finishing of any description in basement, mezzanine and first floor on item No. 28 to 49.	100 Sft	5963.10	380.00	22,660

15b	54/125	Extra for patch plaster and finishing of any description in every additional floor above first floor on item No. 28 to 49..	100 Sft	6444.90	237.50	15,307
		<b>CARPENTARY AND JOINERY</b>				
16	53/121	Providing and fixing with C.P. brass screws main door handle type yale lock (Italy make) of approved design, cutting wood etc., to required size, with two operating keys, as per direction of the engineer-in-Charge.	Nos	59.00	15899.38	938,063
		<b>PAINTING AND VARNISHING</b>				
17	167/125	Repainting two coats with plastic emulsion paint of (ICI) Dulux make and shade to walls and ceiling including cleaning, and sand papering the surface as directed by the Engineer-in-charge in any floor.	100 Sft	36115.75	2578.13	931,111
18	160/125	Distempering three renewal coats with vinyle distemper (Paintex ICI Dulux) of approved make and shade to walls and ceiling etc., including scraping cleaning the old surface in any floor .	100 Sft	10578.15	2681.25	283,627
19	154/122	Painting with wood preservative paint (solignum or equivalent) of any approved proprietary brand two coats complete at any height in any floor .	100 Sft	3318.70	3383.75	112,297
20	158/122	Painting iron work with enamel paint of approved make and shade two coats over and including the cost of one coat of priming complete at any height in any floor.	100 Sft	1395.50	5819.10	81,206
		<b>REINFORCED CEMENT CONCRETE WORKS</b>				
21	55/114	Providing and laying reinforced cement concrete using screened graded bajri 3/4 inch (19 mm) and down gauge having a minimum works cube crushing strength of 2250 lbs. per sq inch (15.52 N/mm <sup>2</sup> ) at 28 days with a mix not leaner than 1:2:4 in ordinary slab 3 inches (76 mm) to less than 5" (127 mm) thick including form work and its removal compacting and curing etc, complete but excluding the cost of reinforcement, in basement plinth and ground floor. (For Chajja only)	100 Cft	822.64	50801.07	417,910
21a	92/114	Extra for first floor	100 Cft	277.66	2811.46	7,806
21b	93/114	Extra for every additional floor above 1st floor	100 Cft	277.66	2210.59	6,138

22	56/114	Providing and faying reinforced cement concrete using screened graded bajri 3/4 inch (19 mm) and down gauge having a minimum works cube crushing strength of 2250 lbs. per sq inch (15.52 N/mm <sup>2</sup> ) at 28 days with a mix not leaner than 1:2:4 in ordinary slab 5 inches (127 mm) to 6 inches (152 mm) thick Including form work and its removal compacting and curing etc. complete but excluding the cost of reinforcement, in basement plinth and ground floor (For slab only)	100 Cft	2690.88	45074.27	1,212,892
22a	93/114	Extra for every additional floor above 1st floor	100 Cft	2690.88	2210.59	59,484
23	50/114	Providing and laying reinforced cement concrete using screened graded bajri 3/4 inch (19 mm) and down gauge having a minimum works cube crushing strength of 2250 lbs. per sq inch (15.52 N/mm <sup>2</sup> ) at 28 days with a mix not leaner than 1:2:4 in straight stairs and landing of required section including form work and its removal, compacting and curing etc. complete but excluding the cost of reinforcement, in basement plinth and ground floor.	100 Cft	272.47	57317.53	156,171
23a	92/114	Extra for first floor	100 Cft	119.31	2811.46	3,354
		<b>REINFORCEMENT WORKS</b>				
24	166/114	Providing and laying hard grade ribbed deformed (minimum yield point 60,000 psi) reinforcement bars with & including the cost of straightening, cutting, bending, binding, wastage, and such overlaps as are not shown in the drawings, placing in position on cement concrete 1:2:4 precast or m.s. chairs, tying with binding wire, cost of chairs and wires etc. in all kinds of RCC work in foundation, basement, plinth and ground floor of building including septic tanks and under ground tanks and in projections for future extension .	Cwt	405.76	14349.00	5,822,179
24a	174/114	Extra for lift for 1st floor	Cwt	42.54	225.63	9,599
24b	175/114	Extra for lift for 2nd floor	Cwt	318.15	225.63	71,784

<b>IRON WORKS</b>						
25	202/124	providing & fixing 2" dia stainless steel pipe (18 gauge) railing alongwith 4 Nos 3/4" dia parallel pipe having S/S pipe vertical post 2" dia at 3 ft c/c average spacing and 4" dia vertical post at start turning and end point including cost of labour, welding charges fitting & fixing in marble floor and wall etc complete as per direction of the Engineer Incharge.	Sft	762.30	2234.38	1,703,268
26	139/124	Providing and installing cast iron spiral stair case with central post, hand rail and braces at required intervals etc. complete but excluding the cost of cement work in base and foundation 6 ft. (1.82 m) dia .	P.Kg	3745.82	311.64	1,167,349
27	32/119	Providing and fixing iron grills with required section of flat iron as per approved design including welding all sides of the section at the junction and fixing with sunk iron screws, painting two coats of red oxide paint etc. complete as required in any floor in masonry or concrete.	P.Kg	2429.23	290.89	706,638
<b>MISCELLANEOUS</b>						
28	207/124	Providing & fixing ward robe 24" deep consisting 19 mm thick laminated sheet on bottom, top sides partition shelves & shutters etc and 4 mm thick pressed on back side, 2-1/2" x 1-1/4" best quality deodar wood frame and all open edges filled 3/4" molding PVC gola complete i/c the cost of glue iron nails screws, heavy type piano hinges, 1/2" handle, catcher, locks etc, complete as per direction of engineer incharge.	P.Sft	594.00	1289.74	766,106
29	192/124	P/F kitchen cabinet wall mounted of 3/4" thick laminated board with best quality deodar wood frame and beading 1/8" thick hard board backing required section in approved pattern etc. fixed on wall with rewal pugs, screws i/c cost of glue, null, piano hinges, handles and painting or polishing etc. as drawing complete all as respect.	P.Sft	524.70	1363.25	715,297
30	204/124	Fabrication and fixing of the Fiber shed consisting of 5-Ply fiber sheet and 2"x2" M.S. Box pipe 16 gauge main frame beams and central bracing 2"x2" at 24" c/c diagonal and 2"x2" support upto 2 feet c/c over 4" dia M.S. pipe 16 gauge 10-14 feet high i/c the cost of excavation, with pcc 1:2:4 and rcc with steel and MS steel plate 1/2" thick in foundation, size 2'x2' cutting fitting, welding painting etc. complete as per direction of engineer incharge.	Sft	300.00	1075.00	322,500

31	65/124	Providing and fixing 4" (100 mm) dia polyvinyl chloride rain water (PVC) down pipe with mild steel clamps, bolts and nuts fixed in cement concrete 1;2:4 etc. complete ...	Rft	160.00	718.67	114,987
32	2/125	Repairs to cracks to reinforced cement concrete work by grouting with cement gun with cement mortar 1:2 including cutting the chase of required size, finishing, curing including removal of rubbish etc. from site complete as directed by the Engineer-in-Charge, in ground floor .	100 Rft	300.00	5695.94	17,088
32a	7/125	Extra in first floor	100 Rft	100.00	380.00	380
32b	8/125	Extra for every additional floor above first floor	100 Rft	100.00	285.00	285
33	18/125	Brushing and cleaning with solution of caustic soda the surface of snow-crete, colour crete, sandtex, stone masonry, brick masonry including removal of rubbish etc. from the site as per direction of the Engineer-in-Charge in all floors .	100 Sft	12274.50	549.38	67,434
<b>TOTAL SCHEDULE ITEMS</b>						<b>27,251,607</b>
<b>NON SCHEDULE ITEMS</b>						
1	NSI	Providing and laying Grey stone, on walls, laid with dry bond over a base of 3/4" thick cement mortar (1:2) including jointing to tiles with joint filler of approved quality as per direction of the Engineer incharge.	Sft	1237.50		
2	NSI	Providing and fixing best quality deodar wood in door shutters solid wood 1-3/4" thick and deodar door frames of 7" x 2" complete in all respect as per design and as per instructions of engineer incharge.	Sft	1060.50		
3	NSI	Supply and fixing UPVC Flush doors with 60mm wide frame 2-2.5mm wall thickness inclusive of all accessories and galvanized iron support i/c all accessories locks complete in all respect as approval by the Engineer Incharge	Sft	252.00		
4	NSI	Supply and fixing UPVC windows with 60mm wide frame 2-2.5mm wall thickness with glass 6mm thick inclusive of all accessories and galvanized iron support i/c all accessories locks complete in all respect as approval by the Engineer Incharge	Sft	1395.50		
5	NSI	Providing and laying floor of 3/4 inch (19 mm) thick badal marble tiles upto 2' x 2' size fine dressed on the surface without windings on roof laid over 1 inch (25 mm) thick lime mortar 1:2 (one cement, two sand) setting the tiles with grey cement slurry over lime mortar, jointing & washing the tiles with white cement slurry including curing, rubbing and polishing etc. complete, including the cost of mortar.	P.Sft	4444.55		

6	NSI	Removing carefully wooden stairs from stone masonry complete in all respect including stacking all serviceable material and disposing off unserviceable material at designated place.	Job	1.00		
<b>TOTAL NON SCHEDULE ITEMS</b>						

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY SHAREEF COMPLEX BEHIND PIR  
GAYEB SHAH MAZAR KEAMARI KARACHI**

**BILL OF QUANTITIES PLUMBING WORKS**

**BLOCK F**

<b>S#</b>	<b>Description</b>	<b>Qty</b>	<b>Unit</b>	<b>Rate</b>	<b>Amount</b>
1	Providing and fixing Pakistani make best available quality European style white glazed earthenware wash down W.C.Pan complete with and including the cost of a plastic seat (PVC cover and huffers a galls. (13.6 litres) white glazed earthenware low level flushing cistern with siphon fittings, 1-1/2 inches (40mm) dia white porcelain enamelled flush bend, 3/4 inch (20mm) dia, G.I. warning pipe carried outside and bent vertically downwards and making requisite number of holes in walls, plinth and floor for pipe connections and making good in cement concrete 1:2:4.. ITEM NO 6/301	6.00	Each	13420.00	80,520
2	Providing and fixing best quality squatting type white glazed earthenware W.C Pan, Pakistani (of not less than 18 Inches clear opening as measured between flushing rims) complete with and including the cost of 13.6 litre best quality low level plastic flushing cistern with internal fittings complete, P.V.C. flushing pipe suitable for squatting type with extra bends and length with fittings, 4 inches (100mm) dia white glazed earthenware trap and making requisite number of holes in walls, plinth & floor for pipe connection and making good in cement concrete 1:2:4. ITEM NO 2/301	6.00	Each	11227.50	67,365
3	Providing and fixing 25 inches x 18 inches (635 mm x 457 mm) lavatory basin with Pedestal in white glazed earthenware (Pakistani) complete with and including the cost of Brass oxidized bolts kit built into wall /2 Inch (15 mm) dia. Chrome plated mixer 1-1/4" Inches (32mm) rubber plug and chrome plated brass chain, 1-1/4 inches (32 mm) dia brass waste of approved pattern, 1-1/4 inches (32 mm) dia. Malleable iron or C.P. brass traps malleable iron or brass unions and making requisite number or holes in walls plinth and floor for pipe connections and making god in cement concrete 1:2:4. item no 8/301+ ITEM NO 10/301	12.00	Each	12262.50	147,150
4	Extra over item No.8 and 9 for providing single hole chromium plated mixer tap 1/2 inch (15 mm) dia English or approved foreign make).. ITEM NO 14/301	12.00	Each	1298.55	15,583
5	Providing 1/2 inch (15 mm) dia plastic connection complete with a 1/2 inch (15 mm) dia brass stop cock two brass nuts and lining jointed to plastic pipe. ITEM NO 17/301	36.00	Each	824.50	29,682
6	Providing and fixing approved quality C.P. brass toilet paper holder. ITEM NO 3/302	12.00	Each	854.40	10,253
7	Providing and fixing 24 inches x 18 inches (510 mm x 457 mm) looking mirror of Imported glass 5 mm thick fixing with CP clamps and screws ITEM NO 5/302	12.00	Each	2173.98	26,088
8	Providing and fixing glass shelf 25 inches x 5 inches 8 (610 mm x 127 mm) brackets and guard rail complete. ITEM NO 7/302	12.00	Each	758.24	9,099
9	Providing and fixing Royal bath room accessories of set of 6 pieces consist of one towel rod with bracket, one tooth brush holder with glass and cover, one double hook one NOTowel ring etc complete of approved quality as per direction of Engineer in-charge. ITEM NO 12 /302	12.00	Each	10405.25	124,863
10	Providing & fixing chromium plated Muslim bib-cock with out Muslim Shower of approved quality. ITEM NO 13/302	12.00	Each	3381.75	40,581
	<b>SANITARY DRAINAGE</b>				

11	Providing and fixing un platized polyvinyl chloride pipe (P.V.C) "D" class and specials etc. including cutting and fitting complete with and including the cust of cutting trench upto 1-1/2 feet deep refilling, watering, ramming, and disposal of surplus earth within one chain and after cleaning the pipe and cartage within 10 miles (16,09 km.) (working pressure 12 kg/cm <sup>2</sup> ) ITEM NO 21/306				
a	Do. Do. 6 inches (150 mm) diapipe.	500.00	Rft	716.62	358,310
b	Do Do. 4 inches (100 mm) dia pipe...	500.00	Rft	600.01	300,005
<b>EXTERNAL DRAINAGE</b>					
12	Providing and fixing un platized polyvinyl chloride pipe (P.V.C) "D" class and specials etc. including cutting and fitting complete with and including the cost of cutting trench upto 1-1/2 feet deep refilling, watering, ramming, and disposal of surplus earth within one chain and after cleaning the pipe and cartage within 10 miles (16.09 km.) (working pressure 12 kg/cm <sup>2</sup> ) ITEM NO 21/306				
a	Do. Do. 6 inches (150 mm) diapipe.	400.00	Rft	716.62	286,648
13	Excavation in all kinds of soil, murum, hard, average or soft including lift up to 5 feet (1.52 m) and lead up to one chain (30.48 m). ITEM NO 5/313.	2250.00	%Cft	4387.08	98,709
14	Filling and disposal of earth.. ITEM NO 28/313	2151.88	%Cft	1095.00	23,563
15	Making connection with the existing manhole including the cost of cutting holes in walls, making them good in cement concrete 1:2:4 and making the required channel etc., complete.... ITEM NO 13 /316	4.00	Pair	828.24	3,313
16	Cutting holes in walls 9 incnes and 8 inches (229 mm and 203mm) thick and making them good in cement concrete 1;2;4... ITEM NO 11 /316	60.00	Each	866.50	51,990
17	Providing G.I. pipes, specials and clamps etc.,including fixing cutting and fitting complete with and including the cost of breaking through walls and roof, making good etc., painting 2 coats after cleaning the pipe etc.; with white zinc paint with pigment to match the colour of the bulding and testing with water to a pressure head of 200 feet (61 M) and cartages within 10 miles (16.09 km.) (ILLM), 1/2 inch (15mm) dia item no 1/305				
a	Do. Do. 3/4 inch (20 mm) dia..	400.00	Rft	257.38	102,952
b	Do. Do. 1 inch (25 mm) dia..	400.00	Rft	366.46	146,584
c	Do. Do. 1-1/2inch (40mm) dia..	300.00	Rft	534.17	160,251
d	Do. Do, 2inch (50 mm) dia..	200.00	Rft	718.54	143,708
18	Providing and fixing dia ball valve (with PVC Ball) made to B.S.S. 1212. ITEM NO 16/307				
a	Do.Do 1 inen (25 m.m) dia..Do (18/307)	30.00	Each	703.70	21,111
b	Do. Do. 1-1/2 inches (40 mm) dia Do. (20/307)	20.00	Each	871.60	17,432
c	Do. Do. 2 inches (50 mm) dia Do. (21/307)	10.00	Each	1084.10	10,841
<b>PLUMBING WORK (SCHEDULE ITEM)</b>				<b>Rs=</b>	<b>2,276,600</b>

#### NON SCHEDULE ITEMS

S#	Description		Unit	Rate	Amount
1	Providing and fixing approved quality double bowl stainless steel Kitchen sink size 800x 470 x200mm Pak made (Atlas) or equivalent complete fixed in alcaloid Mercle counter Top fixed over RCC slob 3" thick cost of slab and marble top is not included in this rate including " dia CP sink mixer with three knobs and CP brass chain 1-1/4" CP waste malleable iron or brass unions and making requisite number of holes in walls, plinth and floor for pipe connections and making good in cement concrete 1:2:4	6.00	Each		

2	Providing and fixing CP double bib cock 1/2" dia. meter 90 degree regular type Master Make or equivalent with crystal plastic knob all complete in approved make with all accessories as per specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12.00	Each		
3	Providing and fixing CP Brass single bib cock 90 degree regulr type with crystal plastic knob all complete in approved Master make or equivalent with all accessories as per sperified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12.00	Each		
4	Providing and fixing CP Brass regular T-Stop cock 1/2" dia meter with crystal plastic knob Master Make or equivalent all complete in approved make with all accessories as par specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12.00	Each		
5	Proving & Fixing Toilet shower with flexible platic pipe and CP thraded nut etc complete Master make or equivalent complete.	12.00	Each		
6	Providing and fixing CP Brass common single hole mixer with U Type long neck (cold ) Master make or equivalent in crverai niastic knch approved make complete with all accessories as per specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 ( Master or Equivalent)	12.00	Each		
7	Providing and fixing CP Brass wall sink mixer with U Type long neck (cold & hot) with two knob plastic crystal knob Master make or equivalent crystal plastic knob approved make complete with all accessories as per specified including making requisite numbers of holes in concrete and masonry, floor as required and making good with concrete 1:2:4 (Master or Equivalent)	12.00	Each		
8	Providing & fixing Floor Drain Grating 6"x6"( 150mm x150mm) Stain less Steel heavy Type 10mm thick, Master Make /Super Asia or equivalent complete as per direction.	36.00	Each		
9	Providing & fixing floor trap Grating 3" dia(75mm) Stain less Steel heavy Type 10mm thick. Master Make /super Asia or equivalent complete as per dirction.	30.00	Each		
10	Providing and fixing UPVC P-Trap confirming to ASTM D-2466 Schedule 40, cost of jointing solvent, cutting and fitting etc. including the cost of 3/8 thier Stall, isab sel grating with 1-1/2" dia hole complete as per specification...				
c	2" Dia	5.00	Each		
11	Providing and fixing UPVC Floor Vent Cowel for Soil Waste pipe confirming to ASTM D-2466 Schedule 40, cost of jointing solvent, cutting and fitting using PVC Clamp etc and cartage complete.				
a	4" Dia	4.00	Each		
b	3" Dia	4.00	Each		
12	Providing and fixing UPVC Clean Out confirming to ASTM D-2466 Schedule 40, with 3/8" thick Stain less steel or brass cover including cost of jointing solvent, cutting and fitting etc and complete. cartage				
a	4" Dia	4.00	Each		
b	3" Dia	4.00	Each		

13	5 Supply, install and commission PP-R COLD & HOT Water pipes SDR 6 (PN 20) piping system including cutting & breaking wall etc & making good complete in all respects with all fittings & special & accessories as per drawings and specifications				
a	3/4Inch Diameter	100.00	Rft		
b	1 inch Diameter	400.00	Rft		
c	1-1/4 inch Diameter	100.00	Rft		
d	1 1/2 inch Diameter	100.00	Rft		
e	2 inch Diameter	500.00	Rft		
14	Supply, install and commission Gate Valves with accessories as per drawings & specifications.				
a	1/2 Inch Diameter	5.00	Each		
b	2 inch Diameter	5.00	Each		
c	2 1/2 inch Diameter	5.00	Each		
15	Supply, install and commission Check Valves with accessories as per drawings & specifications.				
a	1 1/2 inch Diameter	2.00	Each		
b	2 inch Diameter	2.00	Each		
16	Providing and fixing Glass fiber reinforced polymer GFRP water tank with a capacity of 3000 Gallons, thickness of 5mm, pressure rating of 0.5-1.5 bar, temperature range -20 to 80 degree centigrade, resistant to water, chemicals and UV rays and specifications as per manufacturer or as approved by engineer with all necessary accessories required for fixing or proper working complete in all respect.	2.00	Each		
<b>PLUMBING (NON -SCHEDULE ITEMS)</b>				<b>Rs =</b>	

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F CHAUDHARY  
SHAREEF COMPLEX BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI**

**BILL OF QUANTITIES BLOCK F**

**ELECTRICAL WORKS**

**BASED ON PAK. P.W.D SCHEDULE OF RATES 2022.**

S.NO	DESCRIPTION OF WORK	QTY	RATE	UNIT	AMOUNT
	<b>Point Wiring:-</b>				
<b>2-3-01</b>	Wiring for light, fan, point with (3/.029) PVC insulated wire in 20mm (3/4") dia PVC conduite recessed in the wall,column and roof including 1mm <sup>2</sup> single core PVC insulated wire as ECC as required.				
a)	Ground Floor	55	2836	Point	155,980
b)	Ist Floor	65	2836	Point	184,340
c)	2nd Floor	65	2836	Point	184,340
<b>2-5-03</b>	Wiring for plug point with (3/.029) PVC insulated wire in 20mm (3/4") dia PVC conduit recessed in the wall,column and roof including 1mm <sup>2</sup> single core PVC insulated wire as ECC as required.				
a)	Ground Floor	17	1528	Point	25,976
b)	First Floor	10	1528	Point	15,280
c)	2nd Floor	10	1528	Point	15,280
<b>2-35-02</b>	P/Laying (Main or Sub Main) Pvc insulated with size 2-7/.029 copper conductor in 20mm (3/4") dia PVC conduite recessed in the wall or column including 1.5mm <sup>2</sup> single core PVC wire as ECC as required (for pp & circuit wiring).				
a)	Ground Floor	200	449	P/Meter	89,800
b)	First Floor	200	449	P/Meter	89,800
c)	2nd Floor	200	449	P/Meter	89,800
<b>2-35-04</b>	P/Laying (Main or Sub Main) Pvc insulated with size 2-7/.044 (6mm <sup>2</sup> ) copper conductor in (1") dia PVC conduite recessed in the wall, column including 2.5mm <sup>2</sup> single core PVC wire as ECC as required (For Split AC Unit & Electric Gyser)				
a)	Ground Floor	35	805	P/Meter	28,175
b)	First Floor	35	805	P/Meter	28,175
c)	2nd Floor	35	805	P/Meter	28,175
	<b>DB'S Wiring:-</b>				0

<b>2-37-04</b>	P/Laying for submain with 4x6sq-mm,PVC insulated wire 300/500 Volts grade,single core,stranded copper conductor with 25mm(1")dia uPVC conduit recessed in the wall,column and roof etc including 2.5sq-mm PVC insulated wire single core wire as ECC as required.(From Energy Meter to Flats DB)				
a)	Ground Floor	150	1700	P/Meter	255,000
b)	First Floor	175	1700	P/Meter	297,500
c)	2nd Floor	175	1700	P/Meter	297,500
<b>.2-43-04</b>	Wiring for sub-main with 4 core, 6mm <sup>2</sup> , Stranded copper conductor, PVC insulated & PVC sheathed circular/flat cabel I/c 2.5mm <sup>2</sup> single core PVC insulated wire as ECC in 30mm (1¼") dia uPVC conduit fitted on surface as required.(From BusBar to Energy Meter)				
	Ground Floor	20	1443	P/Meter	28,860
<b>2-43-05</b>	Providing and laying 4 core 120mm-sq, PVC insulated & PVC sheathed,600/1000 volts grade with stranded copper conductor,armoured underground,L.T cable buried in the ground dully covered with sand and warning cable tiles as per Pak.P.W.D specification as required. (From Supply Point to BusBar)	60	22180	P/Meter	1,330,800
	<b><u>Accessories</u></b>				
<b>2-64-03</b>	Providing and fixing flush type, 6 Amps,2-pin socket/SP Piano Switch fixed on Plastic or Fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in wall and column including, connection as required.				
	Ground Floor	65	340	Each	22,100
	Ist Floor	50	340	Each	17,000
	2nd Floor	50	340	Each	17,000
<b>2-64-05</b>	Providing and fixing flush type, 6 Amps Piano Fan dimmer fixed on plastic or fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in wall and column including, connection as required.				
a)	Ground Floor	6	449	Each	2,694
b)	Ist Floor	5	449	Each	2,245
c)	2nd Floor	5	449	Each	2,245

<b>2-64-10</b>	Providing and fixing flush type,15Amps 3-Pin switch and combine unit (power plug) fixed on plastic or fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in the wall and column including connection as required.				
a)	Ground Floor	2	898	Each	1,796
b)	Ist Floor	2	898	Each	1,796
c)	2nd Floor	2	898	Each	1,796
<b>2-64-07</b>	Providing and fixing flush type,6/10Amps 3-Pin switch and socket combine unit(universal) fixed on plastic or fiber top covered sheet on (14 SWG) metal board with earth terminal recessed in the wall and column including connection as required.				
a)	Ground Floor	10	766	Each	7,660
b)	First Floor	10	766	Each	7,660
c)	2nd Floor	10	766	Each	7,660
	<b><u>Circuit breakers:-</u></b>				
<b>2-71-01</b>	Providing & fixing 6 to 32 Amps, SP MCCB fixed on existing board I/C inter connection as required.				
a)	Ground Floor	20	870	Each	17,400
b)	Ist Floor	15	870	Each	13,050
c)	2nd Floor	16	870	Each	13,920
<b>2-72-01</b>	Providing and Fixing 30A DP Breaker for Ac and Gyser as switch	6	2410	Each	14,460
<b>2-72-02</b>	Providing & fixing 15 to 60 Amps, TP MCCB fixed on metal board recessed in the wall duly covered with fiber sheet, I/C inter connection as required.				
a)	Ground Floor( <b>20 A TP</b> )	2	9,481	Each	18,962
b)	Ist Floor( <b>20 A TP</b> )	2	9,481	Each	18,962
c)	2nd Floor( <b>20 A TP</b> )	2	9,481	Each	18,962
	<b><u>Distribution Boards:-</u></b>				
<b>2-73-01</b>	Providing & Fixing, testing,commissioning cubical type metal distribution board flush type with locking arrangement duly powder quoted paint including all fastening material including wiring with suitable gauge Pvc / Pvc wire complete in all respect (Pel, Libra, Rco, Karimi, Industrial Power Tech, Global Tech).	6	6006	Sft	36,036
	Ground Floor	3	6006	Sft	18,018
	Ist Floor	3	6006	Sft	18,018
	2nd Floor	3	6006	Sft	18,018

2-75-01	Providing & fixing Pilot lamp set fitted on existing board I/c connection as required.	6	872	Set	5,232
	<b><u>Earthing:-</u></b>				
3-8-01	Providing and fixing Earthing set with 2'x2'x1/8" copper plate buried in the ground at a depth of 12 feet or less if water comes out from the ground level (salt & charcoal, or earthing chemical powder) etc. making the pit 12 feet deep by excavation of all type of soil (except soft or hard rock) including fixing of 2x8 SWG copper wire in 1/2" dia GI conduit complete in as respect as required.	1	54,979	Job	54,979
	<b><u>Exhaust Fan:-</u></b>				
2-84-03	Providing and fixing at site of work Exhaust fan 12"sweep,Plastic body Exhaust fan complete with blades,motor,etc fixed in existing hole including connection with 14/.0076" flexible wire complete as required .Pak,Royal,GFC				
a)	Ground Floor	3	4,672	Each	14,016
b)	First Floor	3	4,672	Each	14,016
c)	2nd Floor	3	4,672	Each	14,016
	<b><u>Ceiling Fan:-</u></b>				
106-03	Providing & Installing 140Cm (56") sweep ceiling fan with blades,canopy,standard length of down rod including connection with 14.0076" flexible wire complete as required.(without regulator).				
a)	Ground Floor	6	9,349	Each	56,094
b)	First Floor	5	9,439	Each	47,195
c)	2nd Floor	5	9,439	Each	47,195
	<b><u>Light Fitting And Fixture:-</u></b>				
2-77-02 (c)	Providing,Installing,Testing and Commissioning of recessed / surface mounted project / professional series ceiling light / downlights including driver having warm / neutral white / cool white colour ,80-90 lm/watts efficiency, 0.9 or above power factor,20000-25000 hours life cycle, including connection, complete in all respect as approved by the Engineer Incharge				
a)	Ground Floor(Ceiling Light)	55	2,737	Each	150,535
b)	Ist Floor(Ceiling Light)	55	2,737	Each	150,535
c)	2nd Floor(Ceiling Light)	55	2,737	Each	150,535
	<b><u>ELECTRIC GEYSER</u></b>				

<b>4-3-04</b>	Providing,Installing,Testing and Commissioning of Instant Electric Geyser,complete in all respect,as approved by the Engineer Incharge 10 Litters	6	24,030	Each	144,180
<b><u>CENTRIFUGAL PUMP</u></b>					
<b>5-12-02</b>	Providing and fixing centrifugal pumping set complete with AC 2HP 2850/2900 RPM 220V 50 HZz motor attached with centrifugal pump having suction & discharge 1 1/2" x1 1/2 " coupled on a common base plate as approved by engineer incharge as required.	1	43,557	Each	43,557
<b><u>DONKEY PUMP</u></b>					
<b>5-12-02</b>	Providing and fixing reciprocating pump(Donkey Pump) 2HP having suction & discharge 1"x1" double belt complete with AC 220V Single Phase motor mounted on a frame.	1	30,393	Each	30,393
<b>TOTAL COST OF SHEDULE ELECTRICAL ITEMS</b>					<b>4,364,717</b>
<b><u>NON-SCHEDULE ITEMS</u></b>					
<b>1</b>	Providing and fixing LED bulkhead fitting Aluminum Body good quality complete in all respect or as approved by the E/I as required.	10		Each	
<b>2</b>	Providing and fixing Energy Analyzer good quality complete in all respect or as approved by the E/I as required.	1		Each	
<b>3</b>	Providing and fixing electric water cooler NAS GAS (DIX - NC-35) Fully stainless steel, Singer, make, including water connection, waste pipe connection and electric connection with existing points etc., complete with testing/commissioning, installed 4" above floor on 4 No purpose made concrete supports under four corners, 30 gallons capacity.	1		Each	
<b>4</b>	Providing and fixing water filter plant 3 stage with existing water cooler i/c connection complete in all respect.	1		Each	
<b>TOTAL COST OF NONSHEDULE ELECTRICAL ITEMS</b>					

**COLLECTORATE OF CUSTOMS ENFORCEMENT, KARACHI**

**RENOVATION / REHABILITATION / REPAIR OF BLOCK E AND F  
CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH  
MAZAR KEAMARI KARACHI**

**BIDDING DOCUMENTS**

**VOLUME-IV**

**TENDER DRAWINGS**

**APRIL, 2026**



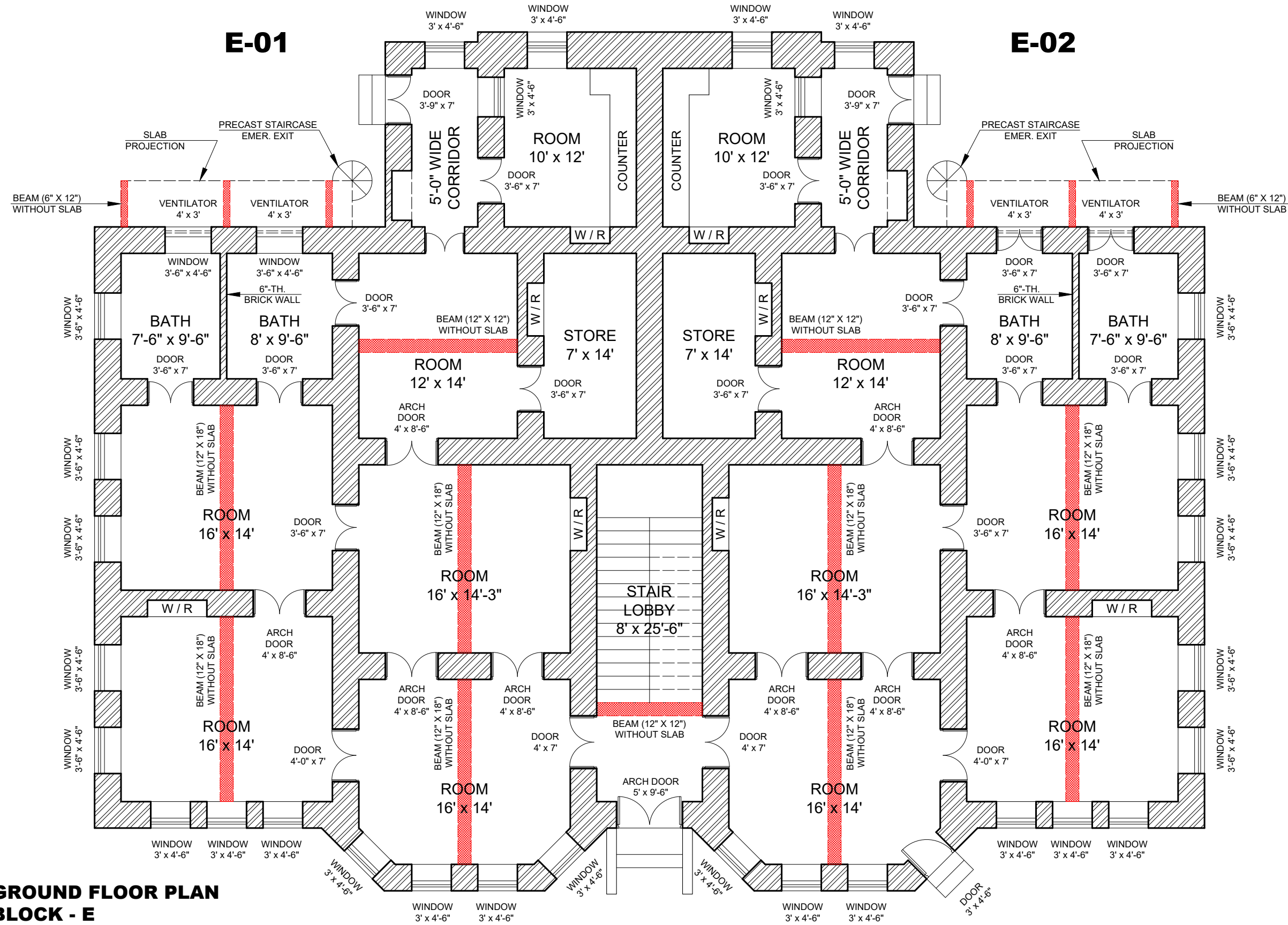
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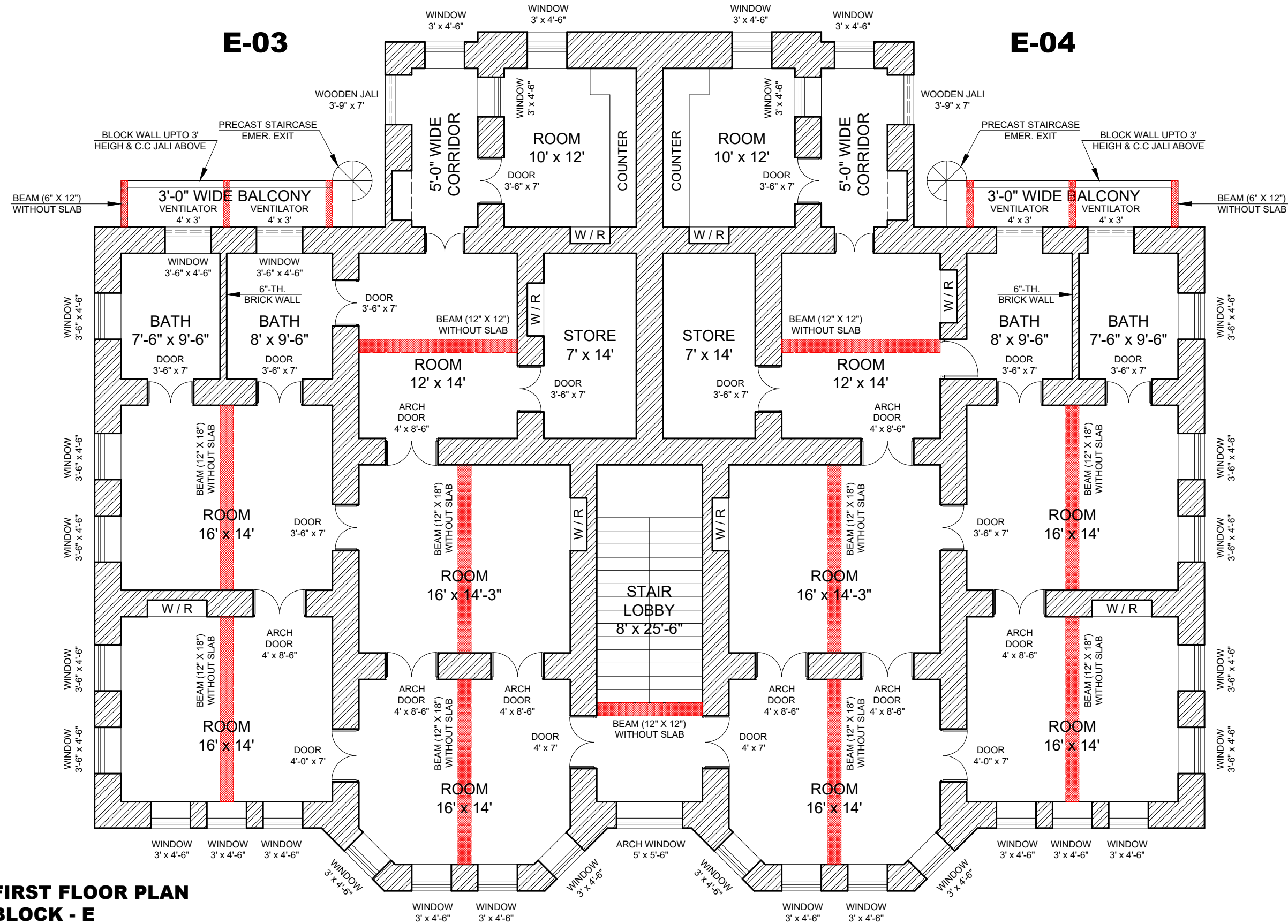
**DI Khan Office:** Office No. 21, 1st Floor, Cantt Market, Dera Ismail Khan Tel No: 0966-715755 & Cell # 0336-0109883

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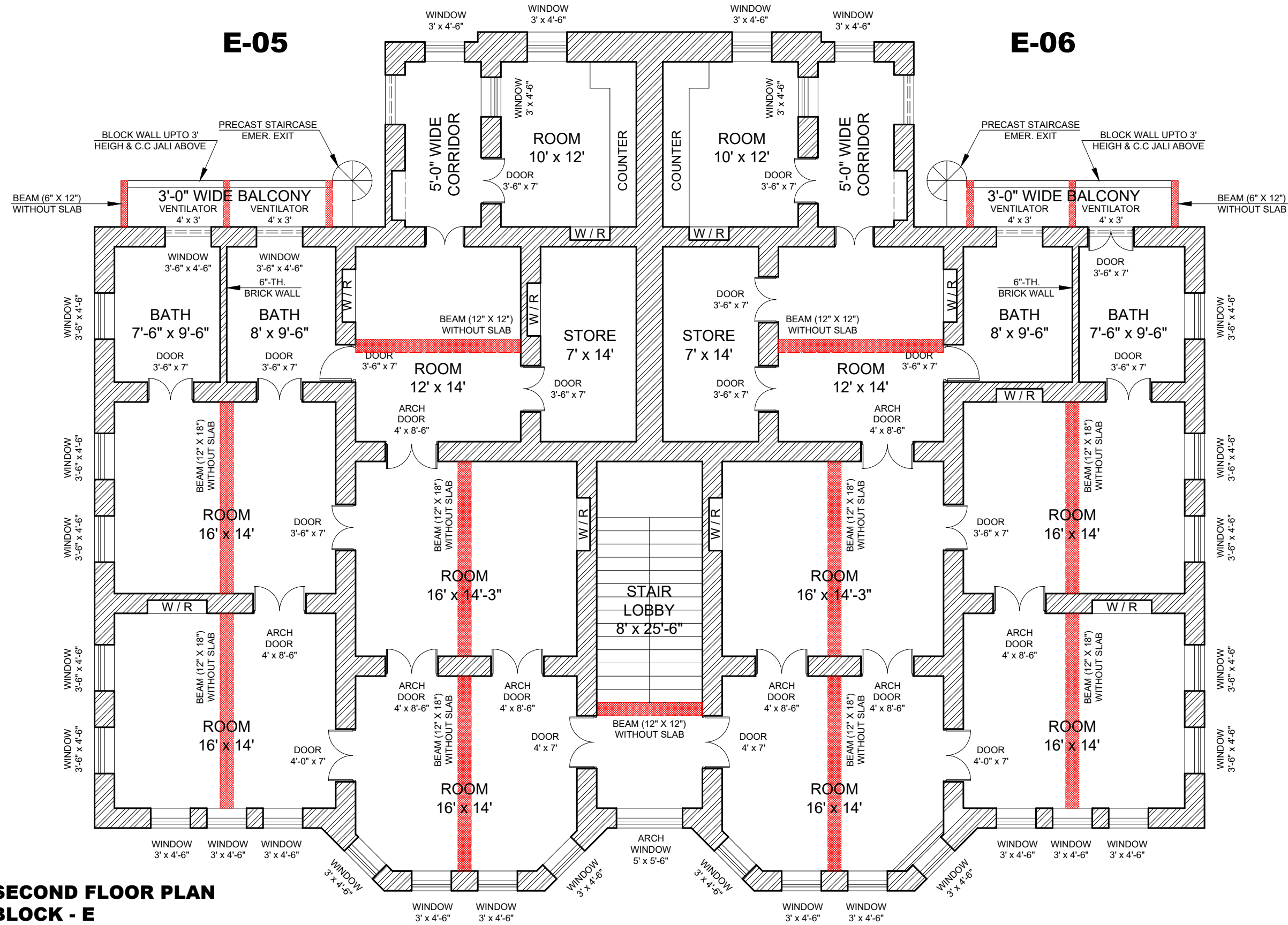
**GROUND FLOOR PLAN  
BLOCK - E**

Client <b>COLLECTORATE OF CUSTOMS ENFORCEMENT, KARACHI.</b>	Project <b>RENOVATION / REHEBELATION / REPAIR OF BLOCK E &amp; F CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI</b>	Job <b>BLOCK -E</b>	Consultant  <b>ESS -I- AAR</b> PLANNING , ENGINEERING & SERVICES CONSULTANTS SUITE NO. 314, 3- RD. FLOOR MASHRIQ CENTER SIR SHAH SULAIMAN ROAD , GULSHAN - E - IQBAL BLOCK NO. 14, KARACHI , P. O. BOX NO. 7608	TITLE GROUND FLOOR PLAN (BLOCK -E)	DATE	COM. LOCATION.	SHEET REF.
				DRAWN M. FAYSAL	SCALE N.T.S	ISSUE	DESCRIPTION



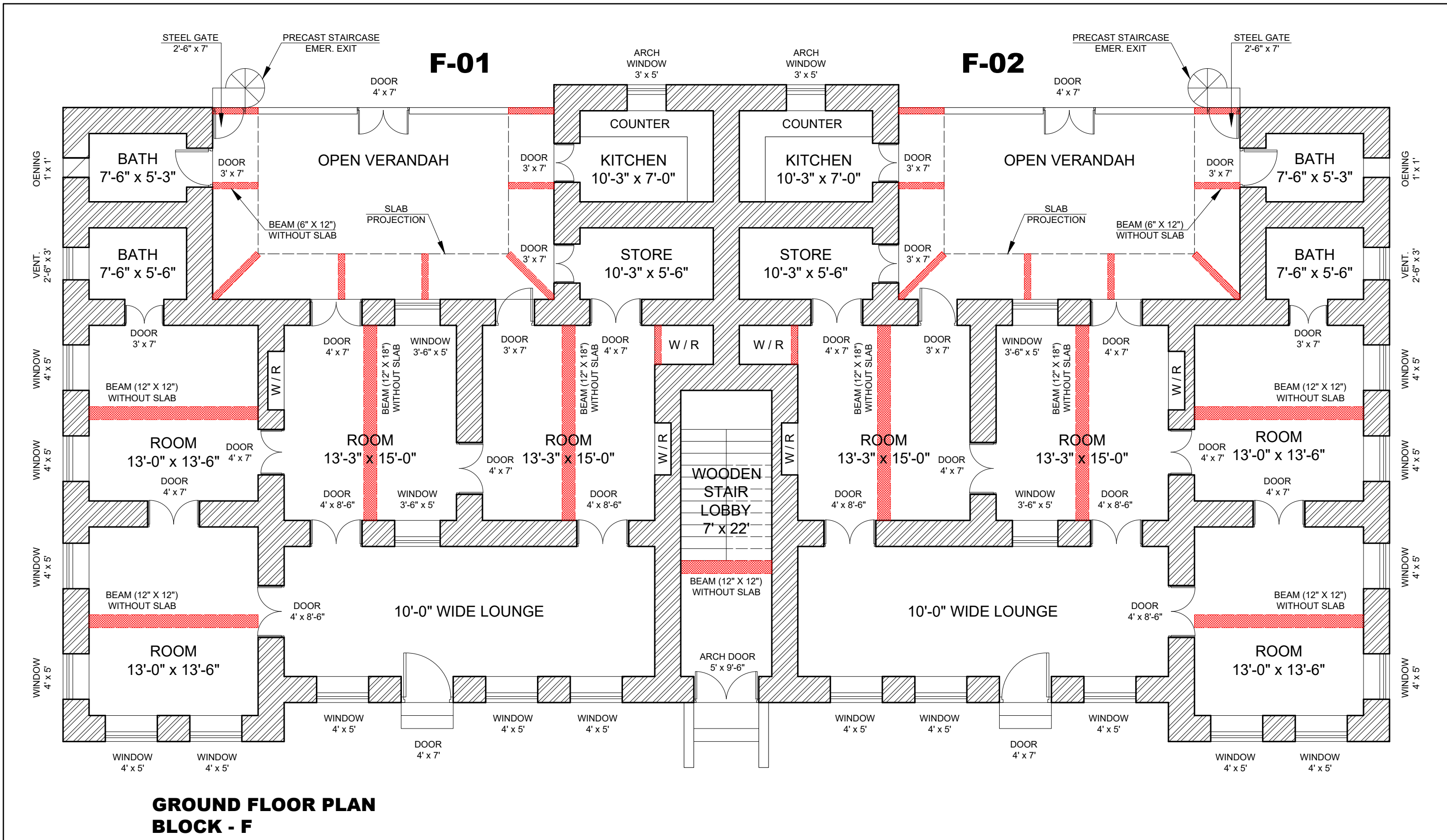
**FIRST FLOOR PLAN  
BLOCK - E**

Client <b>COLLECTORATE OF CUSTOMS ENFORCEMENT, KARACHI.</b>	Project <b>RENOVATION / REHEBELATION / REPAIR OF BLOCK E &amp; F CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI</b>	Job <b>BLOCK -E</b>	Consultant <b>ESS -I- AAR</b> PLANNING , ENGINEERING & SERVICES CONSULTANTS SUITE NO. 314, 3- RD. FLOOR MASHRIQ CENTER SIR SHAH SULAIMAN ROAD , GULSHAN - E - IQBAL BLOCK NO. 14, KARACHI , P. O. BOX NO. 7608	TITLE FIRST FLOOR PLAN (BLOCK -E)	DATE	COM. LOCATION.	SHEET REF.
				DRAWN M. FAYSAL	SCALE N.T.S	ISSUE	DESCRIPTION



**SECOND FLOOR PLAN  
BLOCK - E**

Client <b>COLLECTORATE OF CUSTOMS ENFORCEMENT, KARACHI.</b>	Project <b>RENOVATION / REHEBELATION / REPAIR OF BLOCK E &amp; F CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI</b>	Job <b>BLOCK -E</b>	Consultant  <b>ESS -I- AAR</b> PLANNING , ENGINEERING & SERVICES CONSULTANTS SUITE NO. 314, 3- RD. FLOOR MASHRIQ CENTER SIR SHAH SULAIMAN ROAD , GULSHAN - E - IQBAL BLOCK NO. 14, KARACHI , P. O. BOX NO. 7608	TITLE SECOND FLOOR PLAN (BLOCK -E)	DATE	COM. LOCATION.	SHEET REF.
				DRAWN M. FAYSAL	SCALE N.T.S	ISSUE	DESCRIPTION



**GROUND FLOOR PLAN  
BLOCK - F**

Client <b>COLLECTORATE OF CUSTOMS ENFORCEMENT, KARACHI.</b>	Project <b>RENOVATION / REHEBELATION / REPAIR OF BLOCK E &amp; F CHAUDHARY SHAREEF COMPLEX BEHIND PIR GAYEB SHAH MAZAR KEAMARI KARACHI</b>	Job <b>BLOCK -F</b>	Consultant  <b>ESS -I- AAR</b> PLANNING, ENGINEERING & SERVICES CONSULTANTS SUITE NO. 314, 3- RD. FLOOR MASHRIQ CENTER SIR SHAH SULAIMAN ROAD, GULSHAN - E - IQBAL BLOCK NO. 14, KARACHI, P. O. BOX NO. 7608	TITLE GROUND FLOOR PLAN (BLOCK -F)	DATE	COM. LOCATION.	SHEET REF.
				DRAWN M. FAYSAL	SCALE N.T.S	ISSUE	DESCRIPTION



