

OFFICE OF THE DIRECTOR PLANNING & DEVELOPMENT,
DOW UNIVERSITY OF HEALTH SCIENCES



BIDDING DOCUMENT
(VOLUME-I)

NAME OF WORK: CONSTRUCTION OF WAREHOUSE
AT OJHA CAMPUS, DUHS, KARACHI.

Estimated Cost: Rs. 499.812 Million

Bid Security: 3% of Offered Bid

Tender Cost: Rs. 7000/

Issue to M/s. _____

P.O. No. _____

Amount _____

Dated: _____

Bank _____

Signature and stamp of issuing Authority:

TABLE OF CONTENTS

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

E.	Bid Opening and Evaluation	
	IB.23 Bid Opening	18
	IB.24 Process to be Confidential	18
	IB.25 Clarification of Bids	18
	IB.26 Examination of Bids and Determination of Responsiveness	19
	IB.27 Correction of Errors	20
	IB.28 Financial Evaluation and Comparison of Bids	20
F.	Award of Contract	
	IB.29 Award	22
	IB.30 Procuring Agency Right to Accept any Bid and to Reject any or all Bids	22
	IB.31 Notification of Award	22
	IB.32 Performance Security	23
	IB.33 Signing of Contract Agreement	23
	IB.34 General Performance of the Bidders	24
	IB.35 Integrity Pact	24
	IB.36 Instructions Not Part of Contract	24
	IB.37 Arbitration	24

BIDDING DATA **25-38**

FORM OF BID AND APPENDICES TO BID **39**

FORM OF BID

Appendix-A to Bid	: Special Stipulations	42
Appendix-B to Bid	: Foreign Currency Requirements	43
Appendix-C to Bid	: Price Adjustment (Under Clause 70)	44-45
Appendix-D to Bid	: Bill of Quantities	46-70
Appendix-E to Bid	: Proposed Construction Schedule	71
Appendix-F to Bid	: Method of Performing the Work	72
Appendix-G to Bid	: List of Major Equipment – Related Items	73-74
Appendix-H to Bid	: Construction Camp and Housing Facilities	75
Appendix-I to Bid	: List of Subcontractors	76
Appendix-J to Bid	: Estimated Progress Payments	77
Appendix-K to Bid	: Organization Chart of the Supervisory Staff and Labour	78
Appendix-L to Bid	: Integrity Pact	79

	FORMS	80
	BID SECURITY	81-82
	PERFORMANCE SECURITY	83-84
	CONTRACT AGREEMENT	85-86
	MOBILIZATION ADVANCE GUARANTEE	87-88
	INDENTURE BOND FOR SECURED ADVANCE	89-91
PART-I: GENERAL CONDITIONS OF CONTRACT		92-112
PART-II: SPECIAL CONDITIONS OF CONTRACT		
SPECIFICATIONS		113-449
DRAWINGS		450-461

**INVITATION
FOR BIDS**



**OFFICE OF THE DIRECTOR PLANNING &
DEVELOPMENT,
DOW UNIVERSITY OF HEALTH SCIENCES**
Dow University of Health Sciences, 5th Floor, Baba-e-Urdu Road, Karachi

NIT No: DUHS/P&D/2023/11575, Ref No DUHS/W&S-NIT/134

Dated: 09-Oct-2023

NOTICE INVITING TENDERS

DAWN

TODAY'S PAPER | OCTOBER 10, 2023

OFFICE OF THE DIRECTOR PLANNING & DEVELOPMENT DOW UNIVERSITY OF HEALTH SCIENCES		
No. DUHS/P&D/2023/11575	Dated: October 9, 2023	
TENDER NOTICE		
Dow University of Health Sciences (DUHS), Karachi is a Public Sector University invites the Sealed bids from well-reputed Companies / Bidders having registration with Federal Board of Revenue (FBR), Income Tax Department, Sindh Revenue Service Board, Sales Tax and Pakistan Engineering Council (PEC) for following works.		
S. No	NAME OF WORK	METHOD OF PROCUREMENT
1	CONSTRUCTION OF NEW GIRLS HOSTEL AT OJHA CAMPUS, DUHS, KARACHI. (REF NO: DUHS/W&S-NIT/133)	Single Stage – Two Envelope Procedure as per rule 46 sub rule-2 of SPP Rules 2010 (Amended upto date)
2	CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS, DUHS, KARACHI. (REF NO: DUHS/W&S-NIT/134)	Single Stage – Two Envelope Procedure as per rule 46 sub rule-2 of SPP Rules 2010 (Amended upto date)
Tender Fee	Rs. 7,000/- (Rupees Seven Thousand Only) Non-Refundable in shape of Pay Order / Demand Draft in favor of Dow University of Health Sciences, Karachi.	
Security	Bid Security and Performance Security as mentioned in the bidding document.	
Purchasing Date & Time	From the date of publishing to 28-10-2023 (8:30 a.m to 02:30 p.m)	
Bids Delivery & Opening Date & Time	30-10-2023 at 11:00 a.m & 11:30 a.m.	
Detailed Specification are mentioned in the prescribed tender documents alongwith terms and conditions. Bidding documents can be download from SPPRA website or Dow University of Health Sciences, website. Conditional Bids, Telegraphic Bids, Bids not accompanied by Bid Security of required amount and form, bids received after specific date and time and bids of Black Listed firms will be rejected.		
In case of any unforeseen situation or government holiday resulting in closure of office on the date of opening, bids shall be submitted / opened on next working day at the given time. The Dow University of Health Sciences, Karachi (DUHS) reserves the right to reject any or all the bids subject to the relevant provisions of SPP Rules 2010 (Amended upto date).		
ADDRESS FOR PURCHASING OF BIDDING DOCUMENTS, SUBMISSION AND OPENING OF BIDS: Office of the Director Planning & Development, Dow University of Health Sciences (DMC Campus), 5 th Floor Administration Block, Baba-e-Urdu Road, Karachi-74200 Pakistan. Tel: 9215754-57 Ext: 5811 Website: www.duhs.edu.pk		

(Single Stage – Two Envelope Procedure as per S.P.P Rules, 2010 time to time)

Tenders are invited on Single Stage – Two Envelope Procedure in two separate sealed envelopes; one containing Financial Proposal on and the other containing Technical Proposal for the following work funded through Dow University of Health Sciences, Karachi. The bidders having experience in similar nature of works and registered with PEC in relevant category having up-to-date renewed License of PEC, valid Professional Tax, NTN Certificate, Registration with Sindh Revenue Board, valid copy of CNIC of Proprietors are required to purchase tender documents and submit their bids / proposals in two separate envelopes clearly marked “FINANCIAL PROPOSAL” & “TECHNICAL PROPOSAL” as per schedule given hereunder:-

S.No	Name of Scheme	Estimated Cost (Rs. in Million)	Bid Security in Rupees	Cost (Rs.)	PEC Category with Codes
1	Construction of Warehouse,	499.812	3% of Quoted Amount	Rs.7000/-	Valid PEC License in Category C-1 & above, along with the fields of specialization codes CE-01, CE-09, CE-10, CE-11(iv), EE-01, EE-02, EE-04, EE-09, EE-10, EE-11 (General Electrical works only), BC-01, ME-02, ME-05,

1. Schedule shall be as follows:

Issuance of Tender	Submission Date & Time	Opening Date & Time	VENUE
From: 10 October, 2023 Upto: 28 October, 2023	30 October, 2023 at 11.00 am	30 October, 2023 at 11.30 am	Office of the Director Planning & Development, Dow University of Health Sciences, 5th Floor, Baba-e-Urdu Road, Karachi.

2. Eligibility / Mandatory

- Valid Registration Certificate upto June 2024 and onwards with Pakistan Engineering Councils in relevant category and specialized codes as mentioned against each work.

At least one similar nature i.e. Building work having minimum cost of **80%** of the estimate cost of the work or at least two similar nature i.e. Building works each having minimum cost **50%** of the estimated cost for last five years duly supported with Proof of assignments shall be subject to submission of purchase order, contract award, contract agreement, advance acceptance letter, satisfactory performance certificate completion certificate which shall be treated as a mandatory requirement, failing which the project shall not be considered for evaluation.

- Bio data of Engineering and Technical staff working with the firm as required and mentioned in bidding documents.
- Average Annual turnover at-least not less than equivalent cost of the scheme / project during last three years (turnover will be evaluated from annual Audit Reports).
- Annual audited Reports from (ICAP/ICMAP) registered audited firm, audit reports issued other than (ICAP/ICMAP) registered audit firms will not be accepted.
- List of machinery and equipment available with documentary evidence of its ownership/ rented.
- Bank Statement must be provided for the last three years for each year separately with Bank's Manager Sign and Seal.
- Registration with Income Tax Department (NTN certificates) with active status Federal Board of Revenue.
- Annual Income Tax Returns of last three years must be provided.
- Valid Registration Certificate of Sindh Revenue Board Government of Sindh (SRB) certificate (with Active Status).
- The Bidders must be accompanied by an original Bid Security (amount mentioned) in the form of a Pay Order / Demand Draft, Call Deposit or a Bank Guarantee issued by a scheduled Bank in favour of **Dow University of Health Sciences.**
- Electric inspector valid license of Karachi Region must be provided.
- Undertaking on stamp paper (duly attested by Notary Public / Oath Commissioner) that the firm is not involved in any litigation, Department rift, in the Government Department.
- Affidavit (duly attested by Notary Public / Oath Commissioner) that firm has not been blacklisted by any Local, Provincial & Federal Government.
- Bidder must have 15% tender bidding amount should be show in bank' Closing Balance at least one day before submission date (Mandatory).

- The bidders must quote the rate in figures with maximum two decimals placing only third decimal place shall not be considered.
- Complete set of Bidding Documents including Tender Documents should be submitted in One Original Set and One Photo Copy Set, must be stamped and signed by the owner / representative of each page.

3. Method of Procurement (Signal Stage Two Envelops).

4. Terms & Conditions

1. The tender documents will be issued to the firms on submission of application in their original letter head along with Pay Order from any schedule bank in the favour of **Dow University of Health Sciences** for tender cost as mentioned above. In other case the tender documents can be downloaded from **DUHS** and **SPPRA / PPMS** website & can be dropped on the given date & time place in this NIT along with a pay order of tender cost as mentioned above otherwise tender will be rejected.
2. The tenders in sealed covers mentioning name of work and submit their proposals in two separate envelopes clearly marked as **“Technical Proposal”** and **“Financial Proposal”** Offer should be dropped in the tender box kept at the place and time mentioned above.
3. Initially, the technical proposals will be opened by the Tender Opening Committee on the date and time mentioned above, whereas the financial proposal will be retained with **Dow University of Health Sciences** till evaluation of the technical proposals.
4. The technical proposals submitted by the bidders will be evaluated by Procurement Committee as per evaluation criteria and mandatory requirements given in the Technical Proposal and thereafter financial proposals of technically qualified bids will be opened by the same Committee on the date and time to be communicated to the bidders.
5. The financial proposals of the bids found technically non-responsive shall be returned unopened to the respective bidders.
6. In case the date of opening or last date of sale is declared as a public holiday by the Government or non-working day due to any reason, the next working day shall be deemed to be the date for last date of sale and submission and opening of tenders accordingly. The time and venue shall remain the same.
7. The competent authority reserves the right to reject any or all proposals subject to the relevant provision of **SPPRA Rules**.
8. Canvassing in connection with tendering is strictly prohibited and proposals submitted by the contractors who are reported to be involved in canvassing are liable for rejection.
9. The proposals received in unsealed covers will be entertained and no proposal will be received after schedule data and time.
10. The participants must be quoted the rates in figures with maximum two decimal placing only, third decimal place shall not be considered.

DIRECTOR
Planning & Development
Dow University of Health Sciences

INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS

A. GENERAL

IB.1 Scope of Bid

- 1.1 Procuring agency as defined in the bidding data hereinafter called “the procuring agency” wishes to receive bids for the construction and completion of works as described in these bidding documents, and summarized in the bidding data hereinafter referred to as the “Works”.
- 1.2 The successful bidder will be expected to complete the works within the time specified in Appendix-A to Bid.

IB.2 Source of Funds

- 2.1 Procuring agency has received funds from the source (University Development Funds of **Dow University Health Sciences** in **PKR** currency towards the cost of the project /scheme specified in the bidding data, and it is intended that part of the proceeds of this funds 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 interested bidders who are eligible under provisions of Sindh Public Procurement Rules as mentioned below and the criteria given in the Notice Inviting Tender (NIT)/ Bidding Document.

Firms and individuals, national or international, may be allowed to bid for any project where international competitive bidding is feasible. Any conditions for participation shall be limited to those that are essential to ensure the bidder's capability to fulfill the contract in question.

Bidders may be excluded if;

- (i) as a matter of law or official regulations, commercial relations are prohibited with the bidder's country by the federal government in case of ICB, or
- (ii) a firm is blacklisted/ debarred by the procuring agency and the matter has been reported to the Authority, subject to Rule 30 of Sindh Public Procurement Rules 2010.

- a. Government-owned enterprises or institutions may participate only if they can establish that they are;
 - (a) legally and financially autonomous, and
 - (b) operate under commercial law.

Provided that where government-owned universities or research centers in the country are of a unique and exceptional nature, and their participation is critical to project implementation, they may be allowed to participate; and

Bidders shall include all those contractors who are registered or incorporated in Pakistan, irrespective of the nationality of their owners and professional staff, or

- c. Bidders are:-

pre-qualified with procuring agency for particular project/scheme;

registered with Pakistan Engineering Council in particular category and discipline,

registered with relevant tax authorities (income/sales tax, wherever applicable)

IB.4 One Bid per Bidder

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

IB.5 Cost of Bidding

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

IB.6 Site Visit

- 6.1 The bidders are advised to visit and examine the site of works and its surroundings and obtain all information that may be necessary for preparing the bid and entering into a contract for construction of the works. All cost in this respect shall be at the bidder's own expense.
- 6.2 The bidders and any of their personnel or agents will be granted permission by the procuring agency to enter upon his premises and lands for the purpose of such inspection, but only upon the express condition that the bidders, their personnel and agents, will release and indemnify the procuring agency, his personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of such inspection.

B. BIDDING DOCUMENTS

IB.7 Contents of Bidding Documents (SSP RULE 21)

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

- a. Instructions to Bidders.
- b. Bidding Data.
- c. General Conditions of Contract, Part-I (GCC).
- d. Special Conditions of Contract, Part-II (SCC)
- e. Specifications.
- f. Form of Bid and Appendices to Bid.
- g. Bill of Quantities (Appendix-D to Bid).
- h. Form of Bid Security.
- i. Form of Contract Agreement.
- j. Forms of Performance Security, Mobilization Advance Guarantee, Integrity Pact and Indenture bond for secured advance.
- k. 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 BD will be rejected.

IB.8 Clarification of Bidding Documents (SSP RULE 23(1)):

Any interested bidder requiring any clarification(s) in respect of the bidding documents may notify the procuring agency in writing at the procuring agency's address indicated in the Invitation for Bids/NIT. Procuring agency will respond to any request for clarification provided they are received at least five calendar days prior to the date of opening of bid.

Provided that any clarification in response to query by any bidder; shall be communicated to all parties who have obtained bidding documents.

IB.9 Addendum/Modification of Bidding Documents:

9.1 At any time prior to the deadline for submission of bids, the procuring agency may, for any reason, whether at his own initiative or in response to a clarification requested by a interested bidder, modify the bidding documents by issuing addendum.

9.2 Any addendum thus issued shall be part of the bidding documents pursuant to sub-clause IB 7.1 hereof and shall be communicated in writing to all bidders. Interested bidders shall acknowledge receipt of each addendum in writing to the procuring agency.

9.3 To afford bidders reasonable time in which to take an addendum into account in preparing their bids, the procuring agency may extend the deadline for submission of bids in accordance with IB.20

C. PREPARATION OF BIDS

IB.10 Language of Bid

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

IB.11 Documents Accompanying the Bid

- 11.1 Each bidder shall:

- a. submit a written authorization on the letterhead of the bidding firm, 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 following two 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 joint venture of two (2) or more firms shall comply with the following requirements:

- a. 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;
- b. the bid, and in case of a successful bid, the Form of Contract Agreement shall be signed by the authorized partner so as to be legally binding on all partners;
- c. the partner-in-charge shall always be duly authorized to deal with the procuring agency regarding all matters related with and/or incidental to the execution of works as per the terms and Conditions of Contract and in this regard to incur any and all liabilities, receive instructions, give binding undertakings and receive payments on behalf of the joint venture;

- d. all partners of the joint venture shall at all times and under all circumstances be liable jointly and severally for the execution of the contract in accordance with the contract terms and a statement to this effect shall be included in the authorization mentioned under Sub-Para (a) above as well as in the Form of Bid and in the Form of Contract Agreement (in case of a successful bid);
- e. a copy of the agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly responsible for due performance of the contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partners without prior written consent of the procuring agency;
- f. Submission of an alternative Letter of Intent to execute a Joint Venture Agreement shall be mandatory.

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

IB.12 Bid Prices

12.1 Unless stated otherwise in the bidding documents, the contract shall be for the whole of the works as described in IB 1.1 hereof, based on the unit rates or prices submitted by the bidder or percentage quoted above or below on the rates of Composite Schedule of Rates (CSR), as the case may be.

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

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

Additional / reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 13.7 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 13.7 of GCC. The bidders shall furnish the prescribed information for the price adjustment formulae in Appendix-C to Bid, and shall submit with their bids such other supporting information as required under the said Clause. Adjustment in prices quoted by bidders shall be allowed as per Sub-Para 4(ii) of Section C of Instructions to bidders and bidding data.

IB.13 Currencies of Bid and Payment

- 13.1 The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the works supplied from outside the procuring agency's country (referred to as the "Foreign Currency Requirements") shall indicate the same in Appendix-B to Bid. The proportion of the bid price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the bidder's home country or, (ii) at the bidder's option, entirely in Pak rupees provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in the bid.
- 13.2 The rates of exchange to be used by the bidder for currency conversion shall be the selling rates published and authorized by the State Bank of Pakistan prevailing on the date, 07 (seven) 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 from the date of opening of bid specified in clause IB.23.
- 14.2 In exceptional circumstances, prior to expiry of the original, the procuring agency may request the bidders to extend the period of validity for a specified additional period, which shall not be for more than one third of the original period of bid validity. The request and the responses thereto, shall be made in writing. A bidder may refuse the request without the forfeiture of the bid security. In case, a bidder agreed to the request, shall not be required or permitted to modify the bid, but will be required to extend the validity of the 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 the bid, a bid security in the amount stipulated in the bidding data in Pak Rupees or an equivalent amount in a freely convertible currency.
- 15.2 The bid security shall be at the option of the bidder, in the form of deposit at call, Pay order or a CD-R/Call at deposit issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan in favour of the procuring agency, which should commensurate with the bid validity period. The CD-R/Call at deposit for bid security shall be acceptable in the manner as provided at Annexure BS-1
- 15.3 Any bid not accompanied by an acceptable bid security shall be rejected by the procuring agency as non-responsive.
- 15.4 Bid security shall be released to the unsuccessful bidders once the contract has been signed with the successful bidder or the validity period has expired.
- 15.5 The bid security of the successful bidder shall be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.

- 15.6 The bid security may be forfeited:
- a. if the bidder withdraws his bid except as provided in sub- clause IB 22.1;
 - b. if the bidder does not accept the correction of his bid price pursuant to sub- clause IB 27.2 hereof; or
 - c. In the case of successful bidder, if he fails within the specified time limit to:
 - furnish the required Performance Security; or
 - sign the Contract Agreement.

IB.16 Alternate Proposals/Bids

- 16.1 Each bidder shall submit only one bid either by himself, or as a member of a joint venture, until and unless they have been requested or permitted for alternative bid, then he has to purchase separate bidding documents and alternate bid shall be treated as separate bid.
- 16.2 Alternate proposals are allowed only for procurement of works where technical complexity is involved and more than one designs or technical solutions are being offered. Two stage two envelope bidding procedure will be appropriate when alternate proposal is required.
- 16.3 Alternate bid(s) shall contain (a) relevant design calculations; (b) technical specifications; (c) proposed construction methodology; and (d) any other relevant details / conditions, provided that the total sum entered on the Form of Bid shall be that which represents complete compliance with the bidding documents.

IB.17 Pre-Bid Meeting

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

IB.18 Format and Signing of Bid

- 18.1 Bidders are particularly directed that the amount entered on the Form of Bid shall be for performing the contract strictly in accordance with the bidding documents.
- 18.2 All appendices to bid are to be properly completed and signed.
- 18.3 Alteration is not to be made neither in the form of bid nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.
- 18.4 Each bidder shall prepare by filling out the forms without alterations and shall provide an original copy along with photocopies as per the requirement of the procuring agency specified in the bidding data. The original as well as copies of the document shall be clearly marked as "ORIGINAL" and „COPY", as the case may be. If there is any discrepancy between original and copy(ies) then the original shall prevail.
- 18.5 The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person(s) duly authorized to sign on behalf of the bidder pursuant to sub- clause IB 11.1(a) hereof. All pages of the bid shall be initialed and stamped by the person(s) signing the bid.
- 18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the procuring agency, or as are necessary to correct errors made by the bidder. Such corrections shall be initialed by the person(s) signing the bid.
- 18.7 Bidders shall indicate in the space provided in the Form of Bid their full and proper postal addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the contract is to be sent.
- 18.8 Bidders should retain a copy of the bidding documents as their file copy

D. SUBMISSION OF BIDS

IB.19 Sealing and Marking of Bids

- 19.1 Each bidder shall submit his bid as under:
- ORIGINAL and One COPY of the bid shall be separately sealed and put in separate envelopes and marked as such.
 - The envelopes containing the ORIGINAL and COPIES shall be put in one sealed envelope and addressed as given in sub – clause IB 19.2 hereof.
- 19.2 The inner and outer envelopes shall:
- be addressed to the procuring agency at the address provided in the bidding data;
 - bear the name and identification number of the contract as defined in the bidding data; and
 - Provide a warning not to open before the time and date for bid opening, as specified in the bidding data.

- 19.3 In addition to the identification required in sub- clause IB 19.2 hereof, the inner envelope shall indicate the name and postal address of the bidder to enable the bid to be returned unopened in case it is declared “late” pursuant to Clause IB.21
- 19.4 If the outer envelope is not sealed and marked as above, the procuring agency will assume no responsibility for the misplacement or premature opening of the Bid.

IB.20 Deadline for Submission of Bids

- 20.1
- (a) Bids must be received by the procuring agency at the address specified not later than the time and date stipulated in the bidding data,
 - (b) Bids with charges payable will not be accepted, nor will arrangements be undertaken to collect the bids from any delivery point other than that specified above. Bidders shall bear all expenses incurred in the preparation and delivery of bids. No claims shall be entertained for refund of such expenses,
 - (c) Where delivery of a bid is by mail and the bidder wishes to receive an acknowledgment of receipt of such bid, he shall make a request for such acknowledgment in a separate letter attached to but not included in the sealed bid package,
 - (d) Upon request, acknowledgment of receipt of bids will be provided to those making delivery in person or by messenger.
- 20.2 The Procuring Agency may, at its discretion, extend the deadline for submission of bids by issuing an amendment in accordance with IB 09. In such case, all rights and obligations of the procuring agency and the bidders shall remain the same as mentioned in the original deadline.

IB.21 Late Bids

- Any bid received by the procuring agency after the deadline for submission of bids prescribed in to clause IB 20 shall be returned unopened to such bidder.
- Delays in the mail, person in transit, or delivery of a bid to the wrong office shall not be accepted as an excuse for failure to deliver a bid at the proper place and time. It shall be the bidder’s responsibility to submit the bid in time.

IB.22 Modification, Substitution and Withdrawal of Bids

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

BID OPENING AND EVALUATION.

IB.23 Bid Opening

- 23.1 Procuring agency will open the bids, including withdrawals, substitution and modifications made pursuant to Clause IB.22, in the presence of bidders' representatives who choose to attend, at the time, date and location stipulated in the bidding data. The bidders or their representatives who are in attendance shall sign an attendance sheet.
- 23.2 Envelopes marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to clause IB.22 shall not be opened.
- 23.3 Procuring agency shall read aloud the name of the bidder, total bid price and price of any Alternate Proposal(s), if any, discounts, bid modifications, substitution and withdrawals, the presence or absence of bid security, and such other details as the procuring agency may consider appropriate, and total amount of each bid, and of any alternative bids if they have been requested or permitted, shall be read aloud and recorded when opened.
- 23.4 Procuring Agency shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with the sub-clause IB.23.3.

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

- 24.1 Information relating to the examination, clarification, evaluation and comparison of bid and recommendations for the award of a contract shall not be disclosed to bidders or any other person not officially concerned with such process before the announcement of bid evaluation report in accordance with the requirements of Rule 45, which states that Procuring agencies shall announce the results of bid evaluation in the form of a report giving reasons for acceptance or rejection of bids. The report shall be hoisted on website of authority and that of procuring agency if it website exists and intimated to all bidders at least seven (7) days prior to the award of contract. The announcement to all bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated. Any effort by a bidder to influence the procuring agency's processing of bids or award decisions may result in the rejection of such bidder's bid. Whereas, any bidder feeling aggrieved, may lodge a written complaint as per Rule 31; however mere fact of lodging a complaint shall not warrant suspension of the procurement process.

IB.25 Clarification of Bid (SPP Rule 43)

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

IB.26 Examination of Bids and Determination of Responsiveness

- 26.1 Prior to the detailed evaluation of bids, the procuring agency will determine whether the bidder fulfills all codal requirements of eligibility criteria given in the tender notice such as registration with tax authorities, registration with PEC (where applicable), turnover statement, experience statement, and any other condition mentioned in the NIT and bidding document. If the bidder does not fulfill any of these conditions, it shall not be evaluated further.
- 26.2 Once found to be fulfilling the eligibility criteria, as mentioned in sub- clause 26.1, the bids of eligible bidders will be evaluated for technical responsiveness as per specification and criteria given in the bidding documents. Technical and financial evaluations may be carried out in accordance with single stage-single one envelope, single stage-two envelopes, two stage or two stage-two envelopes bidding procedures, depending on the selection procedure adopted by the procuring agency.
- 26.3 A bid will be considered technically responsive if it (i) has been properly signed; (ii) is accompanied by the required bid security; and (iii) conforms to all the terms, conditions and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the procuring agency's rights or the bidder's obligations under the contract; or (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.
- 26.4 If a bid has major deviations to the commercial requirements and technical specifications will be considered technically non responsive. As a general rule, major deviations are those that if accepted, would not fulfill the purposes for which the bid is requested, or would prevent a fair comparison or affect the ranking of the bids that are compliant with the bidding documents.

(a) Major (material) Deviations include:-

- has been not properly signed;
- is not accompanied by the bid security of required amount and manner;
- stipulating price adjustment when fixed price bids were called for;
- failing to respond to specifications;
- failing to comply with Mile-stones/Critical dates provided in Bidding Documents;
- sub-contracting contrary to the Conditions of Contract specified in Bidding Documents;
- refusing to bear important responsibilities and liabilities allocated in the Bidding Documents, such as performance guarantees and insurance coverage;
- taking exception to critical provisions such as applicable law, taxes and duties and dispute resolution procedures;
- a material deviation or reservation is one :
 - which affect in any substantial way the scope, quality or performance of the works;
 - Adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

(b) Minor Deviations

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

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

IB.27 Correction of Errors before Financial Evaluation

27.1 Bids determined to be substantially responsive will be checked by the procuring agency for any arithmetic errors. Errors will be corrected by the procuring agency as follows:

- where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; and
- where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern, unless in the opinion of the procuring agency there is an obviously gross misplacement of the decimal point in the unit rate, in which case the line item total as quoted will govern and the unit rate will be corrected.

27.2 The amount stated in the Form of Bid will be adjusted by the procuring agency in accordance with the above procedure for the correction of errors and with the concurrence of the bidders. The amount thus corrected shall be considered as binding upon the bidder. If the bidder does not accept the corrected bid price, his bid will be rejected, and the bid security shall be forfeited in accordance with sub-clause IB 15.6(b) hereof.

IB.28 Financial Evaluation and Comparison of Bids

28.1 The procuring agency will evaluate and compare only the Bids determined to be substantially responsive in accordance with clause IB 26.

28.2 In evaluating the Bids, the procuring agency will determine for each bid the evaluated bid price by adjusting the bid price as follows:

- making any correction for errors pursuant to clause IB 27;
- excluding provisional sums (if any), for contingencies in the Summary Bill of Quantities, but including competitively priced Day work; and
- Making an appropriate adjustment for any other acceptable variation or deviation.

28.3 The estimated effect of the price adjustment provisions of the conditions of contract, applied over the period of execution of the contract, shall not be taken into account in bid evaluation.

- 28.4 If the bid of the successful bidder is seriously unbalanced in relation to the procuring agency's estimate of the cost of work to be performed under the contract, the procuring agency may require the bidder to produce detailed price analyses for any or all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the procuring agency may require that the amount of the Performance Security set forth in clause IB.32 be increased at the expense of the successful bidder to a level sufficient to protect the procuring agency against financial loss in the event of default of the successful bidder under the contract.
- 28.5 Bidders may be excluded if involved in **“Corrupt and Fraudulent Practices”** means either one or any combination of the practices given below SPP Rule 2(q);
- a. **“Coercive Practice”** means any impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence the actions of a party to achieve a wrongful gain or to cause a wrongful loss to another party;
 - b. **“Collusive Practice”** means any arrangement between two or more parties to the procurement process or contract execution, designed to achieve with or without the knowledge of the procuring agency to establish prices at artificial, non-competitive levels for any wrongful gain;
 - c. **“Corrupt Practice”** means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence the acts of another party for wrongful gain;
 - d. **“Fraudulent Practice”** means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;
 - e. **“Obstructive Practice”** means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in a procurement process, or affect the execution of a contract or deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements before investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or acts intended to materially impede the exercise of inspection and audit rights provided for under the Rules.

28.6 Evaluation Report (SPP Rule 45)

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

F. AWARD OF CONTRACT

IB.29 Award (SPP Rule 49)

- 29.1 Subject to clauses IB 30 and IB 34 and provision of the rule: The procuring agency shall 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, but not necessarily the lowest submitted price, within the original or extended period of bid validity. Provided that such bidder has been determined to be eligible in accordance with the provisions of clause IB 03 and qualify pursuant to sub-clause IB 29.2.
- 29.2 Procuring agency, at any stage of the bid evaluation, having credible reasons for or having prima facie evidence of any deficiency (ies) in contractor's capacities, may require the contractor to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not for the said project.

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

IB.30 Procuring Agency's Right to reject all Bids or Annul/Cancellation the Bidding Process (SPP Rule 25)

Notwithstanding clause IB 29 and provision of the rule: (1) A procuring agency reserves may cancel the bidding process at any time prior to the acceptance of a bid or proposal; (2) The procuring agency shall incur no liability towards bidders solely by virtue of its invoking sub-rule (1); (3) Intimation of the cancellation of bidding process shall be given promptly to all bidders and bid security shall be returned along with such intimation; (4) The procuring agency shall, upon request by any of the bidders, communicate to such bidder, grounds for cancellation of the bidding process, but is not required to justify such grounds.

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

- 31.1 Prior to expiry of the period of bid validity, including extension, prescribed by the procuring agency, the procuring agency shall notify the successful bidder in writing ("Letter of Acceptance") that his bid has been accepted. This letter shall mention the sum which the procuring agency will pay to the contractor in consideration of the execution and completion of the works by the contractor as prescribed by the contract (hereinafter and in the conditions of contract called the "Contract Price").
- 31.2 No negotiation with the bidder having evaluated as lowest responsive or any other bidder shall be permitted, however, procuring agency may hold meetings to clarify any item in the bid evaluation report.
- 31.3 The notification of award and its acceptance by the bidder will constitute the formation of the contract, binding the procuring agency and the bidder till signing of the formal Contract Agreement.
- 31.4 Upon furnishing by the successful bidder of a Performance Security and signing of the contract, the procuring agency will promptly notify the name of the successful bidder to all bidders and return their bid securities accordingly.

31.5 Within seven days of the award of contract, procuring agency shall publish on the website of the Authority and on its own website, if such a website exists, the results of the bidding process, identify the bid through procurement identifying numbers, and the following information:

- Evaluation Report;
- Form of Contract and letter of Award;
- Bill of Quantities or Schedule of Requirement.

31.6 Debriefing (SPP Rule 51).

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

IB.32 Performance Security (SPP Rule 39)

32.1 The successful bidder shall furnish to the procuring agency a Performance Security in the form of pay order or demand draft or Call deposit, and the amount stipulated in the bidding data and the Conditions of Contract within a period of 28 days after the receipt of Letter of Acceptance.

32.2 Failure of the successful bidder to comply with the requirements of Sub-clause IB.32.1 or clauses IB 33 or IB 35 shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security.

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

IB.33 Signing of Contract Agreement (SPP Rule 39)

33.1 Within 14 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the procuring agency will send the successful bidder the Contract Agreement in the form provided in the bidding documents, incorporating all agreements between the parties.

33.2 The formal Agreement between the procuring agency and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the successful bidder from the procuring agency.

33.3 A procurement contract shall come into force when the procuring agency requires signs contract, the date on which the signatures of both the procuring agency and the successful bidder are affixed to the written contract. Such affixing of signatures shall take place within the time prescribed in the bidding documents.

Provided that the procuring agency may reduce the maximum time limit for signing of contract, as and when required, and shall be mentioned in the bidding documents.

33.4 Stamp Duty.

The formal Agreement between the Procuring Agency and the successful bidder shall be duly stamped at rate of 0.35% of bid price (updated from time to time) stated in Letter of Acceptance

IB.34 General Performance of the Bidders

Procuring agency may in case of consistent poor performance of the contractor and his failure to remedy the underperforming contract may take such action as may be deemed appropriate under the circumstances of the case including the rescinding the contract and/or black listing of such contractor and debarring him from participation in future bidding process.

IB.35 Integrity Pact (SPP Rule 89)

The bidder shall sign and stamp the Integrity Pact provided at Appendix-L to the bidding documents for all Provincial/Local Government procurement contracts exceeding Rupees ten million. Failure to provide such Integrity Pact shall make the bidder non-responsive.

IB.36 Instructions not Part of Contract

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

IB.37 Arbitration (SPP Rule 34)

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

BIDDING DATA

Contact/Bidding Data

Instructions to Bidders

Clause Reference

1.1 Name and address of the procuring agency:

Office of Project Director Planning & Development, Dow University Of Health Sciences, Baba-e-Urdu Road, besides Civil Hospital, Karachi.

1.2 Name of the Project and Summary of the works:

Name of Project:

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS, DUHS, KARACHI

Name of Work:

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS, DUHS, KARACHI

1.2 **The successful bidder will be expected to complete the works within the time specified in Special Stipulations (Appendix-A).**

2.1 Name of the Funding Source;

Funds provided by the Dow University of Health Sciences, Karachi.

2.1 Amount and Type of Financing/Scheme Cost and Allocated Funds.

Allocation for 2023-24 & 24-25 Pak Rs. 499.812 million

Add following IB Clause 3.2

3.2 Qualification of Bidder

To be qualified for award of the Contract, bidders shall provide evidence satisfactory to the Procuring Agency of their capability and adequacy of resources to carry out the Contract effectively. Bids shall include the following documentation and information on the relevant Forms provided in Appendix M to Bid.

- Copies of original documents defining the constitution or legal status, place of registration and principal place of business; written power of attorney of the signatory of the Bid to commit the bidder.
- total annual turnover in the civil works construction business expressed as total of payment certificates for works performed in each of the last three year;

- performance as prime contractor, management contractor, or proportionately as member of a joint venture or subcontractor, on works of similar nature and complexity over the last five years, and details of other work in hand and contractual commitments.
- major items of Contractor's Equipment proposed for carrying out the Contract;
- the qualifications and experience of key personnel for administration and execution of the Contract, both on and off site;
- any proposals for subcontracting elements of the Works such that the total of subcontracting should not be more than 30 percent of the Bid Price;
- Report on the financial standing of the bidders including profit and loss statements / Bank Statements must be provided for the last three years for each year separately with Bank's Manager Sign and Seal.
- Balance sheets of auditor's reports for the past five years, and an estimated financial projection for the next two years;
- Information regarding any litigation or arbitration resulting from contracts executed by the bidder in the last five years or currently under execution. The information shall include the names of the parties concerned, the disputed amount, cause of litigation, and matter in dispute;
- information regarding historic nonperformance and black listing of the bidder by government, semi government, autonomous bodies, private parties; and
- Proposal of work methods and program, in sufficient detail to demonstrate the adequacy of the bidder's proposals to meet the technical specifications and the completion time referred to in Appendix A to bid.

Bid submitted by a joint venture of two or more firms as partners shall comply with the following requirements:

- the Bid shall include all the information listed in Sub-Clauses 3.2 (a) to (e) and (g) to (k) above for each joint venture partner and 3.2 (f) and (l) for the joint venture;
- the Bid, and in case of a successful Bid, the Form of Agreement shall be signed so as to be legally binding on all partners;
- one of the 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 partners;
- the partner in charge shall be authorized to incur liabilities and receive instruction for and on behalf of any and all partners of the joint venture, and the entire execution of the Contract, including payment, shall be done exclusively with the partner in charge;
- all partner of the joint venture shall 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 © above, as well as in the Form of Bid and in the Form of Agreement (in case of a successful Bid); and
- a copy of the Joint Venture Agreement entered into by all partners shall be submitted with the bid. 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.

For the purposes of this particular Contract, bidders shall meet the minimum qualifying criteria set forth at the end of Bidding Data.

The figures for each of the partners of a joint venture shall be added together to determine the bidder's compliance with the minimum qualifying criteria set out in this Sub-Clause 3.2 above and in Evaluation & Qualification Criteria.

The qualifications, capacity, and resources of proposal subcontractors will not be taken into account in assessing those of individual or joint venture bidders, unless they are named specialist subcontractors and the scope of their specialized participation in the Works is clearly defined in the bid.

Refer Evaluation & Qualification Criteria provided at the end of Bidding Data. To establish its qualifications to perform the Contract in accordance with Evaluation and Qualification Criteria the Bidder shall provide the information requested in the corresponding information forms included in Appendix M along with information required in this Sub-Clause 3.2.

8.1 Time limit for clarification:

The written clarification should reach the addressee of the NIT on any working day but not later than 5 working days prior to last date of bid submission.

10.1 Bid language:

Bid language is English

Delete whole Clause 11 and replace with following:

11.1 The Bidder shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the documents listed in Clause 11.1a and the other the Price Bid containing the documents listed in Clause 11.1b, both envelopes enclosed together in an outer single envelop.

11.1a The Technical Bid shall comprise the following:

- Form of Technical Bid
- Appendices to Bid except Appendix D and Appendix J.
- Bid Security in accordance with Clause 15;
- Alternative bids, if permissible, in accordance with Clause 16;
- Written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with Clause 18;
- Documentary evidence in accordance with Clause 3.2 establishing the Bidder's qualifications to perform the contract;
- 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 in Appendices, in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion.

11.1b The Price Bid shall comprise the following:

- Form of Price Bid
- Completed Price Bill of Quantities (Appendix D), in accordance with Clause 11.1c and Clause 12,

11.1c The Forms of Technical Bid and Price Bid, and all documents listed under Clause 11.1a and 11.1b, shall be prepared using the relevant form furnished in Appendix D to M. The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.

13.1 Bidders to quote entirely in Pak. Rupee

The currency of Bid is Pakistan Rupee (PKR). All payment will be made in PKR only.

13.2 **IB Clause 13.2 is not applicable**

14.1 Period of Bid Validity:

Period of Bid Validity shall be 90 days

15.1 Amount of Bid Security:

The amount of the Bid Security mentioned in NIT (must be attached with Technical Proposal).

16.1 Alternate Proposals/Bid

Alternative bids is not permitted, Alternative times for completion is not permitted, Alternative technical solutions is not permitted for any part of the Works

17.1 Venue, time, and date of the pre-Bid meeting:

Office of the Director Planning & Development, Dow University of Health Sciences, 5th Floor, Baba-e-Urdu Road, Karachi.

Date: (in case of any quarry will be informed 3 days prior in writing)

Delete Sub-Clause 18.1 and 18.2 and replace with following:

18.1 The Bidder shall prepare one original of the Technical Bid and one original of the Price Bid comprising the Bid as described in IB Clause 11 and clearly mark it "ORIGINAL - TECHNICAL BID" and "ORIGINAL - PRICE BID".

18.2 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 below 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 un-amended printed literature, shall be signed or initialed by the person signing the bid.

The written confirmation of authorization to sign on behalf of the Bidder shall consist of:

- a. Power of Attorney on Judicial Paper duly attested by Notary Public; and
- b. Bids submitted by an existing or intended JV; shall include an undertaking signed by all parties (i) stating that all parties shall be jointly and severally liable, and (ii) nominating a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.

18.4 Number of copies of the bid to be completed and returned:
Original + One Copy

Delete Sub-Clause 19.1 and replace with following:

19.1 Bidders may always submit their bids by mail or by hand. Procedures for submission, sealing and marking are as follows:

Bidders submitting bids by mail or by hand shall enclose the original of the Technical Bid, the original of the Price Bid, and each copy of the Technical Bid and each copy of the Price Bid, in separate sealed envelopes, duly marking the envelopes as “ORIGINAL – TECHNICAL BID”, “ORIGINAL – PRICE BID” and “COPY NO.. – TECHNICAL BID” and “COPY NO.... – PRICE BID”. These envelopes, the first containing the originals and the others containing copies, shall then be enclosed in one single envelope per set.

19.2 (a) Procuring Agency's address for the purpose of bid submission:

**Director Planning & Development, Dow University of Health Sciences,
Baba-E-Urdu Road, Besides Civil Hospital, Karachi.**

Name and Identification Number of the Contract:

Construction of Warehouse, At Ojha Campus, DUHS, Karachi

20.1 (a) Deadline for submission of bids:

Date: As per Invitation for Bid

Time: As per Invitation for Bid

Venue, time, and date of bid opening:

Venue: As per Invitation of Bid

**Date: As per Invitation for
Bid Time as per Invitation
for Bid**

Delete Sub-Clause 23.1 and replace with following:

23.1 The Procuring Agency shall open the Technical Bids in public at the address, date and time specified in the Invitation for bids in the presence of Bidders designated representative and anyone who choose to attend. The Price Bids will remain unopened and will be held in custody of the Procuring Agency until the specified time of their opening.

Delete Sub-Clause 23.3 and replace with following:

23.3 All other envelopes holding the Technical Bids shall be opened one at a time, and the following read out and recorded.

- a. the name of the Bidder;
- b. whether there is a modification or substitution;
- c. the presence of a Bid Security;
- d. any other details as the Procuring Agency may consider appropriate.

Only Technical Bids and alternative Technical Bids read out and recorded at bid opening shall be considered for evaluation. No Bid shall be rejected at the opening of Technical Bids except for late bids, in accordance with Clause 21.

Delete Sub-Clause 23.4 and replace with following:

23.4 At the end of the evaluation of the Technical Bids, the Procuring Agency will invite bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Procuring Agency. Bidders shall be given reasonable notice for the opening of Price Bids.

And following Sub-Clause 23.5 to 23.8

23.5 The Procuring Agency will notify Bidders in writing who have been rejected on the grounds of their Technical Bids being substantially non-responsive to the requirements of the Bidding Document and return their Price Bids unopened.

23.6 The Procuring Agency shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, in the presence of Bidders' representative who choose to attend at the address, date and time specified by the Procuring Agency. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance.

23.7 All envelopes containing Price Bids shall be opened one at a time and the following read out and recorded.

- a. the name of the Bidder;
- b. whether there is a modification or substitution;
- c. the Bid Prices, including any discounts and alternative offers if permitted; and
- d. any other details as the Procuring Agency may consider appropriate

Only Price Bids, discounts and alternative offers read out and recorded during the opening of Price Bids shall be considered for evaluation. No Bid shall be rejected at the opening of Price Bids.

- 23.8 The Procuring Agency shall prepare a record of the opening of Price Bids that shall include, as a minimum: the name of the Bidder, the Bid Price, any discounts, and alternative offers. The Bidders' representatives who are present shall be requested to sign the record.

Add following paragraph at the end of Sub-Clause 26.1

The Procuring Agency shall examine the Technical Bid to confirm that all documents and technical documentation requested in Clause 11 have been provided and to determine the completeness of each documents submitted.

The Procuring Agency shall confirm that the following documents and information have been provided in the Technical Bid. If any of these documents or information is missing, the offer shall be rejected.

- a. Letter of Technical Bid;
- b. Written confirmation of authorization to commit the Bidder;
- c. Bid Security, if applicable; and
- d. Technical Proposal in accordance with IB 11

26.2 Single Stage Two Envelope Bidding Procedure.

Add following paragraph at the end of Sub Clause 26.3

The Procuring Agency's determination of a Bid's responsiveness is to be based on the contents of the bid itself, as defined in IB 11.

A substantially responsive Technical Bid is one the meets the requirements of the Bidding Document without material deviation.

The Procuring Agency shall examine the technical aspects of the Bid submitted in accordance with IB 11, Technical Proposal, in particular, to confirm that all requirements of Works and Biding Documents have been met without any material deviation.

Add following at the end of Sub Clause 26.4

Provided that a bid is substantially responsive, the Procuring Agency may waive any non-conformity in the Bid that does not constitute a material deviation, reservation or omission.

Provided that a Technical Bid is substantially responsive, the Procuring Agency may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request m result in the rejection of its Bid.

Provided that a Technical Bid is substantially responsive, the Procuring Agency shall rectify nonmaterial nonconformities related to be Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in Evaluation and Qualification Criteria.

The Procuring Agency shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders meet the qualifying criteria specified in Evaluation and Qualification Criteria.

The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to Sub Clause 3.2. An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Procuring Agency shall return the unopened Price Bid to the Bidder.

28.4 **If the successful bidder failed to submit Performance Security of increased amount within fourteen (14) days of demand by the PA, his bid shall be cancelled and his bid security shall be forfeited.**

32.1 Standard form and amount of Performance Security acceptable to the procuring agency:

The performance security will be in the form of a "unconditional, irrevocable and acceptable Pay Order / Demand Draft, Call Deposit or a Bank Guarantee at deposit" in the amount mentioned in NIT acceptable to the Procuring Agency in the attached format.

32.3 Validity of performance security

The Performance Security shall be valid for a period 90 days after the date of issue of Performance certificate.

33.4 Stamp duty

The Contract will be executed on a non-judicial stamp paper of the value @ 0.35% of the contract value. The cost of the stamp duty shall be borne by the successful bidder.

[0.35% may vary depending upon the rules applicable at the time of signing the Contract]

**EVALUATION /
QUALIFICATION CRITERIA**

Evaluation/Qualification Criteria.

1.0 EVALUATION/QUALIFICATION CRITERIA: BASED ON PASS/FAIL SYSTEM

- 1.1 Bidders meeting the minimum requirements mentioned in para 1.2 besides other factors shall be considered for technical qualification. No compromise shall be made on relevant experience and Financial Capacity of the Bidders. Bidders shall not conceal any information in this request.

The Bidders not fulfilling / submitting the below requirements shall be considered as non-responsive and be declared technically non-qualified.

- i) Valid Registration Certificate upto June 2024 with Pakistan Engineering Council in relevant category and specialized codes as mentioned in NIT.
At least one similar nature i.e. Building work having minimum cost of **80%** of the estimate cost of the work or at least two similar nature i.e. Building works each having minimum cost **50%** of the estimated cost for last five years duly supported with Proof of assignments shall be subject to submission of purchase order, contract award, contract agreement, advance acceptance letter, satisfactory performance certificate completion certificate which shall be treated as a mandatory requirement, failing which the project shall not be considered for evaluation.
- ii) Bio data / CV of Engineering and Technical staff working with the firm as required and mentioned in bidding document.
- iii) Average Annual turnover at-least not less than equivalent cost of the scheme / project during last three years (turnover will be evaluated from annual Audit Reports).
- iv) Annual audited Reports from (ICAP/ICMAP) registered audited firm, audit reports issued other than (ICAP/ICMAP) registered audit firms will not be accepted.
- v) List of Machinery and equipment available with documentary evidence of its ownership/ rented.
- vi) Bank Statement must be provided for the last three years for each year separately with Bank's Manager Sign and Seal.
- vii) Registration with Income Tax Department (NTN certificates) with activates status with Federal Board of Revenue.
- viii) Annual Income Tax returns of last three years.
- ix) Valid Registration Certificate of Sindh Revenue Board Government of Sindh (SRB) certificate (with Active Status).
- x) Electric inspector valid license of Karachi Region must be provided.
- xi) Company must be a registered member with Chamber of Commerce & Industry
- xii) Complete set of Bidding Documents including Tender Documents should be submitted in One Original Set and One Photo Copy Set, must be stamped and signed by the owner / representative of each page.
- xiii) The Bidders must be accompanied by an original Bid Security (amount mentioned in NIT) in the form of a single Pay Order / Demand Draft, Call Deposit or a Bank Guarantee issued by a scheduled Bank in favour of **Dow University of Health Sciences**.
- xiv) Evaluation Criteria, sub-criteria, for the evaluation of Full Technical Proposals is based on quantification.

11.2 The following weightages as detailed in 3.1 will be used in the Evaluation of the Bids for technical qualification.

S.No.	Category	Maximum Points
1	Qualification of Firms At least one similar nature i.e. Building work having minimum cost of 80% of the estimate cost of the work or at least two similar nature i.e. Building works each having minimum cost 50% of the estimated cost for last five years duly supported with Proof of assignments shall be subject to submission of purchase order, contract award, contract agreement, advance acceptance letter, satisfactory performance certificate completion certificate which shall be treated as a mandatory requirement, failing which the project shall not be considered for evaluation.	40
2	Personnel	20
3	Equipment	20
4	Financial	20
	Total	100

NOTE: To technically qualify Bidders must obtain not less than the total specified minimum acceptable mandatory **70%** Marks out of **100%**, and each category 1 to 4 should not be less than **50%** marks. However, obtaining of minimum acceptable marks / points in category at S. No. 4 is mandatory; failing which the Bidder shall be considered technically failed and his financial bid shall be returned un-opened.

2.0 INSTRUCTIONS TO APPLICANT

2.1 Submission of Applications

2.1.1 The name and mailing address of the Bidder Firm shall be clearly marked on the left hand of envelop.

2.1.2 The firm must have a permanent office and permanent staff, having registered mail address and an e-mail address and preferably has its own web site & these can be inspected by the client as and when required.

Failure to demonstrate the permanency of the established office, may lead to the disqualification of the Bidder.

2.1.3 The Bidders must respond to all questions and provide complete information as advised in this document. Any lapses to provide essential information may result in disqualification of the Bidder.

2.1.4 The value of work done and other financial figures should preferably be expressed in Pak Rupee.

Qualification Criteria

2.2.1 General

Qualification will be based on the criteria given in succeeding paras regarding the Bidder's relevant experience, personnel and equipment capabilities, and financial position, as demonstrated by the Bidder's responses. Sub-contractor's experience and resources shall not be taken into account in determining the Bidder's compliance with the qualifying criteria.

2.2

2.2.2 Relevant Experience

The Bidder shall meet the following minimum criteria:-

- Successful experience as lead contractor in the execution of at least one projects of similar nature i.e. Building works and complexity comparable to the proposed contract (s) within the last five (05) years.

2.2.3 Personnel Capabilities

The Bidder must have in his employment suitably qualified personnel for last 12 months as regular employees to fill the following key management and specialist positions. The Bidder must submit the CVs of the below listed staff

Sr. No.	Position	Minimum Qualifications	Minimum Experience (Years)
1	Project Engineer (Civil)	Graduate Engineer registered with PEC	10
2	Site Engineer -(Civil)	Graduate Engineer registered with PEC	5
3	Quantity Surveyor	Diploma of Associate Engineer/ Certificate Course	5
4	Surveyor	Diploma of Associate Engineer/ Certificate Course	5
5	Site Supervisor (Electric Work)	Diploma of Associate Engineer/ Certificate Course	5

2.2.4 Equipment Capabilities

The Bidder should own, or have assured access to (through rented, lease, purchase agreement or other means), the following key items of 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 Bidder must provide lists of (1) equipment owned and (2) Equipment to be hired.

Sr. No	Equipment Type & Characteristics	Minimum Number Required
1	Excavator	1
2	Dumper	3
3	Tractor Blade	1
4	Plate Compactor	2
5	Concrete Vibrator	4
6	Generator Min 20KVA	2
7	Shovel / Loader	2
8	Transit Mixer	2
9	Concrete Mixture Machine & Lift Tower Machine	1
10	Shuttering with Folding (Steel Plates / Marine Ply)	20,000 Sft

2.2.5 Financial Position

The Bidder should demonstrate that he has access to, or has available liquid assets, un-encumbered real assets, lines of credit and other financial means sufficient to meet the construction cash flow for the execution of works. Bidder's commitments for other ongoing contracts shall also be considered.

The audited balance sheets for the last three years should demonstrate the soundness of the Bidders' financial position, showing long term profitability and should submit Bank Letter confirming the current available credit line.

2.3 Joint Ventures (NOT Applicable)

DETAILED EVALUATION CRITERIA (Maximum 100 Points)

3.1.1 Qualification of Firm

		Points
3.1.1	i). At least one similar nature i.e. Building work having minimum cost of 80% of the estimate cost of the work or at least two similar nature i.e. Building works each having minimum cost 50% of the estimated cost for last five years duly supported with Proof of assignments shall be subject to submission of purchase order, contract award, contract agreement, advance acceptance letter, satisfactory performance certificate completion certificate which shall be treated as a mandatory requirement, failing which the project shall not be considered for evaluation. In case of Joint venture experience certificates require JV Agreement copy (Notary Public Attested) for calculating proportion of shares and marking according to shares of JV.	40

3.1.2 Key Personnel

Maximum (20 Points)

Sr. No	Position	Minimum Qualification	Minimum Experience (Years)	Points
1	Project Manager (Civil)	Graduate Engineer registered with PEC	10	8
2	Site Engineer (Civil)	Graduate Engineer registered with PEC	5	5
3	Material Engineer	BSc. Geology	5	3
4	Quantity Surveyor	Diploma of Associate Engineer/ Certificate Course	5	2
5	Surveyor	Diploma of Associate Engineer/ Certificate Course	5	2

3.1.2 Key Personnel

Maximum (20 Points)

Sr. No	Equipment Type & Characteristics (The Bidder must provide the list of Equipment owned by the Bidder along with the ownership documents, if the ownership documents are not provided the equipment shall be considered as hired / rental.)	Minimum Number Required	Point on Owner Ship	Point on Hiring
1	Excavator	1	2	1
2	Dumper	3	2	1
3	Tractor Blade	1	2	1
4	Plate Compactor	2	2	1
5	Concrete Vibrator	4	2	1
6	Generator Min 20KVA	2	2	1
7	Shovel / Loader	2	2	1
8	Transit Mixer	2	2	1
9	Concrete Mixture Machine & Lift Tower Machine	1	2	1
10	Shuttering with Folding (Steel Plates / Marine Ply)	30,000 Sft	2	1
	Total Points		20	10

3.1.4 Financial Capacity

Maximum 20 Points

1	Average annual turnover for the last five years	Points 10
a	Average Annual turnover at-least not less than equivalent cost of the scheme / project during last five years through Income Tax Returns & Audit Reports.	10
2	Available credit line (through Bank letter)	Points 10
a	At least equivalent to the estimated cost	10

Note: The Bidder must submit in original the Bank certificate mentioning the currently available credit line of the Bidder.

**FORM OF BID
AND
APPENDICES TO BID**

FORM OF TECHNICAL BID

Bid Reference No. _____

(Name of Contract/Work)

To:

1. Having examined the bidding documents including Instructions to Bidders, Bidding Data, and Conditions of Contract, Specifications, Drawings and Bill of Quantities and Addenda Nos. _____ for the execution of the above-named work, we/I, the undersigned, offer to execute and complete the work and remedy any defects therein in conformity with the Conditions of Contract, Specifications, Drawings, Bill of Quantities and Addenda for the sum of Rs. _____ (Rupees _____) or such other sum as may be ascertained in accordance with the said conditions.
2. We/I understand that all the Appendices attached hereto form part of this bid.
3. As security for due performance of the undertakings and obligations of this bid, we/I submit herewith a bid security in the amount of Rupees _____ (Rs. _____) drawn in your favour or made payable to procuring agency and valid for a period of _____ days beginning from the date, bid is opened.
4. We/I undertake, if our bid is accepted, to commence the works and to complete the whole of the works comprised in the contract within the time stated in Appendix-A to Bid.
5. We/I agree to abide by this bid for the period of _____ days from the date fixed for opening the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
6. Unless and until a formal Agreement is prepared and executed, this bid, together with your written acceptance thereof, shall constitute a binding contract between us.
7. We do hereby declare that the bid is made without any collusion, comparison of figures or arrangement with any other bidder for the works.
8. We understand that you are not bound to accept the lowest or any bid you may receive.
9. We undertake, if our/my bid is accepted, to execute the Performance Security referred to in Clause 10 of Conditions of Contract for the due performance of the Contract.

10. We confirm, if our bid is accepted, that all partners of the joint venture shall be liable jointly and severally for the execution of the Contract and the composition or the constitution of the joint venture shall not be altered without the prior consent of the procuring agency. (Please delete this in case of Bid form a single bidder)

in the capacity of _____ duly authorized to sign Bids for
and on behalf of _____ Dated this _____ day
of _____ 20 _____

Signature: _____

(Name of Bidder in Block Capitals) (Seal)

Address: _____

Witness:

Signature: _____

Name: _____

Address: _____

Occupation: _____

SPECIAL STIPULATIONS

Clause
Conditions of Contract

1.	Amount of Performance Security	4.2	Up to 10% of contract price. Total amount including performance security and retention money deducted from bills should not exceed 5% of contract price stated in the Letter of Acceptance.
2.	Time for Furnishing Programme	8.3	Within 42 days from the date of receipt of Letter of Acceptance.
3.	Minimum amount of Third Party Insurance	18.3	Rs. 150,000/- per occurrence with number of occurrences unlimited.
4.	Time for Commencement	8.1	Within 14 days from the date of receipt of Engineer's Notice to Commence, this shall be issued within fourteen (14) days after signing of Contract Agreement.
5.	Time for Completion (works & sections)	8.2 & 10.2	274 days from the date of receipt of Engineer's Notice to Commence.
6.	Amount of Liquidity Damages/Delay Damages/Penalties	8.7	That will not be more than 10% of contract price
7.	Defects Liability Period	11.1	365 days from the effective date of Taking Over Certificate.
8.	Percentage of Retention Money	14.2	5% of the amount of Interim/Running Payment Certificate.
9.	Limit of Retention Money	14.2	5% of Contract Price stated in the Letter of Acceptance.
10.	Minimum amount of Interim/Running Payment Certificates	14.2	Rs. 10% of the accepted Contract Amount
11.	Time of Payment from delivery of Engineer's Interim/Running Payment Certificate to the Procuring Agency.	14.7	30 days in case of local currency or 42 days in case of foreign funded projects.
12.	Mobilization Advance.	14.2	10% of Contract Price stated in the Letter of Acceptance.

FOREIGN CURRENCY REQUIREMENTS

The bidder may indicate herein below his requirements of foreign currency (if any), with reference to various inputs to the works.

Foreign Currency Requirement as percentage of the bid price excluding Provisional Sums _____%.

Table of Exchange Rates

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

PRICE ADJUSTMENT UNDER CLAUSE 13.8 OF CONDITIONS OF CONTRACT

A. Weight ages or coefficients are used for price adjustment.

The source of indices and the weightages or coefficients for use in the adjustment formula under Clause 13.8 shall be as follows:

Cost Element	Description	Weight ages	Applicable index
1	2	3	4
(i)	Fixed Portion	0.350	
(ii)	Local Labor		Government of Pakistan (GoP) 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	1.000	

Notes:

- Indices for “(ii)” to “(vii)” are taken from the Government of Pakistan Federal Bureau of Statistics, Monthly Statistical Bulletin. The base cost indices or prices shall be those applying 15 days prior to the latest day for submission of bids. Current indices or prices shall be those applying 28 days prior to the last day of the billing period.
- Any fluctuation in the indices or prices of materials other than those given above shall not be subject to adjustment of the Contract Price.
- Fixed portion shown here is for typical road project, procuring agency 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.

B. When Escalation is allowed on the materials only.

Price adjustment on following items shall be allowed:

Cost Element	Description	Base price	Applicable index
1	2	3	4
(i)	Cement – in bags		Government of Pakistan (GoP) Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin.
(ii)	Reinforcing Steel		
(iii)	Block		
(iv)	HSD		
	Total Four items.		

Notes:

1. The base prices shall be those applying 7 days prior to the latest day for submission of bids. Current indices or prices shall be those applying last 28 days prior to the last day of the billing period.
2. Any fluctuation in the prices of materials other than those given above shall not be subject to adjustment of the Contract Price.

BILL OF QUANTITIES

COST OF GRAND SUMMARY
“CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI”

S. No	DESCRIPTION	Amount
A.	CIVIL WORKS (SCHEDULE RATE)	
B.	PLUMBING WORKS (SCHEDULE RATE)	
C.	CIVIL WORKS (NON-SCHEDULE)	
D.	PLUMBING WORKS (NON-SCHEDULE)	
E.	ELECTRICAL WORKS (NON-SCHEDULE)	
F.	FIRE FIGHTING SYSTEM (NON-SCHEDULE)	
G.	STEEL STRUCTURE WORKS (NON-SCHEDULE)	
H.	VOICE & DATA COMMUNICATION (NON-SCHEDULE)	
J.	CCTV SYSTEM IP BASED (NON-SCHEDULE)	
K.	ADDRESSABLE FIRE ALARM SYSTEM (NON-SCHEDULE)	
M.	ACCESS CONTROL SYSTEM (NON-SCHEDULE)	
N.	ROAD WORKS (NON-SCHEDULE)	
	TOTAL AMOUNT RS.	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
A.	CIVIL WORKS (SCHEDULE)				
1.0	EXCAVATION / CUTTING				
1.1	Excavation in Shingle or gravel formation and rock not requiring blasting, undressed, lead upto 100 ft. (S.I. No. 4b, Ch-1, P-1)				
a)	From NGL/EGL (±) 0'-0" to -5'-0" ft depth	19,690.00	6,655.00	0% Cft	131,036.95
	AMOUNT				131,036.95
	PREMIUM ON SCHEDULE ITEMS @ () ABOVE/BELOW				
	TOTAL AMOUNT				
2.0	ANTI-TERMITE				
2.1	Providing Anti-termite treatment by spraying / sprinkling / spreading Neptachler 0.5% Emulsion as an overall pre construction treatment in slab type construction under the slab and along attache perches or entrances etc, complete as per directions of Engineer incharge. (S.I. No. 92, Ch-18, P-80)	32,670.00	9.74	P/Sft	318,205.80
	AMOUNT				318,205.80
	PREMIUM ON SCHEDULE ITEMS @ () ABOVE/BELOW				
	TOTAL AMOUNT				
3.0	SOLING WORKS				
3.1	Soling Course Rubble masonry hammer dressed (a) Dry masonry. (S.I. No. 4a, Ch-6, P-27)				
a)	8" Thick	21,790.89	14,019.50	% Cft	3,054,973.82
	AMOUNT				3,054,973.82
	PREMIUM ON SCHEDULE ITEMS @ () ABOVE/BELOW				
	TOTAL AMOUNT				
4.0	PLAIN CEMENT CONCRETE (P.C.C)				
a)	Cement concrete plain 1:4:8 including placing compacting, finishing and curing, complete (including screening and washing of stone aggregate without shuttering. (S.I. No. 5-i, Ch-4, P-16)	20,020.00	11,288.75	% Cft	2,260,007.75
b)	Providing and laying 1 : 3 : 6 cement concrete solid block masonry wall and below in thickness set in 1: 6 cement mortar in ground floor superstructure including raking out joints and curing etc. complete. (S.I. No. 24, Ch-4, P-19)	1,400.30	15,771.01	% Cft	220,841.45
	AMOUNT				2,480,849.20
	PREMIUM ON SCHEDULE ITEMS @ () ABOVE/BELOW				
	TOTAL AMOUNT				
5.0	DPC, BLOCK MASONRY, WIRE GUZE, DOOR FRAME & PLASTER				
5.1	Providing & laying 2" averagely thick 1:2:4 Damp Proof Course with S.R. cement complete etc. (S.I. No. 28b, Ch-4, P-19)				
a.	2" thick	3,850.00	3,912.85	% Sft	150,644.73
5.2	Providing and laying 1 : 3 : 6 cement concrete solid block masonry wall and below in thickness set in 1: 6 cement mortar in ground floor superstructure including raking out joints and curing etc. complete. (S.I. No. 24, Ch-4, P-19)				

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
a.	6" thick wall	5,129			
b.	4" thick wall	1,842.59			
	Total Qty	6,971.23	15,771.01	% Cft	1,099,433.07
5.3	Cement plaster 1:4 up to 12' height. 1/2" Thick (S.I. No. 11b-Ch-09, P-52)	23,730.08	2,283.00	% Sft.	541,758.00
5.4	Cement plaster 1:4 upto 12' height 3/8" Thick (S.I.No. 11a-Ch-09, P-52)	23,730.08	2,197.52	% Sft.	521,473.00
	AMOUNT				2,313,308.79
	PREMIUM ON SCHEDULE ITEMS @ (_____) ABOVE/BELOW				
	TOTAL AMOUNT				
6.0	EXTERNAL PLASTER WORKS				
6.1	Cement plaster 1:4 upto 12' height 3/4" Thick (External) (S.I.No. 11c-Ch-09, P-52)	7,866.54	3,015.76	% Sft.	237,236.00
	AMOUNT				237,236.00
	PREMIUM ON SCHEDULE ITEMS @ (_____) ABOVE/BELOW				
	TOTAL AMOUNT				
7.0	P.C.C SUB-FLOORING				
7.1	Providing and laying 3" thick topping cement concrete (1:2:4) including surface finishing and dividing into panels: (S.I.No. 16(d), Ch-07, P-42)	32,670.00	4,411.82	% Sft	1,441,341.59
	AMOUNT				1,441,341.59
	PREMIUM ON SCHEDULE ITEMS @ (_____) ABOVE/BELOW				
	TOTAL AMOUNT				
8.0	INTERNAL & EXTERNAL COLOURING WORKS				
a.	Preparing the surface and painting with matt finish i/c rubbing the surface with Bathy (silicon carbide rubbing brick) filling the voids with zink /chalk/ plaster of paris mixture. Applying first coat premix making the surface smooth and then painting 3 coats with matt finish of approved make etc: complete. (new surface) Three Coat (S.I.No. 36a+b, Ch-09, P-03)	32,145.96	3,444.38	% Sft	1,107,229.02
	AMOUNT				1,107,229.02
	PREMIUM ON SCHEDULE ITEMS @ (_____) ABOVE/BELOW				
	TOTAL AMOUNT				
	TOTAL COST OF SCHEDULE WORKS (CIVIL)				

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
B.	<u>PLUMBING WORKS (SCHEDULE)</u>				
A	<u>TOILET FITTINGS & ACCESSORIES</u>				
1	Providing and fixing orsia type white or colour glazed earthen ware w.c. pan with cost of low level plastic flush tank of 3 gallons capacity of approved quality i/c making requisite number of holes in wall. Plinth & floor & making good in cement concrete 1:2:4. (S.I. No. 3A-ii, Ch-1, Pg-2)	4	6,166.60	Each	24,666.40
2	Toilet Accessories Providing and fixing toilets room accessories including fixing with Rawal plug of approved quality complete in all respect.				
i)	Towel rail 36" long 3/4" dia round or square (Superior Quality) (S.I. N.o. 1-(i)-b, Ch-02, Pg-07)	12	1,412.95	Each	16,955.40
ii)	Soap Tray (S.I. N.o. 5, Ch-02, Pg-07)	20	497.20	Each	9,944.00
iii)	Toilet paper holder (S.I. N.o. 2-b, Ch-02, Pg-07) (Superior Quality)	12	1,071.40	Each	12,856.80
	AMOUNT				64,422.60
	PREMIUM ON SCHEDULE ITEMS @ (_____) ABOVE/BELOW				
	TOTAL AMOUNT				
	TOTAL COST OF SCHEDULE WORKS (PLUMBING)				

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
C.	<u>CIVIL WORKS (NON-SCHEDULE)</u>				
1.0	<u>EARTH WORKS</u>				
1.1	Providing, laying and spreading of backfill / earth fill / granular fill under floor / foundation etc.including dressing, leveling, compacting & back filling of suitable excavated or borrow material from approved outside sources including breaking clods, watering, consolidation by ramming in layers not exceeding 9 inches 229mm thickness in depth to full compaction to 95% ASSHTO dry density with all lead & lifts etc, complete in all respects as per drawing, standard , specifications and direction of the Engineer.				
a)	Earth filling / granular fill borrow Material from outside sources	132,000.00		/Cft	
2.0	<u>R.C.C WORKS</u>				
2.1	Providing and laying RCC cement concrete with approved equivalent (super plasticizer concrete admixture / retarder mix according to supplier instruction) where required using SRC /OPC & approved quarry of crushed stone 1 inch (25 mm) and down gauge and sand having preliminary cylindrical crushing strength at 28 days as below mentioned in all Rcc members including water tight form work and its removal, mechanically vibrating, leveling, compacting, construction joints and curing etc. but excluding the cost of reinforcement etc, complete in all respects as per drawing, standard , specifications and direction of the Engineer. (RA Attached)				
i.	Foundation of any type (3000 Psi)	2,937.00		/Cft	
ii.	Plinth Beam (3000 Psi)	2,904.00		/Cft	
iii.	Short Columns (4000 Psi)	1,716.00		/Cft	
iv.	S.O.G (3000 Psi)	16,335.00		/Cft	
2.2	Providing, supplying, straightening, cutting, bending, fabricating, placing and installing / binding in position etc., straight or curved deformed steel bar reinforcement having minimum yield strength 414 Mpa (60 ksi or 60,000 Psi), including cost of G.I binding wire 18SWG, chairs, wastages, precast c.c. spacers and welding where required to be followed ASTM A615 standard. Only those overlaps shall be paid which are according to the approved Bar Bending Schedule / shown on drawings or instructed by the Engineer, all kind of R.C.C. work etc, complete in all respects as per drawing, standard , specifications and direction of the Engineer. (Bars to be cut and placed in position at any level according to the Bar bending schedule prepared by the contractor and approved by the Engineer).	48.40		Ton	
2.3	Providing and applying industrial bitumen paint Coverage as per manufacture specs & recommendation mixed with water component 2 pure coats & 01 primer on all RCC structural surfaces up to plinth etc, complete in all respects as per drawing, standard, specifications and direction of the Engineer.	12,210.00		/Sft	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
3.0	<u>DOOR, WINDOW</u>				
3.1	Providing and fixing G.I frames / Choukhats for door using 16 gauge G.I sheet i/c welded hinges and fixing at site (size of frame to match the existing size) with necessary hold fasts, filling with cement sand slurry of ratio 1:4 painting with 3 coats of approved enamel paint over a coat of primer (at any floor & height) etc, complete in all respect as per drawing, standard , specifications and direction of the Engineer.				
i.	G.I Door frame 7-1/2"x 2"	574.20		/Rft	
ii	Door Lock (Round or Handle type) (Imported)	21.00		Nos.	
iii	12mm Tempered glass door	885.50		/Sft	
iv.	Providing & fixing 12mm thick glass partition over short height block masonry wall.	3,072.30		/Sft	
	<u>FINISHES</u>				
4.1	<i>Note: Expended metal to be provided and fixed on the joints between concrete & block masonry and at all cutting made for Electrical/AC. Conduiting.</i>				
4.2	<u>Epoxy Flooring with Skirting</u>				
	P/A Epoxy Coating 3 mm thick on Floor/walls or wherever required i/c applying priming coat, filling, rubbing smoothing & grinding with sand paper, complete as shown on the drawings i/c application of primer & preparation of surface to be painted complete as per drawings, specifications & as per instructions of Consultant / Engineer In-charge	32,670.00		/Sft	
4.3	<u>Porcelain Tile Flooring</u>				
	Provide and lay imported high grade matt,porcelain tile as specified size from Spanish /Italian or other approved equivalent quality for flooring and in ramps/ slopes, if required, with 1:4 cement sand mortar base of required thickness to achieve a minimum overall finished floor thickness of 2 1/2", or as per required setting the tiles with neat cement mortar, grouting the joints 1/4" wide with matching grout of approved supplier, including curing, cleaning, finishing & hacking/chipping of existing surface for bonding where necessary, (overall thickness as shown in the drawings) etc, complete in all respect as per drawing, standard , specifications and direction of the Engineer. (Basic price of tile shall be Rs. 3000.00 per sq.m.)				
a.	Porcelain Tile Size - 24" X 24"	15,290.00		/Sft	
b.	Bathroom Floor Tile Size - 12" X 12"	737.00		/Sft	
c.	Bathroom Wall Tile Size - 12" X 12"	1,797.00		/Sft	
4.4	<u>Color Crete Works</u>				
	Providing & fixing of color crete to wall surface to provide durable crust and aesthetics having thickness up to 1/2" with specified color hacing water, fire and temite resistance over the base of 1/2" thick cement plater ratio (1:4)	7,867.00		/Sft	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
5.0	<u>SUSPENDED CEILINGS</u>				
5.1	<u>Gypsum Tile Ceiling</u>				
	Providing and fixing suspended ceiling 1/2" thick from (Iqbal sons, Thermec or Protector of elephant brand) tapered edge Gypsum board tile sheet as per sample approved size 2' x 2' of equivalent in mm) moisture resistant false ceiling as shown on the drawing including aluminium metal framing suspension system, with groves, attachment devices, hangers, edge moldings, trim clips and trimming any extra hangers as required, including making provision for light fixtures, A/C diffusers, smoke detectors with providing & applying three cat of matt enamel paint of approved make & color shade including one coat of primer coat, filling putty etc, complete in all respect as per drawing, standard , specifications and direction of the Engineer	8,167.50		/Sft	
6.0	<u>MISCELLANEOUS ITEMS</u>				
6.1	Providing and fixing of M.S base plate with J-shape bolt and nuts etc complete. Size: 12" x 12"	122.10		Each	
6.2	Providing and fixing of mild steel stair railing with bluster 1-1/2" dia 16-Swg 3-feet long and 4-layer pipe 3/4" dia and top railing 2" dia, also welding with of top 1/2" thick checker plate steps, including synthetic enamel paint finish with all respect including plate form as per directed by engineer/required..	231.00		Sft	
6.3	Providing & fixing imported fixed door glass 12 mm thick with necessary frame channel of aluminum including floor machine and door closer as per instruction/approval of engineer In-charge.	885.50		Sft	
6.4	Providing & fixing imported fixed clear glass 12 mm thick with necessary frame channel of aluminum as per instruction/approval of engineer In-charge.	3,072.30		Sft	
TOTAL COST OF NON-SCHEDULE WORKS (CIVIL)					

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
D.	<u>PLUMBING WORKS (NON-SCHEDULE)</u>				
A	<u>TOILET FITTINGS & ACCESSORIES</u>				
1	Fixing European type water closet with coupled flushing cistern, including all accessories and fittings, CP. flexible pipe, including double seat and cover, tee stop cock with check nut, thimble, all joints to services and drains plugging and screwing as necessary to the structure. (P or S trap) (Dell, Master Sanitary, or approved equivalent)	6		Nos.	
2	Fixing wash basin vanity type with all accessories such as basin hot/cold mixer, tee stop cock with check nuts, CP. flexible pipe, uPVC waste concealed pipe, waste coupling bracket set, CP bottle trap and silicon sealant, all joint to service and drain, plugging and screwing as necessary to the structure etc. Complete in all respect. (Dell, Master Sanitary, or approved equivalent)	2		Nos.	
3	Fixing wash basin pedestal type with all accessories such as basin hot/cold mixer, tee stop cock with check nuts, CP. flexible pipe, uPVC waste pipe, waste coupling bracket set, all joint to service and drain, plugging and screwing as necessary to the structure etc. Complete in all respect. (Dell, Master Sanitary, or approved equivalent)	4		Nos.	
4	Fixing S.S. Kitchen sink, Pantry sink including all accessories such as hot/cold mixer, tee stop cock with checkouts, CP. flexible pipe, uPVC waste pipe, coupling bracket set, CP. bottle trap and all joints to service and drains plugging and screwing as necessary to the structure complete in all respect etc. (Casa Milano or approved equivalent)				
a)	Single bowl single drain	2		Nos.	
5	Fixing, testing & commissioning of water cooler set approved make including all fittings such as cold water filter System and drain, etc. complete in all respect.)	2		Nos.	
6	Toilet Accessories Providing and fixing toilets room accessories including fixing with Rawal plug of approved quality complete in all respect. (Master, Faisal or approved equivalent)				
i)	Hand Dryer	26		Nos.	
ii)	Double Bib cock with Muslim shower	6		Nos.	
iii)	Single Bib cock	20		Nos.	
iv)	Shower Head with Mixer & Accessories	88		Nos.	
v)	Roll in Shower with Mixer & Accessories (For Disabled)	11		Nos.	
vi)	Coat Hook	40		Nos.	
B	<u>WATER SUPPLY SYSTEM</u>				
	<u>Polypropylene Piping For Water Supply</u>				
	<u>Cold, Hot & Return Water Supply System</u>				
1	Providing & fixing, jointing, testing & commissioning of polypropylene pipes conforming to DIN 8077/8078 including specials fittings such as hanging system, sockets, tees, elbow, bends, reducers, plugs and union etc. supported on walls or buried in walls / floor or suspended from roof slab as per specification including color coding complete in all respect. (IIL, Dadex, Euro Gulf or approved equivalent)				

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS, DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
i)	3/4" dia (25mm)	500		RFT	
ii)	1" dia (32mm)	100		RFT	
iii)	1-1/4" dia (40mm)	150		RFT	
iv)	1-1/2" dia (50mm)	200		RFT	
v)	2" dia (63mm)	250		RFT	
vi)	2-1/2" dia (90mm)	100		RFT	
2	Providing and fixing of full way gate valves of bronze body with threaded ends with all additional accessories required for a complete installation as described in the as shown on drawings and as approved by the Engineer. (Scon, Kitz or approved equivalent)				
i)	3/4" dia	2		Nos.	
ii)	1" dia	4		Nos.	
iii)	1-1/4" dia	5		Nos.	
iv)	1-1/2" dia	3		Nos.	
v)	2" dia	4		Nos.	
vi)	2-1/2" dia	2		Nos.	
vii)	3" dia	2		Nos.	
3	Providing and fixing of full way gate valves of Cast Iron body with flanged ends with all additional accessories such as nuts, bolts, gasket, etc. required for a complete installation as described in the as shown on drawings and as approved by the Engineer. (Scon, Kitz or approved equivalent)				
i)	4" dia	3		Nos.	
ii)	6" dia	1		Nos.	
4	Providing, fixing, testing & commissioning water supply pump @ 200 gpm & 125 ft head with electric motor, control panel, wirings, discharge and suction piping, gate valve, check valve, foot valve, strainer, rubber bellow, level switches, and all other accessories required to complete the job. (KSB, wilo, xylem or approved equivalent)	1		Nos.	
5	Providing, fixing, testing & commissioning of hot water geyser including inlet/ outlet connections with valves, pressure relief valve automatic air vent etc. complete in all respects. (Nasgas, Super Asia or approved equivalent)				
a)	55 gal. Capacity	3		Nos.	
6	Providing & fixing jointing testing G.I. Pipe lines for exposed piping as per BS 1387 medium duty Including specials sockets tee, elbow, bend, reducer plug and union etc) supported on walls or suspended from roof slab, including protective coating as per drawing and specifications including color coding complete in all respects. (IIL or approved equivalent)				
i)	1-1/4" dia	80		RFT	
ii)	1-1/2" dia	170		RFT	
iii)	2" dia	100		RFT	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS, DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
C	<u>SOIL, WASTE, VENT & RAIN WATER SYSTEM</u>				
1	Providing and fixing in position uPVC pipes conforming to ASTM D1785 Schedule 40 and fittings conforming to ASTM D2466 or approved equivalent for soil, waste water & vent pipe as embedded in floor and wall or suspended from slab or clamped to wall including plugs, specials (bend, tees, Y-tee etc.) Making requisite number of holes in walls and floors where required and making good the same as necessary to the structure labeling testing to 6.5 Ft. water height complete. (Pak Arab, Steelex, Euro Gulf or approved equivalent)				
i)	3" dia	300		RFT	
ii)	4" dia	300		RFT	
iii)	6" dia	150		RFT	
2	Providing and fixing uPVC cowl for vent pipe of the following dia. including all accessories complete.				
i)	3" dia	10		Nos.	
ii)	4" dia	10		Nos.	
3	Providing and fixing Stainless Steel floor drain / Trap with uPVC P-Trap of approved design with S.S. grating & cover including requisite number of holes in floor for pipe connection and making good the same as necessary to the structure complete including gasket and clamp complete. (Master, Faisal or approved equivalent)				
i)	3" dia	15		Nos.	
4	Floor cleanout with brass cover of the following diameter of approved design with Brass cover including requisite number of holes in floor for pipe connection and making good the same as necessary to the structure complete including gasket and clamp complete. (Master, Faisal or approved equivalent)				
i)	3" dia	6		Nos.	
ii)	4" dia	9		Nos.	
5	Providing and fixing uPVC clean out plug of approved design complete.				
i)	3" dia	8		Nos.	
ii)	4" dia	6		Nos.	
D	<u>EXTERNAL SEWER & MANHOLES</u>				
1	Providing and fixing in position uPVC pipes conforming to BS 3505 Class 'B' or approved equivalent for external sewage including excavation, backfilling, sand bedding & encasement, pipe specials (bend, tees, Y-tee etc.) Making requisite number of holes where required and making good the same as necessary to the structure complete.				
i)	8" dia	300		RFT	
2	Construction of sewage & storm water manholes with materials as per drawings and as specified complete with cast iron cover & frame, inlet, outlet connection, including g all types of earth works, concrete works, steel works, complete.				
i)	24"X24" SIZE (cover 24" x 24")	18		Nos.	
ii)	30"X30" SIZE (cover 24" x 24")	8		Nos.	
3	Construction and installation of gully trap including C.I. Covers, frames, excavation, C.C. wall internal plaster inlet outlet connection pipe.				
i)	18"X18" SIZE (cover 12" x 12")	12		Nos.	
TOTAL COST OF NON-SCHEDULE WORKS (PLUMBING)					

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
E.	<u>ELECTRICAL WORKS (NON-SCHEDULE)</u>				
1	<u>WIRING</u>				
1.1	Wiring of light circuits from distribution board (DB) to point/switch including wiring between switches on the same circuit with 3(1x2.5 sq.mm) single core copper conductor PVC cable complete with appropriate size concealed PVC conduit and all accessories etc., complete in all respects (Length 175 Rft).	80		No.	
1.2	Wiring from light/exhaust fan point to switch with 3 (1x1.5 sq.mm) single core copper conductor PVC cable, complete with appropriate size concealed PVC conduit including ceiling rose, 10 Amps light control gang switch, sheet steel back box, 3 core flexible cable and all accessories etc., complete in all respects. (Length 75)	157		No.	
1.3	Same as above item 5.2 but wiring from point to point.	204		No.	
1.4	Wiring of 16A power socket outlet/13/16A international socket outlet/20A DP switch with following size single core, copper conductor, PVC cable complete with appropriate size PVC conduit and all accessories etc., complete in all respects.				
a)	From Distribution Board (DB) to outlet with 3 (1x4.0 sq.mm) cable length 175 Rft.	90		No.	
b)	From outlet to outlet with 3(1x4.0 sq.mm) cable.	60		No.	
2	<u>WIRING ACCESSORIES</u>				
2.1	16 Amp, 250 Volt, 2 pin + earth, power socket outlet with sheet steel back box and all accessories.	240		No.	
2.2	13/16 Amp, 250 Volt, international switch socket outlet with sheet steel back box and all accessories.	150		No.	
2.3	5-Gang switches with back box. (Clipsal/Schider or equivalent)	30		No.	
3	<u>CONDUITS & PIPES</u>				
3.1	Following sizes (Internal Diameter) of underground uPVC Class 'C' pipes including all accessories, pipe range spacers, pull rope, sand bed, excavation & selected backfilling from excavation, above ground pipe end marker on both ends of pipe, complete in all respects:				
a)	1 inch dia	5,000		Rft.	
b)	3/4 inch dia	750		Rft.	
4	<u>LIGHT FIXTURES AND FANS</u>				
4.1	Following LED/conventional lighting fixtures as per the lighting fixtures schedule shown on drawing installed on surface, recessed complete with all accessories such as LED, housing, heat sink, SPD, PSU, drivers, mounting brackets/ suspension systems, etc. as applicable, including all relevant installation material as required and approved by the Engineer:				
a)	Surface mounted batten light fixture body made of cold rolled steel (CRS) sheet, pretreated, painted and stove enameled in white color with 2x36w fluorescent lamp, along with accessories. (Philips or approved equivalent) including hanging rod.	150		No.	
b)	LED panel light fixture (600mm x600mm) with aluminium housing and steel fixation, polystyrene optic material cover, wide beam, atleast 4000lm, IP20 rated, 50,000 burning hours, 4000K color temperature. (Philips or approved equivalent)	97		No.	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
c)	LED flood light with aluminum die-cast housing, polycarbonate optical cover, symmetrical wide beam optics, luminary surge protection level until 15 KV, adjustable mounting bracket with steel fixation material, atleast 16100lm 500 hours salt spray tested ,IP-66 rated,4000k color temperature. (Philips or approved equivalent)	20		No.	
4.2	14" dia single phase 250 Volts Wall Bracket Louvre Fan including all mounting accessories as required complete in all respect.	16		No.	
4.3	Ceiling Mounted Circomatic Fan with copper winding	60		No.	
4.4	12" dia metal Exhaust fan with copper winding	8		No.	
4.5	48" sweep, single phase, 250V, ceiling fan including fan speed regulators / dimmers, fan hook and all mounting accessories, as required, complete in all respects including hanging rod.	16		No.	
4.6	56" sweep, single phase, 250V, ceiling fan including fan speed regulators / dimmers, fan hook and all mounting accessories, as required, complete in all respects including hanging rod.	70		No.	
5	<u>LT CABLES</u>				
5.1	Following sizes of single/multi core PVC insulated and PVC sheathed, armoured/unarmoured, copper conductor, 600/1000 Volts grade cables (Pakistan Cables or approved equivalent) in already installed surface mounted/concealed GI/PVC conduit or underground PVC pipe or in already excavated trenches or concrete trench or on cable trays, for power and miscellaneous wiring including all accessories:				
a)	4 core, 240 sq. mm. PVC/PVC/AWA/PVC	500		Rft.	
b)	4 core, 25 sq. mm. PVC/PVC	2,500		Rft.	
c)	4 core, 35 sq. mm. PVC/PVC	150		Rft.	
d)	1 core, 50 sq. mm. PVC/PVC	2,650		Rft.	
6	M.S. sheet cable tray of size 450 mm x 75 mm ladder type hot dip galvanized with high performance epoxy paint including cover, joints, bend, mounting brackets hanger complete with all accessories.	2,000		Rft.	
7	<u>L.T. SWITCHBOARD / DISTRIBUTION BOARDS</u>				
7.1	Following LT Switchboard / Distribution Boards, with ISO-12944, corrosivity category C4 medium durability paint (as per single line diagrams shown on drawings), recessed/surface/pedestal mounted including all accessories, related civil works etc. complete in all respects:				
a)	MDB-	1		Job.	
b)	LDB	8		Job.	
8.0	<u>EARTHING</u>				
8.1	19 mm dia, 3 meter long copper clad steel Rod type earth electrode including 1x70 sq.mm copper conductor PVC cable (Pakistan Cables or approved equivalent) as earthing lead, clamp with nuts and bolts, R.C.C. inspection chamber with medium duty C.I cover, excavation, backfilling, boring, and all accessories, etc., as shown on the drawings, complete in all respects.	7		Nos.	
TOTAL COST OF NON-SCHEDULE WORKS (ELECTRICAL)					

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,

DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
F.	<u>FIRE FIGHTING SYSTEM (NON-SCHEDULE).</u>				
1	HDP PIPES				
1/a	4" DIA HDPE PIPE PN16 SDR11	1,100		RFT	
1/b	EXCUVATION & BACK FILLING	6,600		CFT	
2	MS Seamless ASTM - A53 Grade B Schedule 40 Pipe				
i)	Size 4" dia	100		RFT	
ii)	Size 3" dia	60		RFT	
iii)	Size 2-1/2" dia	20		RFT	
iv)	Size 1-1/2" dia	120		RFT	
v)	Size 1" dia	20		RFT	
3/a	Single door Cabinet SS/MS Recess type size 800x800x300mm Piano hinge -1no, Round latch lock - 1no. Galvanised Steel & Powder Coated Red. Grade 304, Hairline 1.0mm Bristol, UAE	4		No	
3/b	1inch x 30m Automatic Semi-rigid Hose Reel (Bristol, BF-AS-002N, LPCB) with Nozzle and 1 inch Connection Ball Valve	4		No	
3/c	1" Pressure-Reducing Valve (Chrome Plated, Bristol, BFE06068)	4		No	
3/d	Lockshield Valve (1", Brass)	4		No	
4/a	Double Cabinet, consist of Two Compartment, SS/MS 1.00 mm 304 Hairline finish and back box 1.20 mm thick red finish and piano hinge with round latch lock 1600x800x350mm	3		No	
	UPPER SIDE				
4/b	1inch x 30m Automatic Semi-rigid Hose Reel (Bristol, BF-AS-002N, LPCB) with Nozzle and 1 inch Connection Ball Valve	3		No	
4/c	1" Pressure-Reducing Valve (Chrome Plated, Bristol, BFE06068)	3		No	
4/d	Lockshield Valve (1", Brass)	3		No	
	LOWER SIDE				
4/e	2 ½" x 30m Fire Hose (Red, Canvas, Single Jacket, Bristol, BF-SJ-002, UL) with 2 ½" Inst. Alum. Coupling	3		Length	
4/f	2 ½" F. NST Portable Spray Nozzle (280gpm @ 100psi, Bristol, BF65, UL) (with adaptor)	3		No	
4/g	2 ½ inch Pressure-Restricting Angle Valve (F.NPTxF.NPT, 175psi, Brass, Bristol, RA25F, UL Listed)	3		No	
4/h	Pin Rack for 2 ½" x 30m Lay-Flat Fire Hose	3		No	
4/i	Adapter (2 ½" M.NPT x 2 ½" F.Inst, Pin-Rack Connector, D=72.5mm)	3		No	
5/a	Single door Surface type 700x700x300mm Round hinge welded-2nos,Round latch lock- 1no. Galvanised Steel 1.0mm	5		No	
5/b	2 ½" x 30m Fire Hose (Red, Canvas, Single Jacket, Bristol, BF-SJ-002, UL) with 2 ½" Inst. Alum. Coupling	5		Length	
5/c	2 ½" Jet/Spray/Off - Fire Hose Nozzle (M. Inst., Branchpipe, Aluminum)	5		No	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
6	4" Flange Wet Barrel Pillar Hydrant (2 Threaded Hose Valve), BRISTOL, UAE	5		No	
7	DI Body OSY-Resilient Seated Gate Valve, 4" DI Wedge with EPDM Coated. SS304 Stem, With Handwheel. Flanged to ANSI125. WP:300PSI. Red Ral3000 FBE Coated UL/ULC/FM WEFLO Brand	3		No	
8/a	2-way x 4" Breeching Inlet (PN16 Flanged, 2 1/2" M. Inst. Inlets, Bristol, BFE-2WBI, BSI-Kitemark)	1		No	
8/b	2way BI Cabinet Surface/ Recess type, Wired glass 600x400x300mm Piano/Round hinge welded-2nos,Round latch lock-1no. Galvanized Steel Galvanized Steel 1.0mm	1		No	
9	Automatic Air Vent, size 1"	3		No	
TOTAL COST OF NON-SCHEDULE WORKS (FIRE FIGHTING SYSTEM)					

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
G.	<i>STEEL STRUCTURE WORKS (NON-SCHEDULE).</i>				
1	<p>Loads applied on buildings and tolerances for fabrication and erection are in accordance with: The 2002 edition of the Low Rise Building Systems Manual By Metal Building Manufacturers Association, Inc.(MBMA)</p> <p>Manufacturing, supply & installation of material for pre-engineered steel shed including primary structural steel. Built-Up Members including Rafters, columns of material (ASTM A-572M Grade 50). Secondary structural steel elements. galvanized Roof Z purlins, (ASTM A 653M SS Grade 340 Class 1, Z275), wall girts with 100mm Thick Rockwool Slabs, Density: 80kg/m³ (60 Minutes Fire rated) with 0.5mm PPGI corrugated top sheet and 0.5mm PPGI bottom sheet of ASTM A 792M Grade 340 Class 2, AZM120/PPGI Z 120) for Roof and Wall. Trims, connection plates, gutter, PVC downspout pipe and cross bracing and other necessary hardware and fixing/stitching screws. Anchor bolts (ASTM A 36M Hot Dip Galvanized to ASTM A 153 M Class C)</p> <p>Eave height : 11 m (Total)</p> <p>All primary steel members will be sand blasted and painted at our factory with one coat of epoxy primer.</p> <p>All secondary steel members such as purlins, girts, eave struts, gable angles and base angles are made of pregalvanized steel coils.</p> <p>Including 2 Single Flight Staircases upto Mezzanine Floor are also included having treads may be made of pregalvanized grating, red oxide primed checkered plate or red oxide primed "U" Shaped pans provided with one side hand railing.</p> <p>Grid no. 5 wall: wall on Grid no. 5 is also included in our scope that has wall girts with 100mm Thick Rockwool Slabs, Density: 80kg/m³ (60 Minutes Fire rated) with 0.5mm PPGI corrugated top sheet and 0.5mm PPGI bottom sheet of ASTM A 792M Grade 340 Class 2, AZM120/PPGI Z 120). Block masonry opening is 3m.</p> <p>Total Plinth Area</p>	29,700		Sft	
2	<p>Mezzanine Floor</p> <p>Providing & fixing of Structure including support columns, primary beams (ASTM A 572M Grade 50), secondary joists and a steel 1mm thick deck that supports a 75 mm reinforced concrete slab (slab by others).</p> <p>50mm thick Corrugated Polyurethane Sandwich Panels for mezzanine Roof.</p>	9,900		Sft	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
3	<p>Supply & installation of Canopy-1 & Canopy-2:</p> <p>Canopy # 1: Size: L x W x H 11.176mx3.660mx4.580m</p> <p>Canopy # 2: Size: 5.588mx3.660mx4.580m manufacturing and supply and installation of Canopy for pre-engineered steel shed including primary structural steel.</p> <p>Built-Up Members including Rafters, columns of material (ASTM A 572M Grade 50). Secondary structural steel elements. galvanized Roof Z purlins, (ASTM A 653M SS Grade 340 Class 1, Z275) Covered with 0.5mm PPGI sheeting.</p>	660		Sft	
4	<p>Manufacturing, supply & installation of FRAMECAD structure designed by Internationally recognized Licensed Software FRAMECAD above mezzanine floor. All Primary steel members are made using Z 275 Spangled Galvanized Steel G550.</p> <p>Complete structure is designed according to internationally accepted software and verified accordingly in terms of dead load, live load, collateral load. The design is verified for 150km/h wind speed and Seismic Zone 2B. Wall Frames are formed using Light Gauge Steel Galvanized C Channel of 89mm x 41mm x 0.75mm thick. All C Channel frames are connected to each other with imported screws.</p> <p>0.75mm galvanized LGSS trusses , 70mm thick Rockwool board (60 minutes Fire rated) insulation clad with 9mm thick cement boards (Shera Brand) for Partition walls, connection plates, trims and other necessary hardware and fixing/stitching screws.</p>	28,299		Sft	
5	<p>Providing & Fixing of 2" aluminium frame (Silver) with 8mm tempered glass with 2mm aluminium thick.</p>	615		Sft	
6	<p>Supply and Installation of PU Double Sliding Door. Size : 3660mmx2750mm Infilled material: 50mm thick Polyurethane, Density : 38-42kg/m3 GI Sheet : 0.5mm thick on both sides With imported Locks, Gasket and accessories.</p>	2		Nos.	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
7	Supply and Installation Of Single Leaf Fire Exit Doors: Size: 900mmx2100mm Door Thickness: 45mm Thick (Make to Order). Insulation: 50mm thick Density : 120 kg/m3 Rockwool Rigid Board. 1.2mm G.I Door Panel and Door Frame Vision Panel: 300mm x 400mm Double Glazed Glass of 5mm + 5mm. Hinges 180 Minutes UL certified Locks made in USA 180 minutes UL Certified, with Door closer. All Doors and Door frames will be Epoxy paint of Powder coated 20-25 micron. Push Bar(Made in China)	2		Nos.	
8	Supply and Installation Of Double Leaf Fire Rated Doors: Size: 1830mmx2440mm Insulation: Rockwool Rigid Board. 50mm thick , Density : 120 kg/m3 1.2mm G.I Door Panel 1.5mm G.I Door Frame Hinges 180 Minutes UL certified Locks made in USA 180 minutes UL Certified, with Door closer. All Doors and Door frames will be Epoxy paint of Powder coated 20-25 micron.	3		Nos.	
9	Supply and Installation Of PU Single Sliding Door: Size: 1830mmx2440mm Infilled material: 50mm thick Polyurethane, Density : 38-42kg/m3 GI Sheet : 0.5mm thick on both sides With imported Locks, Gasket and accessories.	3		Nos.	
10	Supply and Installation Monkey Ladder made up of MS Steel Grade 50 available up to the height of 11m. Using 0.5mm GI angle size 75mmx75mm on both sides. Ladder Step: Height : 1 ft, Width:1 ft 6 inches Ladder cage: 2-2.5 (meters)	1		Job.	
TOTAL COST OF NON-SCHEDULE WORKS (STEEL STRUCTURE WORKS)					

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,DUHS, KARACHI

BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
H.	<u>VOICE & DATA COMMUNICATION (NON-SCHEDULE).</u>				
	Supply, installation, testing and commissioning of following items for voice and data communication system including all material, labor, tools, accessories etc. Complete in all respects. Quantities for cables shown in BOQ are estimated and taken from drawings. Contractor is advised to take measurement at site before commencement of works. Different colors of voice and data cables shall be used. (Selected Series for Face plates is Clipsal C-Vivace Series or equivalent)				
1	Duplex Face plate having Cat-6 RJ-45 I/O for Voice / Data , white / off white finish, complete with shuttered click-ins, labels and all accessories including back box, recessed on wall or column as per design drawings.	64		Nos.	
2	Simplex Face plate having Cat-6 RJ-45 I/O for Wifi , white / off white finish, complete with shuttered click-ins, labels and all accessories including back box, recessed on wall or column as per design drawings.	20		Nos.	
3	Following CAT-6, Patch Panel equipped with RJ-45 I/Os for Voice / Data Communication System including all labeling and all mounting accessories. Complete in all respects.				
4	24-Port patch Panel for Data	7		Nos.	
5	Cable Manager	7		Nos.	
6	Media Converter Giga Bit (one for 2 section intercommunication & one for main Uplink)	3		Nos.	
7	6 Fiber Optic Cable (Complete Installation with Termination and testing between 2 sections)	300		Feet	
8	CAT-6 UTP cables , for Data communication system from Com Rack to each workstation in 25mm dia PVC conduit . Cable Tray as per drawings including termination and tagging at both ends. Complete in all respects.	5,000		Meter	
9	CAT-6 factory certified Patch Cords of specified color having RJ-45 connectors at both ends for Data communication. (Gray /Green Color)				
10	3 meter long.	140		Nos.	
11	1 meter long.	140		Nos.	
12	Communication Cabinet 42U (Floor Standing) , suitable for installation of standard patch panels and etc. Complete with floor base, vertical cable managers. Rack shall be equipped with power distribution units (PDUs) with at least 2 imported power sockets & proper ventilation system including fan etc. Complete in all respects. etc.	1		Nos.	
13	Communication Cabinet 18U (Wall Mounted) , suitable for installation of standard patch panels and etc. Complete with floor base, vertical cable managers. Rack shall be equipped with power distribution units (PDUs) with at least 2 imported power sockets & proper ventilation system including fan etc. Complete in all respects. etc.	2		Nos.	
14	Out Door ODF Box with Complete Accessories for main Uplink from Dow IT Room	1		Nos.	
15	Testing and commissioning of all above items, termination, tagging and connectivity at both ends, including submission of detailed test report from the Principals.	1		Job	
	TOTAL COST OF NON-SCHEDULE WORKS (VOICE & DATA COMMUNICATION SYSTEM)				

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
J.	<i>CCTV SYSTEM (IP BASED)(NON-SCHEDULE).</i>				
	Supply, Installation, Testing and Commissioning of following items for CCTV System (IP Cameras) including but not limited to the description given here under including all power and communication accessories, housings, mounting brackets, suspension rods etc. required for completion of the system.				
1	Fixed type, POE I.P Camera with day and night feature having resolution 1024x768 pixels with live and recording quality of 30 fps, along with all mounting accessories complete in all respects.	49		No.	
2	PTZ 36x 360 Degree POE I.P Camera with day and night feature having resolution 1024x768 pixels with live and recording quality of 30 fps, along with all mounting accessories complete in all respects.	1		No.	
3	Network Video Recorder (NVR) with 32 channel Video input. The NVR shall be equipped with LAN / WAN facility. NVR should have 2 Tb Surveillance Grade HDD , RW CD Drive. Complete with all connecting cords, accessories, software for Integration with	2		No.	
a	24 port Patch panel	3		No.	
b	24 Port POE Network switch	3		No.	
4	Supply and wiring of Cat-6 Cable for CCTV system from NVR to each camera in 25mm dia PVC conduit as per drawings including termination and tagging at both ends. Complete in all respects. (Maximum 4 No. cable in each conduit)	2,000		Metre	
5	Programming, testing and commissioning of the complete system as per the Client requirement.	1		Job	
TOTAL COST OF NON-SCHEDULE WORKS (CCTV SYSTEM IP BASED)					

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
K.	<u>ADDRESSABLE FIRE ALARM SYSTEM (NON-SCHEDULE).</u>				
1	Supply & Installation of 2-Loop Standalone FACP with 80-Character Display expandable up to 4 loop with Addressable Notifications 500 Devices - Any Combination Approvals: UL, ULC Listed and FM Approved Simplex-Tyco Fire Protection Products, Johnson Controls, USA	1		No.	
2	Supply & Installation of Dry Rechargeable Battery 12V 18Ah MAINTENANCE FREE, LEAD ACID, GELL TYPE	2		No.	
3	Supply & Installation of Addressable Photoelectric Smoke Detector Addressable Smoke Detector which provides seven levels of sensitivity from 0.2% to 3.7% with 2 wire Base having inbuilt remote LED provision. Features: <ul style="list-style-type: none"> • UL listed to Standard 268 • Louvered smoke sensor design enhances smoke capture by directing flow to chamber; entrance areas are minimally visible when ceiling mounted • Designed for EMI compatibility • Magnetic test feature is provided • Optional accessories include remote LED alarm indicator and output relays Specifications: Operating Temperature Range: 15° to 122° F (-9° to 50° C) Humidity Range: 10 to 95% RH Approvals: UL, ULC, CSFM Listed; FM Approved; MEA (NYC) Acceptance Simplex-Tyco Fire Protection Products, Johnson Controls, USA	64		No.	
4	Supply & Installation of Addressable type Heat Detector Intelligent Addressable Programmable fixed temperature range is 57.2° C / 68° C or rate-of-rise temperature range is 18.3° C / 11.1° C. with 2 wire Base having inbuilt remote LED provision. Features: <ul style="list-style-type: none"> • UL listed to Standard 268 • Louvered smoke sensor design enhances smoke capture by directing flow to chamber; entrance areas are minimally visible when ceiling mounted • Designed for EMI compatibility • Magnetic test feature is provided • Optional accessories include remote LED alarm indicator and output relays Specifications: Operating Temperature Range: 32° to 122° F (0° to 50° C) Humidity Range: 10 to 95% RH Approvals: UL, ULC, CSFM Listed; FM Approved; MEA (NYC) Acceptance Simplex-Tyco Fire Protection Products, Johnson Controls, USA	3		No.	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
5	Supply & Installation of Addressable Manual Double Action Push Pull Station-Break Glass Type Specifications: Temperature Range: 32° To 120° F (0° To 49° C) Intended For Indoor Operation Humidity Range: Up To 93% RH At 100° F (38° F) Housing Color: Red With White Raised Lettering Pull Lever: Color White With Red Raised Lettering Approvals: (UL, ULC LISTED & FM APPROVED) Simplex, TYCO Fire Protection Products, Johnsons Controls, USA	8		No.	
6	Supply & Installation of Intelligent Addressable Horn cum Multi Candela strobe Unit Intelligent Addressable Horn cum Multi Candela strobe Unit, Customization of intensity selection from 15cd to 185cd of strobe with self-test diagnostic feature, which is able to generate NAC, pass / fail report. Approvals: UL, ULC, CSFM Listed; FM Approved; MEA (NYC) Acceptance Simplex Tyco Fire Protection Products, Johnson Controls, USA	8		No.	
7	Supply & Installation of EC-50R Beam Detector Reflective Beam Smoke Detector Complete With Two Reflectors and Test Filters Specifications: RANGE: 4.6 MTR TO 48.8MTR (15 FT TO 160 FT) SPAN: 9.14MTR (30 FT) OPERATING TEMPERATURE: 32° F to 100° F (0° C to 37° C) HUMIDITY: 93%RH, NON-CONDENSING CURRENT STANDBY: LESS THAN 4 mA ALARM/TROUBLE: LESS THAN 14 mA POWER SUPPLY: 10.2 VDC to 30 VDC APPROVALS: UL, ULC LISTED EST, UTC FIRE & SECURITY, USA	6		No.	
8	Supply & Installation of 601F IR Flame Detector Solar Blind Infrared Detector for fast response towards flaming fires typically cause by flammable liquids with 2-wire base having LED indication. Features: <ul style="list-style-type: none"> • Least possible False Alarming • Suitable for long distances solar blind • Low profile, discrete and unobtrusive • Superior performance and reliability • Fast and easy installation • Integral and remote alarm LED Specifications: Operating voltage:18 to 28 VDC Current consumption: <ul style="list-style-type: none"> • Average Quiescent:24 VDC 300 µA • Alarm: 18 VDC 36 mA Operating temperature(non-condensing):-20°C to +70°C Storage temperature(non-condensing):-40°C to +80°C Relative Humidity (non-condensing)0:-95% Dimensions (h x Ø):Head 53 mm x 109 mm Reset Time:2-5 seconds Approvals: EN54 and CPD Approved, LPCB & VDS CERTIFICATION FIRECLASS, THORN, TYCO FIRE PROTECTION PRODUCTS, UK 	1		No.	

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
9	INSTALLATION MATERIAL INCLUDING 2 CORE X 1.5 Sq.mm2 FR CABLE-MAKE: NEWAGE PVC CONDUIT & FITTINGS, (TO BE CHARGED AS PER ACTUAL)	8,000		Rft	
10	PROGRAMMING, TESTING & COMMISSIONING OF COMPLETE SYSTEM	1		Job	
	TOTAL COST OF NON-SCHEDULE WORKS (ADDRESSABLE FIRE ALARM SYSTEM)				

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
<i>M.</i>	<i>ACCESS CONTROL SYSTEM(NON-SCHEDULE).</i>				
	Supply, Installation, testing and commissioning of Proximity Door Access Control System comprising of following equipments including all accessories required for the completion of the system in all respects.				
1	Proximity Door Access Controller suitable for 4 doors / 4 readers for door access (connecting to readers at upto 100m), monitoring, store at least 10,000 events for 500 card holders, provided with power supply unit with battery back-up for at-least 8 hours. Built-in interfacing with TCP / IP switch for LAN/WAN networking	2		Nos.	
2	Proximity Card Reader 125KHz , (for outside door) card only reader, operating at low voltage DC supply, with mounting base suitable for interior and exterior environment with dual color LED and speaker for comprehensive audible feedback to user.	8		Nos.	
3	Proximity Cards ISO credit card standard size and thickness, thin, flexible polyvinyl chloride laminated, passive type, easy printable on both sides.	200		Nos.	
4	Drop Bolt Lock (Single Door) with holder and fixing accessories.	8		Nos.	
5	Push Button (Exit Switch) suitable for installation on BS standard size back box connected to door controller for access.	8		Nos.	
6	Power Supply Units for push buttons complete in all respects.	8		Nos.	
7	Supply and wiring for Power Supply Unit using 2C, 1.5 sqmm shielded wire in 25mm dia PVC conduit. Complete in all respects.	300		Mtr	
8	Supply and wiring of CAT-6 cable from Communication Module to all devices as shown in the schematic diagram run in 25 mm dia PVC conduit. Complete in all respects.	300		Mtr	
9	Access Control Time and Management Software along with Security Control system features a password protected user logon system suitable to interface with CCTV, Fire Alarm, BMS and Intrusion System. It provide cardholder management, full alarm and event processing, multi division supports, alarms alerting via SMS and calls on mobile and detailed audit rail records.	1		Nos.	
10	Programming, testing and commissioning of the complete system as per the Client requirement.	1		Job	
	TOTAL COST OF NON-SCHEDULE WORKS (ACCESS CONTROL SYSTEM)				

CONSTRUCTION OF WAREHOUSE AT OJHA CAMPUS,
DUHS, KARACHI
BILL OF QUANTITIES

Sr.#.	Description	Quantity	Rate (Rs.)	Unit	Amount (Rs.)
<i>N.</i>	<i>ROAD WORKS (NON-SCHEDULE).</i>				
1	Clearing and grubbing the site by cutting, uprooting and removing all rubbish and shrubs including disposal of all rubbish outside the Project limits.	60,000		Sft	
2	Compaction of Natural Ground upto 90% density modified AASHTO.	60,000		Sft	
3	Preparing sub grade over earth cutting or filling including disposal of surplus material and dressing to camber / Slope and compaction upto 90% density modified AASHTO with power Roller.	55,000		Sft	
4	Providing and spreading granular sub- base course from approved quarry in required thickness to proper camber and grade having plasticity index not more than 6% of suitable quality watering and compacting to achieve 98% to 100% density as per modified AASHTO specifications.	55,000		Cft	
5	Providing and spreading Aggregate base course in proper grade and chamber having CBR 80% as per AASHTO standard specifications i/c spreading and compacting, watering, compaction of each layer 100% density as per modified AASHTO specifications.	27,500		Sft	
6	Providing and applying prime coat of emulsified asphalt of approved grade including cleaning and brooming of existing surface.	55,000		Sft	
7	Providing and laying hot-mix bituminous concrete in road pavement laid with mechanical paver and mixed in central mixing plant in required thickness and density, rolled hot with different types of rollers complete as per specifications and job-mix formula and design in single layer (3" thick)	55,000		Sft	
8	Providing and applying tack coat of liquid asphalt (cut back) of approved grade including cleaning and brooming of existing road surface	55,000		Sft	
9	Providing and laying hot-mix bituminous concrete in road pavement laid with mechanical paver and mixed in central mixing plant in required thickness and density, rolled hot with different types of rollers complete as per specifications and job-mix formula and design in single layer (2" (50 mm) thick).	55,000		Sft	
10	Providing and fixing Precast Kerb Block having 3750 PSI Industrial Made 18"x12"x6" including excavation, 4" thick lean CC 1:4:8 concrete under the Kerb Block and hunching, haunching 6"x6" using CC 1:3:6 concrete, Jointing with CM 1:4 mortar complete in alignment and levels.	2,050		Rft	
	TOTAL COST OF NON-SCHEDULE WORKS (ROAD WORKS)				

Appendix-E to Bid

PROPOSED CONSTRUCTION SCHEDULE

Pursuant to Sub-Clause 43.1 of the General Conditions of Contract, the works shall be completed on or before the date stated in Appendix-A to Bid. The bidder shall provide as Appendix-E to Bid, the Construction Schedule in the bar chart (CPM, PERT or any other to be specified herein) showing the sequence of work items and the period of time during which he proposes to complete each work item in such a manner that his proposed programme for completion of the whole of the works and parts of the works may meet procuring agency's completion targets in days noted below and counted from the date of receipt of Engineer's Notice to Commence (Attach sheets as required for the specified form of Construction Schedule):

<u>Description</u>	<u>Time for Completion</u>
1) Whole works	_____ days
2) Part-A	_____ days
3) Part-B	_____ days
4) _____	_____ days
5) _____	_____ days

METHOD OF PERFORMING THE WORK

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

1. Organization Chart indicating head office and field office personnel involved in management and supervision, engineering, equipment maintenance and purchasing.
2. Mobilization in Pakistan, the type of facilities including personnel accommodation, office accommodation, provision for maintenance and for storage, communications, security and other services to be used.
3. The method of executing the works, the procedures for installation of equipment and machinery and transportation of equipment and materials to the site.

LIST OF MAJOR EQUIPMENT – RELATED ITEMS

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

Appendix-G to Bid

LIST OF MAJOR EQUIPMENT (SAMPLE)

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

CONSTRUCTION CAMP AND HOUSING FACILITIES

The Contractor in accordance with Clause 6 of the Conditions of Contract shall provide description of his construction camp's facilities and staff housing requirements.

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

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

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

Appendix-I to Bid

LIST OF SUBCONTRACTORS

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

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

Part of Works (Give Details)	Subcontractor (With Complete Address)
1	2

Appendix-J to Bid

ESTIMATED PROGRESS PAYMENTS (SAMPLE)

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 Pakistani Rupees:

Quarter/ Year/ Period	Amounts (in thousands)
1	2
Ist Quarter	
2 nd Quarter	
3 rd Quarter	
Bid Price	

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

(To be filled in by the bidder)

(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC; PAYABLE BY CONTRACTORS.

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE)

Contract No. _____ Dated _____

Contract Value: _____

Contract Title: _____

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

Without limiting the generality of the foregoing, [name of Contractor] 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, from Procuring Agency (PA) except that which has been expressly declared pursuant hereto.

[name of Contractor] accepts full responsibility and strict liability 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 PA and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

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

Notwithstanding any rights and remedies exercised by PA in this regard, [name of Supplier/Contractor/Consultant] agrees to indemnify PA for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to PA in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [name of Contractor] 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 PA.

.....
[Procuring Agency]

[Contractor]

FORMS

**BID SECURITY
PERFORMANCE SECURITY
CONTRACT AGREEMENT
MOBILIZATION ADVANCE GUARANTEE
INDENTURE 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 'Procuring Agency') in the sum stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

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

WHEREAS, the Procuring Agency has required as a condition for considering said bid that the **bidder** furnishes a bid security in the above said sum from a Scheduled Bank in Pakistan or from a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan, to the procuring agency, conditioned as under:

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

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

PROVIDED THAT the Surety shall forthwith pay the procuring agency, the said sum upon first written demand of the procuring agency (without cavil or argument) and without requiring the procuring agency to prove or to show grounds or reasons for such demand,

notice of which shall be sent by the procuring agency by registered post duly addressed to the Surety at its address given above.

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

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

SURETY (Bank)

WITNESS:

Signature _____

1. _____

Name _____

Title _____

Corporate Secretary (Seal)

Corporate Guarantor (Seal)

2. _____

Name, Title & Address

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

Guarantee No. _____
Executed on _____
Expiry date _____

[Letter by the Guarantor to the Procuring Agency]

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

Name of Principal (Contractor) with address: _____

Penal Sum of Security (express in words and figures) _____

Letter of Acceptance No. _____ Dated _____

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

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

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

Our total liability under this Guarantee is limited to the sum stated above and it is a condition of any liability attaching to us under this Guarantee that the claim for payment in writing shall be received by us within the validity period of this Guarantee, failing which we shall be discharged of our liability, if any, under this Guarantee.

We, _____ (the Guarantor), waiving all objections and defenses under the Contract, do hereby irrevocably and independently guarantee to pay to the procuring agency without delay upon the procuring agency's first written demand without

cavil or arguments and without requiring the procuring agency to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the procuring agency's written declaration that the Principal has refused or failed to perform the obligations under the Contract which payment will be effected by the Guarantor to Procuring Agency's designated Bank & Account Number.

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

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

	_____ Guarantor (Bank)
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 "Procuring Agency") of the one part and _____ (hereafter called the "Contractor") of the other part.

WHEREAS the Procuring Agency is desirous that certain works, viz _____ should be executed by the Contractor and has accepted a bid by the Contractor for the execution and completion of such works and the remedying of any defects therein.

NOW this Agreement witnesseth-- as follows:

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

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

Signature of the Contactor

Signature of Procuring Agency

(Seal)

(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:

Witness:

(Name, Title and Address)

(Name, Title and Address)

MOBILIZATION ADVANCE GUARANTEE

Bank Guarantee No. _____ Date _____

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

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

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

AND WHEREAS, _____
(Scheduled Bank in Pakistan)
(hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the **procuring agency** agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

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

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

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

(Date)

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

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

GUARANTOR

- 1. Signature _____
- 2. Name _____
- 3. Title _____

WITNESS

1. _____
Corporate Secretary (Seal)

2. _____
(Name Title & Address)

Corporate Guarantor (Seal)

INDENTURE FOR SECURED ADVANCES.

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

This INDENTURE made the day of
..... 20..... BETWEEN (hereinafter called "the Contractor" which expression shall where the context so admits or implied be deemed to include his heirs, executors, administrators and assigns) of the one part and The Vice Chancellor of DUHS (hereinafter called "the Procuring Agency" of the other part).

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

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

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

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

NOW THIS INDENTURE WTTNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees..... (Rs.) on or before the execution of these presents paid to the Contractor by the procuring Agency (the receipt whereof the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as aforesaid (all of which advances are hereinafter collectively referred to as the said amount) the Contractor doth hereby assign unto the procuring agency the said materials by way of security for the said amount

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

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

(2) That the materials detailed in the said Running Account Bill (B) which have been offered to and accepted by (the procuring agency as security for the said

amount are absolutely by the Contractors own property free from encumbrances of any kind and the Contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the contractor hereby agrees, at all times, to indemnify and save harmless the procuring agency against all claims whatsoever to any materials in respect of which an advance has been made to him as aforesaid.

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

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

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

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

(7) That if the Contractor shall at any time make any default in the performance or observation in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the procuring agency shall immediately on the happening of such default be repayable by the Contractor to the procuring agency together with interest thereon at twelve percent per annum from the date or respective dates of such advance or advances to the date of repayment and with all costs, charges, damages and expenses incurred by the procuring agency in or for the recovery thereof or the

enforcement of this security or otherwise by reason of (he default of the Contractor and any moneys so becoming due and payable shall constitute a debt due from the Contractor to the procuring agency and the Contractor hereby covenants and agrees with the procuring agency to repay and the same respectively to it accordingly.

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

Once there with the procuring agency may at any time thereafter adopt all or any of following courses as it may deem best ;-

- (a) Seize and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor he is to pay the same to the procuring agency on demand.
- (b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable to the procuring agency under these presents and pay over the surplus (if any) to the Contractor.
- (c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

(9) That except as is expressly provided by the presents interest on the said advance shall not be payable.

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been hereinbefore expressly provided for the same shall be referred to the Superintending Engineer/Executive District Officer/Officer one grade higher to officer signed the agreement Circle whose.....decision shall be final and the provisions of the Arbitration Act 1940 for the time being in force so far as they are applicable shall apply to any suchreference.

Singed, sealed and delivered by*
In the presence of

SEAL

1st witness
2nd witness

Singed, sealed and delivered by*
In the presence of

SEAL

1st witness
2nd witness

Notes on the Conditions of Contract

The Conditions of Contract comprise two parts:

- (a) **Part I - General Conditions of Contract**
- (b) **Part II - Special 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 Internationale des Ingenieurs-Conseils, or FIDIC), and is commonly known as the FIDIC Conditions of Contract. (The used version is the harmonized Edition March 2006).

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 procuring agency. 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 procuring agency and Contractor, general acceptability of its provisions, and savings in time and cost for bid preparation and review, leading to more economic prices.

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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:

To request such permission please contact:

FIDIC CASE POSTALE, CH-1215 Switzerland;

Tel. +41 22 799 49 00;

Fax; +41 22 799 49 01

E-mail: fidic@fidic.org.

Conditions of Contract for CONSTRUCTION

FOR BUILDING AND ENGINEERING
WORKS DESIGNED BY THE EMPLOYER

Multilateral Development Bank Harmonised Edition
March 2006

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FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS
INTERNATIONAL FEDERATION OF CONSULTING ENGINEERS
INTERNATIONALE VEREINIGUNG BERATENDER INGENIEURE
FEDERACION INTERNACIONAL DE INGENIEROS CONSULTORES



General Conditions

CONTENTS

Definitions listed alphabetically GENERAL

PROVISIONS

- 1.1 Definitions
- 1.2 Interpretation
- 1.3 Communications
- 1.4 Law and Language
- 1.5 Priority of Documents
- 1.6 Contract Agreement
- 1.7 Assignment
- 1.8 Care and Supply of Documents
- 1.9 Delayed Drawings or Instructions
- 1.10 Employer's Use of Contractor's Documents
- 1.11 Contractor's Use of Employer's Documents
- 1.12 Confidential Details
- 1.13 Compliance with Laws
- 1.14 Joint and Several Liability
- 1.15 Inspections and Audit by the Bank

2 THE EMPLOYER

- 2.1 Right of Access to the Site
- 2.2 Permits, Licences or Approvals
- 2.3 Employer's Personnel
- 2.4 Employer's Financial Arrangements
- 2.5 Employer's Claims

3 THE ENGINEER

- 3.1 Engineer's Duties and Authority
- 3.2 Delegation by the Engineer
- 3.3 Instructions of the Engineer
- 3.4 Replacement of the Engineer
- 3.5 Determinations

4 THE CONTRACTOR

- 4.1 Contractor's General Obligations
- 4.2 Performance Security

- 4.3 Contractor's Representative
- 4.4 Subcontractors
- 4.5 Assignment of Benefit of Subcontract
- 4.6 Co-operation
- 4.7 Setting Out
- 4.8 Safety Procedures
- 4.9 Quality Assurance
- 4.10 Site Data
- 4.11 Sufficiency of the Accepted Contract Amount
- 4.12 Unforeseeable Physical Conditions
- 4.13 Rights of Way and Facilities
- 4.14 Avoidance of Interference
- 4.15 Access Route
- 4.16 Transport of Goods
- 4.17 Contractor's Equipment
- 4.18 Protection of the Environment
- 4.19 Electricity, Water and Gas
- 4.20 Employer's Equipment and Free-Issue Materials
- 4.21 Progress Reports
- 4.22 Security of the Site
- 4.23 Contractor's Operations on Site
- 4.24 Fossils

5 NOMINATED SUBCONTRACTORS

- 5.1 Definition of "nominated Subcontractor"
- 5.2 Objection to Nomination
- 5.3 Payments to nominated Subcontractors
- 5.4 Evidence of Payments

6 STAFF AND LABOUR

- 6.1 Engagement of Staff and Labour
- 6.2 Rates of Wages and Conditions of Labour
- 6.3 Persons in the Service of Employer
- 6.4 Labour Laws
- 6.5 Working Hours
- 6.6 Facilities for Staff and Labour
- 6.7 Health and Safety
- 6.8 Contractor's Superintendence
- 6.9 Contractor's Personnel
- 6.10 Records of Contractor's Personnel and Equipment
- 6.11 Disorderly Conduct
- 6.12 Foreign Personnel
- 6.13 Supply of Foodstuffs
- 6.14 Supply of Water
- 6.15 Measures against Insect and Pest Nuisance
- 6.16 Alcoholic Liquor or Drugs
- 6.17 Arms and Ammunition
- 6.18 Festival and Religious Customs
- 6.19 Funeral Arrangements
- 6.20 Prohibition of Forced or Compulsory Labour
- 6.21 Prohibition of Harmful Child Labour
- 6.22 Employment Records of Workers

7 PLANT, MATERIALS AND WORKMANSHIP

- 7.1 Manner of Execution
- 7.2 Samples
- 7.3 Inspection
- 7.4 Testing
- 7.5 Rejection
- 7.6 Remedial Work
- 7.7 Ownership of Plant and Materials
- 7.8 Royalties

8 COMMENCEMENT, DELAYS AND SUSPENSION.....

- 8.1 Commencement of Works
- 8.2 Time for Completion
- 8.3 Programme
- 8.4 Extension of Time for Completion
- 8.5 Delays Caused by Authorities
- 8.6 Rate of Progress
- 8.7 Delay Damages
- 8.8 Suspension of Work
- 8.9 Consequences of Suspension
- 8.10 Payment for Plant and Materials in Event of Suspension
- 8.11 Prolonged Suspension
- 8.12 Resumption of Work

TESTS ON COMPLETION

- 9.1 Contractor's Obligations
- 9.2 Delayed Tests
- 9.3 Retesting
- 9.4 Failure to Pass Tests on Completion

10 EMPLOYER'S TAKING OVER

- 10.1 Taking Over of the Works and Sections
- 10.2 Taking Over of Parts of the Works
- 10.3 Interference with Tests on Completion
- 10.4 Surfaces Requiring Reinstatement

11 DEFECTS LIABILITY

- 11.1 Completion of Outstanding Work and Remedying Defects
- 11.2 Cost of Remedying Defects
- 11.3 Extension of Defects Notification Period
- 11.4 Failure to Remedy Defects
- 11.5 Removal of Defective Work
- 11.6 Further Tests
- 11.7 Right of Access
- 11.8 Contractor to Search
- 11.9 Performance Certificate
- 11.10 Unfulfilled Obligations
- 11.11 Clearance of Site

- 12 MEASUREMENT AND EVALUATION
 - 12.1 Works to be Measured
 - 12.2 Method of Measurement
 - 12.3 Evaluation
 - 12.4 Omissions

- 13 VARIATIONS AND ADJUSTMENTS
 - 13.1 Right to Vary
 - 13.2 Value Engineering
 - 13.3 Variation Procedure
 - 13.4 Payment in Applicable Currencies
 - 13.5 Provisional Sums
 - 13.6 Daywork
 - 13.7 Adjustments for Changes in Legislation
 - 13.8 Adjustments for Changes in Cost

- 14 CONTRACT PRICE AND PAYMENT
 - 14.1 The Contract Price
 - 14.2 Advance Payment
 - 14.3 Application for Interim Payment Certificates
 - 14.4 Schedule of Payments
 - 14.5 Plant and Materials intended for the Works
 - 14.6 Issue of Interim Payment Certificates
 - 14.7 Payment
 - 14.8 Delayed Payment
 - 14.9 Payment of Retention Money
 - 14.10 Statement at Completion
 - 14.11 Application for Final Payment Certificate
 - 14.12 Discharge
 - 14.13 Issue of Final Payment Certificate
 - 14.14 Cessation of Employer's Liability
 - 14.15 Currencies of Payment

- 15 TERMINATION BY EMPLOYER
 - 15.1 Notice to Correct
 - 15.2 Termination by Employer
 - 15.3 Valuation at Date of Termination
 - 15.4 Payment after Termination
 - 15.5 Employer's Entitlement to Termination for Convenience
 - 15.6 Corrupt or Fraudulent Practices

- 16 SUSPENSION AND TERMINATION BY CONTRACTOR
 - 16.1 Contractor's Entitlement to Suspend Work
 - 16.2 Termination by Contractor
 - 16.3 Cessation of Work and Removal of Contractor's Equipment
 - 16.4 Payment on Termination

- 17 RISK AND RESPONSIBILITY
 - 17.1 Indemnities
 - 17.2 Contractor's Care of the Works

- 17.3 Employer's Risks
- 17.4 Consequences of Employer's Risks
- 17.5 Intellectual and Industrial Property Rights
- 17.6 Limitation of Liability
- 17.7 Use of Employer's Accommodation/Facilities

18 INSURANCE

- 18.1 General Requirements for Insurances
- 18.2 Insurance for Works and Contractor's Equipment
- 18.3 Insurance against Injury to Persons and Damage to Property
- 18.4 Insurance for Contractor's Personnel

19 FORCE MAJEURE

- 19.1 Definition of Force Majeure
- 19.2 Notice of Force Majeure
- 19.3 Duty to Minimise Delay
- 19.4 Consequences of Force Majeure
- 19.5 Force Majeure Affecting Subcontractor
- 19.6 Optional Termination, Payment and Release
- 19.7 Release from Performance

20 CLAIMS, DISPUTES AND ARBITRATION

- 20.1 Contractor's Claims
- 20.2 Appointment of the Dispute Board
- 20.3 Failure to Agree on the Composition of the Dispute Board
- 20.4 Obtaining Dispute Board's Decision
- 20.5 Amicable Settlement
- 20.6 Arbitration
- 20.7 Failure to Comply with Dispute Board's Decision
- 20.8 Expiry of Dispute Board's Appointment

APPENDIX: DISPUTE BOARD

General Conditions of Dispute Board Agreement
Annex: Procedural Rules

INDEX OF SUB-CLAUSES

77

Definitions listed alphabetically

1.1.4.1	Accepted Contract Amount	1.1.4.7	Interim Payment Certificate
1.1.2.11	Bank	1.1.6.5	Laws
1.1.3.1	Base Date	1.1.1.3	Letter of Acceptance
1.1.1.9	Bill of Quantities	1.1.1.4	Letter of Tender
1.1.2.12	Borrower	1.1.4.8	Local Currency
1.1.3.2	Commencement Date	1.1.5.3	Materials
1.1.1.1	Contract	1.1.2.1	Party
1.1.1.2	Contract Agreement	1.1.4.9	Payment Certificate
1.1.1.10	Contract Data	1.1.3.8	Performance Certificate
1.1.4.2	Contract Price	1.1.6.6	Performance Security
1.1.2.3	Contractor	1.1.5.4	Permanent Works
1.1.6.1	Contractor's Documents	1.1.5.5	Plant
1.1.5.1	Contractor's Equipment	1.1.4.10	Provisional Sum
1.1.2.7	Contractor's Personnel	1.1.4.11	Retention Money
1.1.2.5	Contractor's Representative	1.1.1.7	Schedules
1.1.4.3	Cost	1.1.1.9	Schedule, Payment Currencies
1.1.6.2	Country	1.1.5.6	Section
1.1.2.9	DB	1.1.6.7	Site
1.1.3.9	day	1.1.1.5	Specification
1.1.1.9	Daywork Schedule	1.1.4.12	Statement
1.1.3.7	Defects Notification Period	1.1.2.8	Subcontractor
1.1.1.6	Drawings	1.1.3.5	Taking-Over Certificate
1.1.2.2	Employer	1.1.5.7	Temporary Works
1.1.6.3	Employer's Equipment	1.1.1.8	Tender
1.1.2.6	Employer's Personnel	1.1.3.6	Tests after Completion
1.1.2.4	Engineer	1.1.3.4	Tests on Completion
1.1.2.10	FIDIC	1.1.3.3	Time for Completion
1.1.4.4	Final Payment Certificate	1.1.6.8	Unforeseeable
1.1.4.5	Final Statement	1.1.6.9	Variation
1.1.6.4	Force Majeure	1.1.5.8	Works
1.1.4.6	Foreign Currency	1.1.3.9	year
1.1.5.2	Goods		

General Conditions

General Provisions

1.1

Definitions

In the Conditions of Contract (“these Conditions”), which include Particular Conditions, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.

1.1.1

The Contract

1.1.1.1 “Contract” means the Contract Agreement, the Letter of Acceptance, the Letter of Tender, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.

1.1.1.2 “Contract Agreement” means the contract agreement referred to in Sub- Clause 1.6 [Contract Agreement].

1.1.1.3 “Letter of Acceptance” means the letter of formal acceptance, signed by the Employer, of the Letter of Tender, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression “Letter of Acceptance” means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.

1.1.1.4 “Letter of Tender” means the document entitled letter of tender or letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.

1.1.1.5 “Specification” means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.

1.1.1.6 “Drawings” means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.

1.1.1.7 “Schedules” means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Tender, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

1.1.1.8 “Tender” means the Letter of Tender and all other documents which the Contractor submitted with the Letter of Tender, as included in the Contract.

1.1.1.9 “Bill of Quantities”, “Daywork Schedule” and “Schedule of Payment Currencies” mean the documents so named (if any) which are comprised in the Schedules.

1.1.1.10 “Contract Data” means the pages completed by the Employer entitled contract data which constitute Part A of the Particular Conditions.

1.1.2

Parties and Persons

1.1.2.1 “Party” means the Employer or the Contractor, as the context requires.

1.1.2.2 “Employer” means the person named as employer in the Contract Data and the legal successors in title to this person.

1.1.2.3 “Contractor” means the person(s) named as contractor in the Letter of Tender accepted by the Employer and the legal successors in title to this person(s).

1.1.2.4 “Engineer” means the person appointed by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under Sub-Clause 3.4 [Replacement of the Engineer].

1.1.2.5 “Contractor’s Representative” means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under Sub-Clause 4.3 [Contractor’s Representative], who acts on behalf of the Contractor.

1.1.2.6 “Employer’s Personnel” means the Engineer, the assistants referred to in Sub-Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer’s Personnel.

1.1.2.7 “Contractor’s Personnel” means the Contractor’s Representative and all personnel whom the Contractor utilises on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.

1.1.2.8 “Subcontractor” means any person named in the Contract as a subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.

1.1.2.9 “DB” means the person or three persons appointed under Sub-Clause 20.2 [Appointment of the Dispute Board] or Sub-Clause 20.3 [Failure to Agree on the Composition of the Dispute Board].

1.1.2.10 “FIDIC” means the Fédération Internationale des Ingénieurs-Conseils, the international federation of consulting engineers.

1.1.2.11 “Bank” means the financing institution (if any) named in the Contract Data.

1.1.2.12 “Borrower” means the person (if any) named as the borrower in the Contract Data.

1.1.3

Dates, Tests, Periods and Completion

1.1.3.1 “Base Date” means the date 28 days prior to the latest date for submission and completion of the Tender.

1.1.3.2 “Commencement Date” means the date notified under Sub-Clause 8.1 [Commencement of Works].

1.1.3.3 “Time for Completion” means the time for completing the Works or a Section (as the case may be) under Sub-Clause 8.2 [Time for Completion], as stated in the Contract

Data (with any extension under Sub-Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.

1.1.3.4 “Tests on Completion” means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under Clause 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.5 “Taking-Over Certificate” means a certificate issued under Clause 10 [Employer’s Taking Over].

1.1.3.6 “Tests after Completion” means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.7 “Defects Notification Period” means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects], which extends over twelve months except if otherwise stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].

1.1.3.8 “Performance Certificate” means the certificate issued under Sub-Clause 11.9 [Performance Certificate].

1.1.3.9 “day” means a calendar day and “year” means 365 days.

1.1.4 Money and Payments

1.1.4.1 “Accepted Contract Amount” means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.

1.1.4.2 “Contract Price” means the price defined in Sub-Clause 14.1 [The Contract Price], and includes adjustments in accordance with the Contract.

1.1.4.3 “Cost” means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

1.1.4.4 “Final Payment Certificate” means the payment certificate issued under Sub-Clause 14.13 [Issue of Final Payment Certificate].

1.1.4.5 “Final Statement” means the statement defined in Sub-Clause 14.11 [Application for Final Payment Certificate].

1.1.4.6 “Foreign Currency” means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.

1.1.4.7 “Interim Payment Certificate” means a payment certificate issued under Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.

1.1.4.8 “Local Currency” means the currency of the Country.

1.1.4.9 “Payment Certificate” means a payment certificate issued under Clause 14 [Contract Price and Payment].

1.1.4.10 “Provisional Sum” means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.5 [Provisional Sums].

1.1.4.11 “Retention Money” means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause 14.9 [Payment of Retention Money].

1.1.4.12 “Statement” means a statement submitted by the Contractor as part of an application, under Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5

Works and Goods

1.1.5.1 “Contractor’s Equipment” means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor’s Equipment excludes Temporary Works, Employer’s Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.

1.1.5.2 “Goods” means Contractor’s Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

1.1.5.3 “Materials” means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.

1.1.5.4 “Permanent Works” means the permanent works to be executed by the Contractor under the Contract.

1.1.5.5 “Plant” means the apparatus, machinery and vehicles intended to form or forming part of the Permanent Works, including vehicles purchased for the Employer and relating to the construction or operation of the Works.

1.1.5.6 “Section” means a part of the Works specified in the Contract Data as a Section (if any).

1.1.5.7 “Temporary Works” means all temporary works of every kind (other than Contractor’s Equipment) required on Site for the execution and completion of the Permanent Works and the remedying of any defects.

1.1.5.8 “Works” mean the Permanent Works and the Temporary Works, or either of them as appropriate.

1.1.6

Other Definitions

1.1.6.1 “Contractor’s Documents” means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

1.1.6.2 “Country” means the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.

1.1.6.3 “Employer’s Equipment” means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

1.1.6.4 “Force Majeure” is defined in Clause 19 [Force Majeure].

1.1.6.5 “Laws” means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.6 “Performance Security” means the security (or securities, if any) under Sub-Clause 4.2 [Performance Security].

1.1.6.7 “Site” means the places where the Permanent Works are to be executed, including storage and working areas, and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site..

1.1.6.8 “Unforeseeable” means not reasonably foreseeable by an experienced contractor by the Base Date.

1.1.6.9 “Variation” means any change to the Works, which is instructed or approved as a variation under Clause 13 [Variations and Adjustments].

1.2

Interpretation

In the Contract, except where the context requires otherwise:

- (a) words indicating one gender include all genders;
- (b) words indicating the singular also include the plural and words indicating the plural also include the singular;
- (c) provisions including the word “agree”, “agreed” or “agreement” require the agreement to be record in writing;
- (d) “written” or “in writing” means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and
- (e) the word “tender” is synonymous with “bid”, and “tenderer” with “bidder” and the words “tender documents” with “bidding documents”.

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

In these Conditions, provisions including the expression “Cost plus profit” require this profit to be one-twentieth (5%) of this Cost unless otherwise indicated in the Contract Data.

1.3

Communications

Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

- (a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and
- (b) delivered, sent or transmitted to the address for the recipient’s communications as stated in the Contract Data. However:
 - (i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and
 - (ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

1.4

Law and Language

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

The Contract shall be governed by the law of the country or other jurisdiction stated in the Contract Data.

1.5

Priority of Documents

The ruling language of the Contract shall be that stated in the Contract Data.

The language for communications shall be that stated in the Contract Data. If no language is stated there, the language for communications shall be the ruling language of the Contract.

The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:

- (a) the Contract Agreement (if any),
- (b) the Letter of Acceptance,
- (c) the Tender,
- (d) the Particular Conditions - Part A,
- (e) the Particular Conditions - Part B,
- (f) these General Conditions,
- (g) the Specification,
- (h) the Drawings, and
- (i) the Schedules and any other documents forming part of the Contract.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

TABLE OF CONTENTS

PART II - SPECIAL/PARTICULAR CONDITIONS OF CONTRACT

Clause	Title	Page
1.1	Definitions	145
3.1	Engineer's Duties and Authority	
4.3	Contractor's Representative	145
6.10	Records of Contractor's Personnel and equipment	145
7.9	Use of Pakistani Materials and Services	145
8.1	Commencement of Works	145
8.11	Prolonged Suspension	
8.3	Programme	
13.1	Right to vary	
13.3	Variation procedure	
13.8	Adjustment for changes in cost	
14.1	Contract Price	
14.2	Advance Payment	
14.5	Plants and Materials intended for Works	
14.8	Delayed Payments	
15.2	Termination by Employer/Procuring Agency	
15.6	Corrupt and fraudulent Practices (Integrity Pact).	
16.4	Payment on Termination	
17.3	Employer's/Procuring Agency's Risks	
18.1	General Requirements for Insurance	
19.6	Optional Termination, Payment and release by the Employer	
20.1	Contractor's Claims	
20.2	Appointment of the Dispute Board / Notification of the Committee	
20.3	Failure to agree on the composition of the Dispute Board.	
20.4	Obtaining Dispute Board's Decision	
20.5	Amicable Settlement.	
20.6	Arbitration	
20.7	Failure to comply with Dispute Board's Decision	
20.8	Expiry of Dispute Board's Appointment	
APPE		
NDIX.	General Conditions of Dispute Board Agreement	
Annex	PROCEDURAL RULES	

PART II - SPECIAL /PARTICULAR CONDITIONS OF CONTRACT

1.1 Definitions

1.1.1.4 “Form of Bid” is synonymous with “Letter of Tender”.

1.1.1.5 “Bid” is synonymous with “Tender”.

1.1.1.10 “Bidding” is synonymous with “contract”.

The following paragraph is added:

1.1.1.11 “Programme” means the programme to be submitted by the contractor in accordance with Sub-Clause 8.3 and any approved revisions thereto.

1.12.2 “Employer” is synonymous with “Procuring Agency”

1.1.2.9 “DB” is synonymous with “Committee”.

1.1.3.1 Replace 28 days by 7 days in LCB and 15 days in ICB..

1.1.3.7 “Defects notification Period” is synonymous with “Defects liability Period”.

1.15 Inspections and Audit by the Bank

Deleted

Procuring Agency can retain this clause with or without changes, in case of contracts under Project, Bank and donor’s programme.

3.1 Engineer’s Duties and Authority.

The following paragraph is added after duties:

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

4.3 Contractor’s Representative

The following text is to be added after last line:

The contractor’s authorised representative and his other professional engineers working at site shall register themselves with the Pakistan Engineering Council.

6.10 Records of Contractor’s Personnel and 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-clause 7.9 is added in (GCC):

7.9 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.

8.1 Commencement of Works

The last para 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.

8.11 Prolonged Suspension

Replace 84 days by 120 days.

8.3 Programme

The following text is to be added after [Commencement of Works]

The programme shall be submitted in the either form of:

- a) Bar Chart identifying the critical activities.
- b) Critical Path Method (CPM) identifying the critical path/activities.
- c) Program Evaluation and Review Techniques (PERT).
(Procuring Agency to select appropriate one)

13.1 Right to vary

In the last line of Para, after the word "Variation", the word "in writing" is added.

13.3 Variation procedure

In the tenth line, after the words "as soon as practicable" following is added:
"and within a period not exceeding one-eighth of the completion time"

13.8 Adjustment for changes in cost

This clause will be applicable for Foreign funded Project/ Schemes or ICB Contracts (locally & foreign funded) only.

The following provision is added for Local funded Project/ Schemes/National Competitive Bidding Contracts:

The amounts payable to the Contractor, pursuant to Sub-Clause 14.6, shall be adjusted in respect of the rise or fall in the cost of materials only, and will be paid to the contractor on those items mentioned in the **Appendix –C (B)**.

Similarly reduction in the cost of these materials will also be recovered from the contractor accordingly

14.1 The Contract Price
Sub-para (d) is deleted.

14.2 Advance Payment

The Text is deleted and replaced with following:

Advance Payment/Mobilization Advance shall be made available to the Contractor by the procuring agency on following conditions:

Mobilization Advance/Advance Payment

- (i) Mobilization advance up to 10 % of the Contract Price may be paid by the procuring agency to the Contractor on the works costing Rs2.5 million or above on following conditions:
 - a. on submission by the Contractor of a mobilization advance guarantee for the full amount of the advance in the specified form, from a Scheduled Bank in Pakistan, acceptable to the procuring agency;
 - b. [XXX]¹
- (ii) This Advance [XXX] shall be recovered in 5 equal installments from the 5 R.A bills and in case the number of bills is less than 5 then 1/5 of the advance [XXX] shall be recovered from each bill and the balance [XXX] be recovered from the final bill. It may be insured that there is sufficient amount in the final bill to enable recovery of the Mobilization Advance.

14.5 Plants and Materials intended for Works

Add the following paragraph as sub-clause 14.5 (d) for Secured Advance on non – perishable materials and sub-clauses (a), (b) and (c) will be applicable for plants only :-

- (I) The Contractor shall be entitled to receive from the procuring agency Secured Advance against an INDENTURE BOND in Public Works Account Form No.31 (Fin. R. Form No. 2) acceptable to the procuring agency of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the site but not yet incorporated in the Permanent Works provided that:
 - (i) The materials are in accordance with the specifications for the permanent works;
 - (ii) Such materials have been delivered to the site and are properly stored and protected against loss or damage or deterioration to the satisfaction and verification of the Engineer/Assistant Engineer but at the risk and cost of the Contractor;
 - (iii) The Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records shall be available for inspection by the Engineer;
 - (iv) The Contractor shall submit with his monthly statement the estimated value of the materials on site together with such documents as may be required by the Engineer for the purpose of valuation of materials and providing evidence of ownership and payment therefore;

¹ Deleted in the light of amendment in Sindh Financial Rules, vide Finance Department's Notification dated 27th April, 2017 and approval from SPPRA Board in its 30th Meeting held on 9th August, 2017.

- (v) Ownership of such materials shall be deemed to vest in the procuring agency and these materials shall not be removed from the site or otherwise disposed of without written permission of the procuring agency;
- (vi) The sum payable for such materials on site shall not exceed 75 % of the (i) landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of locally manufactured or produced materials, or (iii) market price of stands other materials;
- (vii) Secured Advance shall not be allowed unless and until the previous advance, if any, is fully recovered;
- (viii) Detailed account of advances must be kept in part II of running account bill or a separate statement; and
- (ix) Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 3 months from the date of issue of secured advance and in no case for full quantities of materials for the entire work/contract.

(II) Recovery of Secured Advance:

Secured Advance paid on non-perishable materials to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis, but not later than period specified in the rules not more than three months (even if unutilized);

14.8 Delayed Payment

Second Para is replaced with following text:

In the event of the failure of the Procuring Agency to make the payment within the time stated, the procuring agency shall pay to the contractor in case of **ICB contracts only**, the compensation at rate of KIBOR+2% per annum in local currency and Libor+1% for foreign currency, upon all sums to be paid from the date of which the same would have been paid.

15.2 Termination by Employer

The following Para is added at the end of the sub-clause:

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

15.6 Corrupt and fraudulent Practices.

The following text is to be added as 3rd paragraph:

Successful Contractor has to provide Integrity Pact (for contracts worth Rs.10.0 million and above).

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

- Ⓐ 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;
- Ⓑ terminate the Contract; and
- Ⓒ recover from the Contractor any loss or damage to the procuring agency as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agents or servants.

The termination under sub-para (b) of this Sub-Clause shall proceed in the manner prescribed under sub-clauses 15.2 & 15.5 and the payment under Sub-Clause 15.4 shall be made after having deducted the amounts due to the procuring agency under Sub-Para (a) and (c) of this Sub-Clause.

16.4 Payment on Termination

Sub-paragraph (c) is deleted.

17.3 Employer's/ Procuring Agency's Risks

Sub-Clause 17.3 (h) is deleted.

The following text is added in Clause 18.1 (GCC):

18.1 General Requirements for Insurance

The contractor shall be obliged to place all insurances relating to the contract (including, but not limited to, the insurances referred to in Clauses 18.1,18.2,18.3,18.4) with Insurance Company having at least AA rating from PACRA/JCR in favour of the Employer//Procuring Agency valid for a period 28 days after beyond the Bid Validity date.

Costs of such insurances shall be borne by the contractor.

19.6 Optional Termination, Payment and release by the Employer

Sub-clauses (c), (d) and (e) are deleted.

20.6 Arbitration

Text will be replaced as under; Any dispute in respect of which:

(a) *the decision, of the Dispute Board has not become final and binding pursuant to sub- clause 20.2, and*

(b) *amicable settlement has not been reached within the period stated in sub-clause 20.5, shall be finally settled, under the provisions of the Arbitration Act, 1940 as amended or any statutory modification/Rules of Conciliation And Arbitration PEC Islamabad or re-enactment thereof for the time being in force.*

The place of arbitration shall be Karachi, in Sindh Province.

PART II –SPECIAL/PARTICULAR CONDITIONS OF CONTRACT

INDEX	CLAUSE
Adjustment for changes in cost	13.8
Advance Payment	14.2
Amicable Settlement.	20.5
Appointment of the Dispute Board / Notification of the Committee	20.2
Arbitration	20.
6	
Commencement of Works	8.1
Contractor's Representative	4.3
Contractor's Claims	20.1
Contract Price	14.1
Corrupt and fraudulent Practices (Integrity Pact).	15.6
Definitions	1.1
Delayed Payments	14.8
Employer's/Procuring Agency's Risks	17.3
Engineer's Duties and Authority	3.1
Expiry of Dispute Board's Appointment	20.8
Failure to agree on the composition of the Dispute Board.	20.3
Failure to comply with Dispute Board's Decision	20.7
General Conditions of Dispute Board Agreement	
	Appendi
x General Requirements for Insurance	18.1
Optional Termination, Payment and release by the Employer	19.6
Obtaining Dispute Board's Decision	20.4
Payment on Termination	15.6
Plants and Materials intended for Works	14.5
PROCEDURAL RULES	Annex
Prolonged Suspension	8.11
Programme	8.3
Records of Contractor's Personnel and equipment	6.10
Right to vary	13.1
Termination by Employer/Procuring Agency	15.2
Use of Pakistani Materials and Services	7.9
Variation procedure	13.3



(VOLUME -II)
SPECIFICATIONS

SPECIFICATIONS CIVIL WORKS

GENERAL FOR “SITE CLEARING”

1.0 DESCRIPTION OF WORK

- a) Extent of site clearing is shown on the drawings.
- b) Site clearing includes, but is not limited to the following:
 - Protection of existing trees.
 - Removal of trees and other vegetarian.
 - Top Soil stripping.
 - Clearing and grubbing.
 - Removing redundant structures.

2.0 JOB CONDITIONS

- a) Traffic
Conduct site clearing operation to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.
- b) Salvagable Improvements
Carefully remove items indicated to be salvaged, and store Employer's premises where indicated or directed.

3.0 EXECUTION

3.0.1 SITE CLEARING

- a) General
Remove trees, shrubs, grass and other vegetation, improvements, or obstructions interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated. Removal includes digging out stumps and roots.
- b) Topsoil
Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Dispose off unsuitable or excess topsoil same as waste material, herein specified.
- c) Clearing and Grubbing
Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing.
- d) Removal of Improvements
Remove existing structures (e.g. Septic Tank, Soak pit, perimeter drain, broken boundary wall, kutcha huts) necessary to permit construction, and other work as indicated.

Abandonment or removal of certain underground pipe or conduits may be shown on mechanical or electrical drawings, and is included under work of those sections. Removal of abandoned underground piping or conduit interfering with construction is included under this section.

3.0.2 DISPOSAL OF WASTE MATERIAL

- a) Removal from Employer's Property
Remove waste materials and unsuitable and excess topsoil from Employer's property and dispose of off site in legal manner.

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

GENERAL FOR “DEWATERING”

4.0 DESCRIPTION

The work to be performed under this item shall consist of supplying all labor, materials and plant and the performance of all work necessary for lowering and continuously controlling the piezometric levels of the groundwater in the subsurface material as well as the control and handling of surface water, in such a manner as to maintain the bottom and slopes of the excavations for the structures in a stable condition, and to perform in the dry, and as shown on the excavation drawings. Dewatering drawings to be prepared by the Contractor for deep foundations as specified herein and as required by the Engineer.

5.0 QUALITY ASSURANCE

The Contractor shall build, maintain and operate all dams, channels, flumes, sumps and other temporary diversion and protective works needed to divert the surface water through or around the required excavations.

All excavations shall be dewatered and kept free of standing water. Water seeping from the sides and bottom of the excavations above the free level or excessively muddy conditions as needed for proper execution of the excavation operations. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps and other equipment needed to dewater the excavation areas. Dewatering methods that cause a loss of fines from the bottom and slopes of the excavations will not be permitted.

The work shall include designing, supplying, installing, operating, and maintaining a system of wells complete with pumps and associated equipment, standby power arrangements, piezometers and all other equipment necessary to achieve the required control of the groundwater and surface water in the areas as shown on the drawings, as specified herein and as required by the Engineer. The work shall also include the construction and maintenance of ditches, land sumps as required to achieve the specified results.

6.0 SUBMITTAL

Prior to commencement of the work, the contractor shall furnish the Engineer for review and comments with complete plans and sketches for diverting surface water and dewatering of the required excavations. The Contractor shall submit detailed design calculations where required. To provide safe and stable excavations is the sole responsibility of the Contractor. Submission for review and comments of the required plans and sketches and any approval from Engineer shall not relieve the Contractor of any of his duties under the Contract.

The Dewatering System shall consist of the Basic Dewatering System, the Standby Dewatering System, Standby Power System, monitoring devices, ditches, sumps, pumps and all associated equipment as specified herein.

The basic Dewatering System shall be the minimum dewatering system required to achieve the specified results.

The Standby Dewatering System shall be that system which may be required to achieve the specified results should part or all of the Basic Dewatering System becomes ineffective for maintenance or any reason other than a failure of the power

supply.

The Standby Power System shall be the independent generating system which may be required to keep the dewatering system fully operational in the event of a power failure.

7.0 DESIGN OF DEWATERING SYSTEM

The Contractor shall arrange to have the entire Dewatering System designed in detail, installed, maintained and operated by qualified and experienced personnel throughout the course of the work.

Should the Contractor wish consideration to be given to some properly qualified dewatering sub-contractor his name, qualifications, record of previous jobs of a similar nature, personnel to be employed on the work, and other pertinent information shall be submitted to the Engineer for approval with the tender.

Two weeks prior to commencement of installation of the Dewatering System, Contractor shall submit to the Engineer for his technical approval, complete final plans, details and descriptions of the Dewatering System.

The Contractor shall be responsible for the arrangements and locations of the various Dewatering System components necessary to accomplish the specified work.

The Engineer's approval of the installed dewatering System will be based on the demonstrated performance of the System and the effectiveness with which it satisfies the requirements for dewatering the foundation areas during the entire period upto elevation + 4.00.

Approval of the Dewatering System by the Engineer shall in no way relieve the Contractor from the responsibility for satisfying the entire dewatering requirements as specified herein and to the satisfaction of the Engineer.

8.0 EXECUTION OF DEWATERING THE EXCAVATION

The Contractor shall install maintain and operate a system wells, trenches and pumps as required to perform the excavations for the areas and subsequent construction of the structures and placement of back fill in the dry.

The dewatering of the excavations shall be accomplished in a manner that will prevent seepage, boils, loss of fines, corrosion, softening of the strata, and that will maintain the stability of the bottom and slopes of excavation. Should any damage to work, in the opinion of the Engineer, be due to the inadequacy or failure of the Dewatering System, in part or in whole, then the supply of all labor, materials and plant & the performance of all work necessary to carry out additional or remedial work resulting from such damage shall be undertaken by the Contractor at no additional compensation. The cost of any damage caused to the structures or the permanent works like structures and machinery and other equipment due to the failure of the dewatering system shall be borne by the Contractor and shall be covered by proper insurance to be provided by the Contractor and in accordance with insurance clauses of the "General Conditions of Contract".

The Dewatering System shall be designed to operate on a continuous basis in such a manner that during excavation, the water level as observed in all piezometers installed near the periphery of the excavation with their tips located below the prevailing excavation level, is at least one meter below the prevailing excavation level. If the water level observed in any or all of the piezometers is higher than that specified, the excavation shall be halted until remedial measures to the Dewatering

System have been effected and the specified water levels in the piezometers attained or until the Contractor demonstrates to the satisfaction of the Engineer that it is safe to proceed with the excavation. piezometers tips shall be installed near the bottom of the hole drilled for that purpose.

During construction of structures and subsequent back fill placement and associated work operations, the Dewatering System shall operate in a continuous basis in such a manner that the water level, as observed in the piezometers located below the level of the construction and back fill placement is at least one meter below the lowest point of construction and back fill placement and the water level in the piezometers is maintained at such level till the concrete if any, has sufficiently hardened and until in the opinion of the Engineer, it is safe to allow the water level to rise upto a predetermined level.

The Dewatering System shall be maintained in operating condition so as to achieve the specified results until the construction of the structures and the back fill placement at all points, and installation of machinery reached a state when, in the opinion of the Engineer Dewatering is no longer required. Thereafter the Dewatering system shall shut off in stages as directed by the Engineer.

The Contractor shall not permit the accumulation of surface water within the confines of the excavation areas. The Contractor shall control, remove and divert surface water runoff, and water discharging from the Dewatering System away from the excavations, to a point outside the working area as required by the Engineer.

The Contractor shall perform all work including, but not limited to, the construction and maintenance of ditches and sumps and provide, install maintain and operate pumps and pipelines of adequate capacity as are necessary for the effective control of surface runoff and groundwater not required to be intercepted by the Dewatering Systems.

The Contractor shall supply, install, maintain and operate as required, the generators for power supply which shall be of sufficient capacity to maintain all pumps and equipment for both the Basic and Standby Systems, operating on a continuous basis.

The Contractor shall supply, install and maintain an alarm system which will alert responsible personnel at the time of power failure and at the same time will automatically activate the standby power units.

The Dewatering System shall be designed in such a manner that all or parts of the Standby System may be directly connected to the Basic System. If during construction, it becomes necessary to make this connection, the contractor shall expeditiously perform all work necessary to resolve the Standby Dewatering system to the requirements as hereto specified.

The Standby Dewatering System shall be operated for a period of at least 3 hours duration each week to demonstrate its complete effectiveness. For such demonstration no payment or compensation shall be paid to the Contractor.

9.0 OBSERVATIONS

Contractor's Dewatering System shall include the supply, installation, data recording and maintenance of piezometers as may be required to demonstrate the satisfactory performance of the Dewatering System.

In order to ascertain the continuous effectiveness of the Dewatering System, Contractor shall supply all equipment and perform all work necessary to obtain and correlate records of the water elevations in each of the piezometric observation well as records of the discharges from the Dewatering System. These data shall be

obtained on a continuous basis and shall be properly compiled and copies of the compiled data shall be submitted to the Engineer daily, or as required. The Contractor shall also keep the Engineer advised on a daily or as required basis on the equipment being utilized to effect the required results during the period when the Dewatering System is in operation.

10.0 PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities.

The cost thereof shall be deemed to have been included in the other items of the Bill of Quantities.

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

GENERAL FOR “*SHORING AND UNDERPINING*”

11.0 DESCRIPTION

Extent of shoring and bracing work includes, but is not limited to the following:
Shoring and bracing necessary to protect existing foundations, building, streets, walkways, utilities, and other improvements and excavation against loss of ground or caving embankments.

Maintenance of shoring and bracing.

11.1 QUALITY ASSURANCE

1. Supervision:
Assign supervision of shoring and bracing work to qualified personnel.
2. Regulations:
Comply with local codes and ordinances of governing authorities having jurisdiction.

11.2 SUBMITTALS

1. Design Drawings
Provide design drawings or methods for shoring and bracing system and other data. System design and calculations must be acceptable to local authorities having jurisdiction and as well as consultants and Engineer.

12.0 JOB CONDITIONS

12.1 GENERAL

Before starting work, check and verify governing dimensions and elevations. In company with Engineer jointly survey condition of adjoining properties. Take photographs, as directed by Engineer, recording any prior settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages, verified by dated photographs, and signed by Contractor and Engineer and others conducting the investigation.

Survey adjacent structures and improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. Locate datum level used to establish benchmark elevations sufficiently distant so as not to be affected by movement resulting from excavation operations.

During excavation, resurvey benchmarks weekly. Maintain accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags or other damage is evident.

12.2 EXISTING UTILITIES

Protect existing active sewer, water, gas, electricity and other utility services and structures schedule to remain.

Notify municipal agencies and service utility companies having jurisdiction. Comply with requirements of governing authorities and agencies for protection, relocation, removal and discontinuing of services, as affected by this work.

13.0 EXECUTION

13.1 SHORING AND SHEET PILES

Protect the existing foundations and site from caving and unacceptable soil movement. Wherever shoring or sheet piles are required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring or pile system adequately anchored and braced to resist earth and hydrostatic pressures.

13.2 BRACING

Locate bracing to clear columns, floor framing constructions, and other permanent work. If necessary to move a brace, install new bracing prior to removal of original brace. Do not place bracing where it will be cast into or included in permanent concrete work, except as otherwise acceptable to Engineer. Install internal bracing, if required, to prevent spreading or distortion to braced frames. Maintain bracing until structural elements are rebraced by other bracing or until permanent floor construction is able to withstand lateral earth and hydrostatic pressures. Repair or replace, as directed by Engineer adjacent work damaged or displaced through the installation or removal of shoring and bracing work.

14.0 PAYMENT

No payment shall be made for the works involved within the scope of this section of specification unless otherwise specifically stated in the Bill of Quantities. The cost thereof shall be deemed to have been included in the other items of the Bill of Quantities.

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

GENERAL FOR “EXCAVATION & EARTHWORK”

15.0 DESCRIPTION

The works covered by this section of the Specifications, consist of furnishing all plant, labor, equipment, appliances and materials, and in performing all operations in connection with earthworks, in accordance with this section of the Specifications and the applicable drawings, subject to the terms and conditions of the Contract.

16.0 GENERAL

- i The Contractor shall acquaint himself with the nature of the ground, existing structures, foundations and sub-soil conditions which may be encountered during excavation or other earthworks.
- ii The Subsoil Investigation Report is available with the Engineer for reference. However, the Employer does not guarantee or warrant in any way that the material 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 Report, Drawings or in any other Contract Documents or to material obtained from boring or trial holes. 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, sub- soil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.
- iii. All excavation, cutting, embankments and fill shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Period of Maintenance the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Period of Maintenance, any damage or defects in cutting and embankments, to structures and other works, caused by slips, falls or wash-ins or any other ground movement due to the Contractor’s negligence shall be made good by the Contractor at his own cost.
- iv. Arrange for inspection by Local Authority to verify and approve the discharge of surface water and to verify the location of the sewer connection.

17.0 DUST CONTROL

- i Control dust on and near the work and near off-site borrow areas if such dust is caused by the Contractor’s operations during performance of the work or if resulting from the condition in which the Contractor leaves the Site.
- ii Thoroughly moisten surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the Site.

18.0 ANTIQUITIES

Any ancient carvings, relics of antiquity, coins, or other curiosities, which are discovered or excavated during the progress of the work will remain the property of the Employer and are to be handed over to the Engineer.

19.0 SITE PREPARATION

- i The Contractor shall set out the works and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If, at any time, any error in this respect should appear during the progress of the works, the Contractor shall at his own expense rectify such an error to the satisfaction of the Engineer.
- ii The Contractor shall construct and maintain accurate bench marks, so that, the lines and levels can be easily checked by the Engineer.
- iii The Contractor shall construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction, at no extra cost to the Employer.
- iv Clearing shall consist of filling and cutting up, or the trimming of trees and the satisfactory disposal of the trees and other vegetation designated for removal, together with downed timber, snags, bushes and rubbish occurring within the areas to be cleared. Trees, other vegetation, stumps, roots, and bushes in areas to be cleared shall be cut off flush with or below the original ground surface except such individual trees, group of trees, and vegetation as may be indicated on the drawings or designated by the Engineer to be left standing. Individual trees, group of trees, and other vegetation, to be left standing shall be thoroughly protected from damage incident to construction operations, by the erection of the barriers or by such other means as the circumstances require, as approved by the Engineer. Clearing operations shall be conducted, so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and to provide for the safety of workers, so as to provide for the safety of employees and others.
- v Grubbing shall consist of the removal and disposal of all stumps, roots, larger than 1-1/2" (38 mm) in diameter, matted roots in the designated grubbing areas. Stumps, roots, logs or other timber larger than 1-1/2" (38 mm) in diameter, matted roots & other debris shall be excavated and moved to a depth not less than 18" (450mm) below any sub grade, shoulder or slope. In areas, where the cut is over 3ft (1.0m), grubbing shall not be necessary. In areas to be paved, or in areas indicated on the drawings as future paved areas, where, excess excavation from grading operations is placed, or in areas designated by the Engineer as future paved areas, where excess excavation from grading operations is placed, grubbing will be necessary.
- vi Timber and other refuse to be disposed off by burning, shall be burned at locations specified by the Engineer in a manner that will avoid all hazards such as damage to the existing structures, construction in progress, trees and vegetation. The Contractor shall be responsible for compliances with all pertinent laws and regulations. Disposal by burning shall be kept under constant attention until the fires have been burned out or have been extinguished. No materials will be permitted to be pushed or placed on adjacent private property without prior written approval of the Engineer.

19.1 EXISTING UTILITIES

Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protecting during excavation operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the utility Employer immediately for directions. Cooperate with Employer, and public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility Employer.

Do not interrupt existing utilities servicing facilities occupied and used by the Employer or others, except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.

Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with local utility companies for shut-off of services if lines are active.

19.2 USE OF EXPLOSIVES

The use of explosive is not permitted without specific and written approval from the Engineer.

Protection of Person and Property.

Barricade open excavations occurring as part of this work. Protect structures, utilities, side walks, pavements and other facilities from damage caused by settlement, lateral movement, under mining, washout and other hazards created by excavation operations.

20.0 EXCAVATION

- i Excavation shall include the removal of all material of every name and nature.
- ii The Contractor shall give reasonable notice that he intends to commence any excavation and he shall submit to the Engineer full details of his proposals. The Engineer, may require modifications to be made if he considers the Contractor's proposal to be unsatisfactory and the Contractor shall effect such modifications but shall not be relieved of any of his responsibilities with respect to such work.
- iii For major excavations, the Contractor shall submit for prior approval of the Engineer, full details and drawings showing the proposed method or procedure of supporting and strutting, de-watering and maintenance of adjacent structures. The design, provision, construction, maintenance and removal of such temporary works shall be the responsibility of the Contractor, and all costs in this respect shall be included in the billed rates for the permanent works.
- iv The Contractor shall preserve the completed excavation from damage resulting from slips and earth movements, ingress of water from any source whatsoever and deterioration by exposure to the sun and the effect of the weather.

- v All excavation of every description in whatever material encountered shall be performed to the elevations and dimensions shown on the drawings in such a manner as to avoid interruption to work in other parts of the Site. The Contractor, shall be responsible for damage to the permanent works caused by excavation in other parts of the work.
- vi Excavation shall extend to sufficient distance from walls and footing to allow for placing and removal of forms, installations of services, and for inspection, except where it is required to deposit concrete for walls and footings directly against excavated surface.
- vii All excavations in foundations shall be taken to 6" (150 mm) above the final excavation elevations shown on the drawings and the last 6" (150 mm) shall be trimmed carefully to a smooth and level surface. Immediately after trimming to the final elevation a layer of blinding concrete shall be placed to the thickness shown on drawings. All excavations for foundations which have been trimmed shall be covered by over site concrete by the end of the day. It is specifically brought to the notice of the Contractor, that, any excavation taken down to the trimmed elevation which is left overnight or for any length of time thereafter, uncovered by the blinding concrete, shall be required to be trimmed to such lower elevation as directed by the Engineer and any extra work or any consequent increase in the quantities caused thereby shall not be paid to the Contractor.
- viii No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the Engineer and his permission to proceed given.
- ix If excavation for footings are carried below the required level, as shown in the Drawings or as directed by the Engineer, the surplus depth shall be filled with concrete having $f'c = 1.5$ ksi at the sole cost of the Contractor.
- x All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry and the Contractor shall have sufficient equipment for this purpose. Adequate precautions shall be taken to prevent any erosion due to undercutting from underneath the previously constructed adjoining foundations. Any dewatering required for this purpose shall be deemed to be included in Contractor's rates for this excavation.
- xi Shoring, including sheet piling, where required during excavation, shall be installed to protect workmen and the banks, adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor elects to adopt, with prior approval of Engineer, for upholding the sides of excavation and also for planking and strutting the excavation against the side of public roadways and adjoining properties in existing hard core of 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.
- xii Excavations, for deep retaining walls, shall be protected from drying out by covering with tarpaulins or other means, if excavation is to stand open more than 24 hours. This is a precaution to prevent excessive surcharge loads acting on the wall, from the drying out and subsequent swelling of the clay soils when saturated either by rain or capillarity of ground water.
- xiii If rock is encountered, it shall be removed carefully and without excessive noise and vibration. Blasting, if required shall be done by persons skilled in such work

and as directed by the Engineer. Necessary permission for blasting should be obtained from respective Government Authorities by the Contractor. All necessary precautions shall be taken to see that the general public and the properties in the vicinity shall not receive any damage by such blasting. Rock, to receive footings shall be stepped and leveled.

- xiv Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, which are to be retained, as well as those utility lines constructed during excavation operations, shall be protected from damage during excavation and back filling, and if damaged, shall be repaired by the Contractor at his own expense. Any existing utility lines, which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor at his own cost. When, utility lines which are to be removed, are encountered within the area of operations, the Contractor shall notify the Engineer in ample time for the necessary measures to be taken to prevent interruption of the service.
- xv Excavated material suitable for use as filling material shall be deposited as directed by the Engineer. Surplus or material unsuitable for use as filling shall be disposed off by the Contractor to areas approved by relevant authorities for this purpose.

21.0 PESTICIDES

- i Pesticides for the control of termites shall be Dieldrine, Aldrine or Chloride Heptachlor conforming to manufacturer's specifications and approved by Engineer.
- ii Pesticides shall be mixed with clean water to produce a 0.5% solution (0.396 for Chloride Heptachlor) for application in earth.
- iii. Pesticide solutions shall be applied inside building lines and for a distance of 10 feet outside all buildings with an approved pressure spray maintaining a pressure of 1 N/mm^2 (150 psi).
- iv Stockpiled excavated material to be used for back fill shall be sprayed to penetrate 1 in. minimum depth.
- v After excavations for foundations, trenches pits etc. are completed and passed by Engineer as ready to receive concrete, pesticide solution shall be applied to sides and bottoms.
- vi After granular material fill is laid under ground floor or grade slabs to buildings but before plastic sheet membranes are set, pesticide solution shall be applied over same area to which extend.
- vii Penetration of pesticide solution shall be 1 in. minimum to sides of excavations and 3 ins minimum to bottoms and beneath slabs. Spray treatment is not to be used below bearing footings.

22.0 FILLING

- i After completion of foundation work, walls, and other construction below the elevation of the final grades, and prior to filling, forms shall be removed and the excavation shall be cleaned of trash and debris.
- ii Filling shall be approved selected material from excavation or other predominantly granular material and free from slurry, mud, organic or other unsuitable matter and capable of compaction by ordinary means.
- iii Filling in trenches and foundations shall be placed in 6" (150 mm) layers and compacted to optimum moisture content by mechanical means, where possible.
- iv Filling around pipes and cables shall be carefully placed fine material to cover the pipe or cable completely before the normal in filling is placed.
- v Material for bulk filling shall be as approved by the Engineer and shall be placed in layers of 6" (150 mm) and saturated with sufficient water or otherwise compacted to produce not less than 95% in-situ density with respect to the maximum density, at optimum moisture content, as per ASTM D- 1557 method C. In place determination of dry density of soil shall be by ASTM D-1556-64.
- vi All filled areas shall be left neat, smooth and well compacted, the top surface consisting of the normal site surface soil, unless directed otherwise.
- vii Filling shall not be placed against foundation walls prior to approval by the Engineer. Filling shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the filling shall not be operated closer to the wall than a distance equal to the height of the filling above the top of footing.
- viii All structures retaining the earth shall have a filling of granular material for drainage through the weep holes or rubble drain as shown on the drawings or as additionally directed by the Engineer. This granular material shall consist of following gradation requirements.

SIEVE % PASSING BY WEIGHT 1-1/2" 100

3/4"	80 - 90
# 4	60 - 70
# 10	45 - 55
# 40	15 - 25
# 100	5 - 15
# 200	less than 5

Drainage mediums shall be free of dirt, chemically inert and well graded so that when placed and compacted this filling shall be stable.

- ix Fill material to bring sub grade for slab on grade, exterior pavements, steps etc. to underside of slab shall be free draining granular material such as concrete sand or approved fill material with fineness modulus between 2.7 & 3.0.

23.0 EMBANKMENT

- i No embankment shall be commenced until the foundations have been approved by the Engineer. When approved as suitable by the Engineer, material arising from the excavations may be used for filling as required. Mud, slurry, organic matter, peat and any other unsuitable material shall not be used for filling for any purpose on the Site. Where suitable materials from the excavations are insufficient for filling, the requirements shall be made up of other granular material which the Contractor shall obtain from sources approved by the Engineer.
- ii The location of sources of supply of this filling material will be left to the Contractor, but the quality of the filling material brought from outside will be subject to the approval of the Engineer. The Engineer shall require the Contractor to carry out various tests of the filling material. All such tests, shall be made at an approved laboratory at the cost of the Contractor.

Once, a material from a specific source has been approved, the material of the same quality and from the same source shall be used. Any filling material from borrow pits, which has not been approved or the quality of which differs from the approved material shall be rejected outright without recourse. The Engineer reserves the right to order the removal of any such materials brought to the Site of the works, at Contractor's expense. In order to ensure satisfactory compaction, it will be necessary to carry out, depending upon the type of material, particle size distribution tests, determination of organic content tests, maximum and minimum density tests and determination of optimum moisture content for the filling material.
- iii The method of compaction, namely type of roller, weight of roller and number of passes proposed by the Contractor for any particular filling material shall be subject to the approval of the Engineer, after the completion of satisfactory field tests, subsequent to the laboratory analysis, using the materials and equipment proposed to be used for the earthwork in conditions similar to those likely to be encountered during construction. The final selection of the soil moisture content, the thickness of layers, the type of compaction equipment and the number of passes shall be decided after these tests, which shall be conducted at Contractor's expense.
- iv Having established the method of compaction to be used, no departure from this approved method shall be permitted without the prior approval of the Engineer. The adequate control of the filling and compacting operations shall be ensured by in-situ density tests and in order to obtain significant results, not less than two measurements shall be carried out per one thousand square feet (100 square meter) of area compacted. The frequency of tests shall be determined on Site and may be varied at the discretion of the Engineer as the work proceeds. Tests shall be carried out in accordance with ASTM D - 1557 method C or such other standards as approved by the Engineer. The standard of acceptance of the compaction be not less than 95% in-situ density with respect to the maximum density, at optimum moisture content, achieved in accordance with ASTM D - 1557 method C.
- v The exact thickness of layers and the method of placing and compacting the filling shall be determined by the field tests, as stated above, but notwithstanding the results of these trials, filling shall not be placed in layers exceeding 6" (150 mm) in thickness. The full width of the embankment shall be placed in one operation. In order to maintain control of the thickness of layers, timber profiles

shall be used. The Contractor shall provide adequate supply of water and sufficient capacity of mechanical water carriers to ensure uniform and uninterrupted operation of compaction. The Engineer may forbid the Contractor to proceed with pacing and/or compaction of filling and/or removal and re-compaction of such filling if he finds that the Contractor has insufficient or defective equipment or that the work is improper.

If it is found necessary to alter the moisture content of the filling material in any way, then very strict control shall be exercised over the wetting and/or the drying process and frequent moisture content tests shall be made.

- vi Where directed, earth slopes shall be protected with handset stone pitching, either dry or in mortar as specified. Pitching stones shall be approved rock rubble, each stone having a minimum depth of 10" (250 mm) and a minimum volume of 0.5 cubic ft (0.015 C.M).

24.0 MEASUREMENT AND PAYMENT

- i Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of, but not limited to the following:
 - a. Labor and all cost in connection therewith.
 - b. Materials, goods, equipment and all costs in connection therewith (e.g. conveyance; delivery; unloading; storing; returning, packing; dewatering; handling; hoisting; lowering; shoring; form works;
 - c. Setting out of works.
 - d. Cost of all laboratory and field tests stipulated in these Specifications.
 - e. Use of Plant.
 - f. Waste of Materials.
 - g. Establishment charges, overhead charges & profit.
 - h. All other expenses, royalties, charges and taxes specified in Conditions of Contract.
- ii Quantities of excavation, filling, embankments, etc. shall be calculated from level taken by the Contractor and agreed by the Engineer before commencement of the work.
- iii Site Preparation
The cost of site preparation shall be deemed to be included in cost of excavation.
- iv Excavation
 - a) The quantities given for excavating and subsequent disposal, shall be deemed to be the bulk before excavating and no allowance shall be made for any subsequent variation in bulk or for any extra space required to accommodate planking and strutting.
 - b) The unit price for excavation shall be deemed to include the following also:
 - Excavating below water-level and excavating in rock
 - Getting out excavated materials by any means necessary and subsequent disposal of excavated material to any lift and lead.
 - Keeping excavations free from water, from any source whatsoever, and providing pumps and other equipment, power attendance for pumping and standing time.
 - Shoring, which shall mean providing everything requisite to uphold the sides of excavation by whatever means are necessary.
 - Placing and compacting of back filling in the excavations to the required degree and elevations as stipulated in the Drawings and as directed by the Engineer.

- c) Excavation and its measurements for foundation/ trenches shall be to the exact dimensions shown on the drawings multiplied by vertical depth of excavation.
 - d) The area, shall be that of the lean concrete layer under all footings and shall not include any extra excavation required for shoring, form work etc. No payment shall be made for any excavation beyond that defined above, or for any unauthorised width and depth.
- v Embankment
- a) Quantities for embankment shall be deemed to be the net volume of the embankment after being placed and compacted to the required degree and elevation as stipulated in the Drawings and as additionally directed by the Engineer.
 - b) Treating the surface of the embankment, filling (e.g. leveling, grading to falls, grading to cambers) shall be deemed to be included in the unit price of embankment.
 - c) Trimming the sides of embankment to slope shall be deemed to be included in the unit price of embankment.

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

GENERAL FOR “*TERMITE CONTROL*”

25.0 DESCRIPTION

The work covered by this section of Specification consists of furnishing all labor, materials, equipment, services, miscellaneous and necessary items required to complete Termite Control and, related works as indicated on drawings, and specified herein, in strict accordance with this section of Specifications, subject to the terms and conditions of the Contract.

26.0 MATERIALS

- i Pesticides shall be solution of 0.5% Dieldrin or a 0.5% Aldrin mixed in clean water for application in earth, and mixed in pure turpentine for application to wood.
- ii Pesticides (Agenda) shall be obtained from the Government of Pakistan, approved Department of Agriculture, or other sources approved by Engineer in sealed drums in the quantity necessary for the requirement of works. All mixing shall be done at Site and the proportion of pesticides used shall be verified by the Engineer.

27.0 METHOD OF APPLICATION

Pesticides solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150 psi (10.5 kg/cm.sq) to all applications to, on or in earth. Spraying to wood shall be done by hand compression with an approximate pressure of 20 psi (1.4 kg/cm.sq).

28.0 WORKMANSHIP

The treatment operation shall be carried out as follows:-

- i After excavation for foundation trenches and pits is complete in each and every respect, and passed for concreting work, but before laying of concrete, Pesticides shall be penetrated to a depth of 1 ins (25 mm) minimum in porous earth at bottom and 2 ins (50 mm) to 3 ins (75 mm) at sides of excavations.
- ii Stock piled excavated materials to be used as back fill is to be treated as above. After back filling to required grade the area is again to be sprayed.
- iii After grading, compaction and leveling of fill and before installation of any soling, all such areas are to be sprayed with pesticide, penetrating a minimum of 1 ins (25 mm) into soil.
- iv Pesticide solution shall be applied inside the building lines and for a distance of 10 feet (3m) outside all building with specified pressure.
- v All rough wood work for the entire project is to be pesticide treated (before application of solignum in the case of material to receive both treatments). Pesticide shall be sprayed on all surfaces of all the wooden work viz., door frames blocking, furring, planks, boards etc., before installation. Spraying is to be done at the Site, after delivery and before installation. No spraying shall be necessary after field sawing, planning, joining or installation of such material. All spraying will be done within one week of working of the materials.

29.0 LOCATION AND SCHEDULING

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

30.0 STANDARDS

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

31.0 GUARANTEE

The Contractor is to guarantee that the building shall be free from termites (white ants), wood bores and other pests or rodents which cause damage to wood or other organic materials for 10 years from the date of acceptance of the building. The Contractor will submit a bond to this affect to the Employer.

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

32.0 SAMPLES & TESTS

All material and samples shall be subject to testing in accordance with the relevant standards specified herein or recommended by approved supplier and shall be rejected if found below these standards. Rejected materials shall be removed from the site immediately.

33.0 MEASUREMENT & PAYMENT

- i Unless otherwise specifically stated in the Bill of Quantities or herein, all the works involved within the scope of this section of Specifications shall be deemed to be inclusive of but not limited to the following:
 - a) CONTRACTORS establishment charges, overhead charges, profit, interest.
 - b) All other expenses, charges, taxes specified in the Conditions of CONTRACT.
 - c) Labor and all costs in connection therewith.
 - d) Use of plant, equipment and machinery and all costs in connection therewith, e.g. mobilization, demobilization, transporting, fuel, energy charges, grease, oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand parking, removing, damaged, destroyed, salvaged.

- ii Material and goods, e.g. marketing, selecting, conveyance, loading, unloading, storing, watching, returning, handling, hoisting, lowering, cutting, joining, fixing, wastage, destroyed, damaged, salvaged.
 - a) The cost of all the works involved within the scope of this section of Specifications as per all the Drawings and Conditions of CONTRACT are covered only within the quoted lump sum rate of the item of the Bill of Quantities.
 - b) No separate payment will be made for Termite Control treatment on wood work covered under this section of Specifications, and all cost in connection therewith shall be deemed to have been included in the unit rates of the relevant items.

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

GENERAL FOR “STONE SOLING”

34.0 SCOPE

The work to be done under this section of Specifications consists of furnishing all plant, labor, equipment, appliances and materials for performing all operations required in connection with the construction of stone soling, in strict accordance with this section of Specifications & Drawings and/or as directed by the Engineer, subject to the terms and conditions of the Contract.

35.0 STONE

Stone to be used shall comprise of strong, hard, durable stone of the approved size free from impurities, quarry sap, dust, dirt and solubility characteristics. The stone shall be obtained from approved quarries and shall be sound free from luminations and weak cleavages.

36.0 CONSTRUCTION

Preparation of sub-grade:

Sub-grade shall be formed of suitable materials free of clods, sod, roots, stumps, brush or other objectionable material. Sub-grade material shall be placed in successive layers not exceeding 6" (150 mm) in thickness loose measure, and each layer shall be thoroughly compacted to the satisfaction of the Engineer, to levels and grades shown on the drawings. Compaction shall be done by approved methods compatible with the soil/material to be compacted.

37.0 STONE BALLAST/ SOLING

- i The stone ballast shall be well graded and broken hard stone of 2" (50 mm) in maximum size obtained from an approved quarry.
- ii The well compacted soling stone shall be approximately 6" (150 mm) in size from an approved quarry.

Laying:

The stone shall be laid and packed to even grades and well rolled using a 10 ton roller to a consolidated thickness as shown on the Drawings.

The whole of the surface of the compacted stone soling will be blinded with murum or any other approved material, after the interstices have been filled with smaller size stones, so as to effectively fill in the voids and crevices, watered, if necessary and again thoroughly rolled with the same roller to produce a smooth and even surface free from irregularities and true to line and level.

Care is to be taken to avoid any damage to existing structures, mains or pipes while rolling operation is in progress. In places inaccessible for a roller, compaction shall be done by hand tampers weighing not less than 20 lb (9 kg) or power rammers, or motorized compacting machines as directed by the Engineer.

38.0 MEASUREMENT & PAYMENT

- i Unless otherwise specifically stated in the Bill of Quantities or herein, all the work involved within the scope of this section of Specifications shall be deemed to be inclusive of but not limited to the following:
 - a) Contractor's establishment charges, overhead charges, profit, interest.
 - b) All other expenses, charges, taxes specified in conditions of Contract.
 - c) Labor and all costs in connection therewith.
 - d) Use of plant, equipment and machinery and all costs in connection therewith e.g. mobilization, demobilization transporting, fuel, energy charges, grease, oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand, parking, removing, damaged, destroyed, salvage.
 - e) Material and goods e.g. marketing, selecting, conveyance, loading, unloading, storing, watching, returning, handling, hoisting, lowering, cutting, joining, fixing, wastage, destroyed, damaged, salvaged.
- ii The cost of all the works involved within the scope of this Specifications as per all the drawings and conditions of Contract are covered only within the quoted rate of items of the B.O.Q.
- iii Unless due to change of Technical Specifications or change in the Drawings, no payment for separate items shall be made.
- iv The measurement for payment of stone soling as specified in the Specifications and B.O.Q will be made on the basis of Cft (Cum) of compacted stone soling conforming to the drawings or as directed by the Engineer.

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

GENERAL FOR “CONCRETE WALKS, ROADWAYS, CURBS & GUTTERS”

39.0 DESCRIPTION

1. Work included.
 - a) This work of providing and installing concrete walkways, roadways, curbs, curb / gutters, walls copings, concrete posts, drainage trenches and covers, water courses, base courses and foundations to same, as shown on Drawings.
 - b) Curbs / gutters, curbs, copings, concrete posts and drainage trench units to be pre cast items.
 - c) Concrete slabs forming bases for paving Work.
 - d) Non-metallic surface drainage pipes required to complete exterior landscaping.
2. Work not included:

Provision and setting of cast iron surface drainage pipes required under parts of the building or connecting surface water drainage trenches. Refer to Plumbing Contract.
3. Related Work:
 - a) For adjacent paving refer to Section 2515 Unit Paving.
 - b) For adjacent block work walling refer to Section 4200 Unit Masonry.
 - c) For adjacent pre cast concrete steps refer to Section 2515 Unit Paving.
 - d) Surface drain rock is described in Section 2900 Landscaping.
 - e) For adjacent road surfacing refer to Section 2545 Tarmacadam Roadway Surfacing.
 - f) Miscellaneous metal required for supporting or joining units described in this Section are described under Section 5100 Miscellaneous Metal.
 - g) For details of excavation, filling and grading not described here refer to Section 2200 Earthworks.

40.0 QUALITY ASSURANCE

1. Qualification of workmen:
 - a) Provide at least one person who shall be thoroughly trained and experienced in the skills required, be completely familiar with the design and application of the Work described for this Section, be present during progress of the Work and direct work performed under this Section.
 - b) For actual finishing of concrete surfaces and operation of the required equipment, use only personnel thoroughly trained and experienced in the skills required.

41.0 SUBMITTALS

1. Make all relevant submittals affecting the work of this Section as described in pertinent Sections of Division 3 of Concrete.
2. Submit 4 ft to 4 ft (1m * 1m) panel samples of pigmented concrete showing finishes described in this Section, within 90 days after the award of Contract, to Engineer for his approval.

42.0 PRODUCT HANDLING

1. Refer to pertinent Sections of Division 3 Concrete.

PART 2 MATERIALS

43.0 CONCRETE FORMWORK

1. Refer to Division 3 Concrete Formwork.

44.0 STEEL REINFORCEMEN

1. Refer to Division 3 Concrete Reinforcement.

45.0 IN-SITU CONCRETE

1. Material for concrete shall be the same in all respects as that used for foundations, beams and slabs. Use ordinary Portland cement. Mix design for external concrete shall be as described in Section 3300 Cast-in-Place Concrete, unless otherwise noted in this Section. No colour tinting is required unless specifically mentioned in the drawings.

46.0 DAMPROOFING

1. Refer to section 7100 Dam proofing for horizontal dam proof courses under copings and wherelse shown on Drawings

47.0 BASE MATERIALS

1. Aggregate for bases under walks to be 1/2 in. to 2 ins (12mm to 50mm) size crushed stone, rock or broken brick approved by Engineer.
2. Granular material behind low retaining walls shall be crushed rock or stone and sand, free of dirt or extraneous matter, graded in even proportions and sized as follows:
 - i) Type 1 6 ins to 4 ins (150mm to 100mm)
 - ii) Type 2 1 -1/2 ins to 1/4 in. (37mm to 6mm)
 - iii) Type 3 sand, graded 1/4 in / down (6mm down)

3. Hardcore for concrete road base shall be hard, durable crushed stone or crushed rock of 3 ins to 4 ins (75mm - 100mm) size, free of thin elongated or laminated pieces, soft, disintegrated or decomposed stones. it shall be clean and free of dirt, organic and other deleterious matter.

48.0 DRAIN PIPES

1. This item includes short lengths of non-metallic pipe for rubble drains carrying percolated water from behind the walls or transferring surface water through walls above grade.
2. Concrete pipes shall be cylindrical with plain butt ends to diameters and lengths shown on Drawings. Comply with pertinent requirements of B.S. 556.
3. Vitrified clayware pipes, similar to those used for soil drains, shall be to diameters and lengths shown on Drawings. Comply with pertinent requirements of B.S. 65.
4. Mesh used at ends of rubble drains shall be expanded metal lath of flat diamond mesh type weighing a minimum of 0.37 lbs per sq. ft. and galvanised to B.S. 729.

49.0 MORTAR MATERIALS

- a) Ordinary Portland cement as described in Section for Cast-in-Place Concrete.
- b) Sand to be clean, sharp angular, free from alkali, slit or organic matter. Comply with BS 1198 - 1200.

50.0 DOWELS AND ANCHORS

1. Refer to Section for Miscellaneous Metal.

51.0 CONCRETE UNITS

1. Pre-cast concrete curbs and curb / gutters to comply with B.S. 340. Curbs to corners, turning spaces etc to be curved to radii shown on Drawings. Fabricate copings, posts and drainage trenches, etc. in accordance with pertinent data of Section 3400 Pre-cast Concrete.
2. Copings shall be cast in 18 in (450 mm) min. lengths.

52.0 CONCRETE WALL FINISH

1. For finishing of exposed concrete walls and foundations below masonry and above grade, refer to Section 9200 External Plasterwork.

53.0 CAULKING

1. Refer to Section 7900 Sealants.

54.0 OTHER MATERIALS

1. Other materials and methods not specifically described, but required for proper fabrication and installation of items in this Section, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

PART 3 EXECUTION

55.0 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to work of this Section, carefully inspect the installed work of other trades and verify that all such work is complete to the point where this installation may properly commence.
 - b) Verify that materials may be installed in strict accordance with the original design, pertinent codes and regulations, and pertinent portions of the referenced Standards.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

56.0 EXCAVATION

1. This article is pertinent to all items of this Section unless otherwise described.
2. The natural sub grade shall be prepared in accordance with the cross section shown on plans. Soft and yielding spots or other unsuitable materials shall be removed and replaced with suitable type. The sub grade shall be compacted and finished to a firm smooth surface. Refer to Section 2200 Earthworks for pertinent data.
3. At road excavation remove a minimum of 1 ft of top soil from existing grade before earth filling and compacting is carried out.

57.0 PLACEMENT OF BASE COURSE

1. Concrete walks and concrete sub-bases:
 - a) This part is pertinent to bases under concrete walks and concrete sub-bases under unit paving.

- b) When laying base course the alignment shall be controlled by an approved method, from Engineer.
 - c) Install 6 ins (150mm) minimum thickness of crushed rock aggregate to BS 6f3 and roll the surface to a smooth and uniform texture, free from lumps rock pockets, soft spots and spongy areas. Compact with smooth wheel roller having a weight of 120 lbs per in. width to density specified in Section 2200 Earthworks.
 - d) Place 3" (75mm) blinding concrete over base, under walks adjacent to roadways and bring to an even surface. Mix to be 1:5:10.
2. Curbs, gutters and roadway:
- a) Apply a layer of 3 in to 4 ins (75mm to 100 mm) hard core evenly over sub-grade. Compact and blind with two passes of a smooth wheel roller of 6-8 tones (13220 - 18210 lbs). Repeat process until a fully compacted, dense close-knit surface is obtained. Finer material being added as required. Total thickness of base to be 6 ins. (150 mm). Density for compaction shall be as specified in Section 2200 Earthworks.
 - b) Place 3 ins. (75mm) blinding concrete over base and bring to an even surface. Compressive strength of concrete shall be 2000 p.s.i. minimum.
 - c) Pre-cast concrete curbs shall be set on a 6 ins (150 mm) of bed of 1:6 by volume all-in concrete mix, haunched up at back.

58.0 FORMS

1. Forms to be wood, straight and free from warp, and of sufficient strength to resist springing during the process of depositing the concrete against them. Use 1 in (25mm) minimum surface wooden planks. Thickness less than 1 in (25mm) may be used for short radii. Ensure that divider plates or other devices holding forms in place do not cause planes of weakness and cracking of concrete. Form depth to be equal to depth to be equal to depth of curbing, gutter, wall or paved walkway and securely fastened at the top.
2. Forms to be securely staked, braced, held firmly to the required line and grade, and be sufficiently tight to prevent leakage of mortar.
3. Forms to be cleaned and oiled before the concrete is placed against them.

59.0 RUBBLE DRAINS

1. Position rubble drains as shown on drawings or as required by Engineer for proper drainage of water from behind the walls.
2. Adequately support pipe drains with concrete benching and secure to forms before casting concrete walls.
3. Ensure that pipes passing through block work are located correctly
4. Wrap expanded metal across end of pipe and wire tie before placement of graded aggregate to prevent backfill from entering pipe.

5. Carefully pack granular backfill material over and around pipes after in-situ concrete work is complete, for protection.

60.0 PLACING CONCRETE

1. GENERAL :
 - a) Refer to pertinent data of Section for Cast-in-Place Concrete for construction joints, where and if required.
 - b) For flat areas, complete panels between expansion joints with same or successive pours. Do not commence pouring panels which cannot be completed the same working day.
2. In-situ walls and curbs :

Placement of in-situ work to conform to pertinent data of Section 3.3 Cast-in-Place Concrete. Install steel dowels to key walls to footings as shown on Drawing.
3. Walkways, roadways and concrete sub-bases :
 - a) Base courses and forms to be checked and approved by Engineer before concrete is placed.
 - b) Set reinforcement, where required, as per Drawings and in accordance with Section 3300 Concrete Reinforcement.
 - c) Concrete to be placed on moist base and deposited to 8 ins. depth or as indicated on Drawings, as specified in Section 3300. Cast-in-place Concrete.

61.0 EXPANSION AND CONTRACTION JOINTS

1. Install as indicated or directed as follows:
 - a) Expansions joints at maximum 20 ft. (6 meters) intervals, as required
 - b) Transverse contractions joints 5 ft. (1.5 meters) intervals (except roadway).
 - c) Roadway expansion joints shall occur at joints with brick border strips.
 - d) Roadway control joint locations are shown on Drawings, if not then it should be placed as per instructions of the Engineer.
2. Where walkway is adjacent to curb, make expansion joints of curb, gutters and walkway coincide.
3. Install expansion joints around manholes or other penetrations and at joints adjacent to concrete curbs, buildings, or permanent structure.
4. Install softwood strips at expansion joints in accordance with Structural Drawings. Permanent strips to be immersed in water for 48 hours prior to placing, and set down sufficient to allow finishing sealant to be placed.
5. Transverse contraction joints to be 1/2 in. wide tooled 'U' shaped depressions.

62.0 GRANULAR BACKFILLING

1. Granular material shall be placed behind retaining walls for percolation of water through to rubble drains. Material shall be placed in layers simultaneously with general fill, and such that filling is stable.
2. Placing shall be as follows:
 - a) Type 1 stones shall be hand packed behind walls to a thickness of 1 ft. (0.5 meters)
 - b) Type 2 stones placed behind Type 1 to a thickness or 1 ft. (0.5 meters).
 - c) Type 3, sand, placed behind Type 2 to a thickness of 1 ft. (0.5 meters) and above.

63.0 DAMPROOF COURSE

1. Install damproof courses under copings, and where shown on Drawings, in accordance with Section 7100 Damproofing.

64.0 PRECAST UNIT PLACEMENT

1. Pertinent data of Section 3400 Pre-cast Concrete relating to installation shall apply to this article.
2.
 - a) Embed and joint in cement sand mortar mix 1:3 by volume, pre-cast concrete curbs, copings, gutters and drainage trench units at locations shown on Drawings. Install dowels and anchors to copings as indicated on Drawings, min. 2 anchors per unit. This operation shall precede the placement of adjacent paved surfaces.
 - b) Placement of units shall be on sufficient bed material to allow all tamping and to attain finish grades shown on Drawings.

65.0 HOT WEATHER REQUIREMENTS

1. Refer to section 3300, Cast-in-Place Concrete.

66.0 COLD WEATHER

1. Refer to Section 3300, Cast-in-Place Concrete.

67.0 FINISHING CAST-IN-PLACE CONCRETE

1. Finish exposed surfaces smooth and uniform, free of open texturing and exposed aggregate, while concrete is still finishing, do not use neat cement as a drier to facilitate finishing. Broom by lightly combing with a medium-stiff broom, after trowelling is complete. Round edges at joints with a 1/2 in. (12.5 mm) radius edging tool. Wood trowel finish all other exposed surfaces unless specified otherwise.

2. Cure and protect concrete in accordance with Section 3300.
3. Where occurring, forms shall be removed within 24 hours after placing of concrete. Minor defects shall be rectified and, where necessary, filled with mortar composed of one part Portland Cement and two parts of fine aggregate. Cure as described in item 2.
4. Finish exposed concrete surfaces below masonry and above finished levels in accordance with Division 9 External finish work

68.0 BACKFILLING

1. Upon completion of setting or casting items of this Section, backfill to designated levels with appropriate material to allow installation of walkways or adjacent surfaces. Compact and shape to required.

69.0 CAULKING

1. Caulking installed under this Section shall be in accordance with Section 7900 Sealants.
2. Install caulking material at:
 - a) Joints between edge of building and adjacent hard surfaces installed under this Section.
 - b) Roadway expansion joints.
 - c) Other locations shown on Drawings.

70.0 TOLERANCES

1. Materials shall be laid so as to provide levels and grades with rises and falls as shown on Drawings with optical instruments. Surfaces shall be smooth and free from bulges and depressions exceeding 1/4 in 10 ft. (6mm in 3 meters).

71.0 CLEANING UP

1. Upon completion of the work of this Section immediately remove debris and excess materials from the Job Site, to approval of Engineer.

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

GENERAL FOR “UNIT PAVING”

72.0 DESCRIPTION

Work included

Work in this Section includes providing and installing the following:

1. Concrete paving, Brick Paving, Sandstone paving, and pool edging including skirting related items and bedding, where shown on Drawings.
2. Masonry accessories necessary to complete the Work of this Section.
3. Base courses.
4. Cutting and patching of Work of this Section as required by the work of other trades.
5. Cleaning and pointing of Work of this Section exposed to view.
6. Related work
 - a) For adjacent in-situ and pre-cast concrete items refer to Section 2510 Concrete Walks, Roadways, Curbs and Gutters.
 - b) For adjacent tile work refer to Section 4200 Unit Masonry.
 - c) Surface drain rock marked as ‘Pebbles’ on Drawings is described in Section 2900 Landscaping.
 - d) For concrete sub-bases and their base courses required under paving refer to Section 2510 Concrete Walks, Curbs and Gutters, Section 2200 Earthworks and Section 3300 Cast-in-Place Concrete.

73.0 QUALITY ASSURANCE

1. Qualification of workmen:
 - a) For cutting and placing of unit materials, use only skilled masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.
 - b) In acceptance or rejection of installed paving units, no allowance will be made for lack of skill on the part of workmen.
 - c) Provide one skilled mason who shall be present at all times during execution of the Work of this Section and who shall personally direct the execution of this portion of the work.

74.0 SUBMITTALS

1. Samples:
 - a) Within 90 days after award of Contract, and before any materials are delivered to the Job Site, submit samples of the proposed units to the Engineer for his approval in accordance with these Specifications.
 - b) Samples shall indicate the total color range, and be supplied in 4 ft. x 4 ft. (1m x 1m) squares or as required by Engineer.
 - c) Samples of other materials to be used and samples for testing shall be submitted as requested by the Engineer.
 - d) Submit samples of Grasscrete units and concrete Brick pavers

75.0 PRODUCT HANDLING

1. Materials shall be delivered, stored, and handled to protect them from wetting, staining, chipping and any other damage. Store cement, and similar perishable materials in water-tight sheds with raised floors. Store paving units off the ground and under water-tight covers.

“MATERIALS”

76.0 ACCEPTABLE MANUFACTURERS

1. Subject to compliance with requirements, provide products of one of the following:
 - a) Envicrete Ltd, Karachi.
 - b) Tuff Tiles, Pvt. Ltd., Lahore.

77.0 CONCRETE PAVERS

1. Units to be 100% solid:
 - a) Sizes should be 8"x4"x3" (200x100x80 mm), Weight 3.8 kg approximate and 8"x4"x2.5" (200x100x60 mm), Weight 2.9 kg approximate
 - b) Average compressive strength should be 4000 psi or 28 N/mm²
 - c) Material should be a mixture of sand, cement and aggregates, in necessary approved colors and additives of texture, tint and durability.
 - d) It should be resistant to attack by oils, grease and other petroleum based fuels and free from all types of salts.
 - e) The surface texture will be abrasive, and have a non slip finish to the approval of the Engineer.

Units to be 100% solid, free from cracks or other flaws. Concrete to be of 4000 psi or as specified in the structural specification. from finely crushed hard stone and cement to sizes shown on Drawings and texture as approved by Engineer. Pavers shall also conform to pertinent data of Section 3400 Pre-cast Concrete.

78.0 PRECAST GRASSCRETE UNITS

1. Grasscrete units are manufactured from Portland Cement complying with B.S. 12 with a minimum cement content of 320 kg/m³. Coarse and fine aggregate employed conform to the requirements of B.S. 882. Steel mesh reinforcement to B.S. 4483.
 - a) Manufacture: machine made using high frequency vibration and low water/cement ratio permitting rapid de-moulding.
 - b) Grasscrete pavers shall be 2'-0" x 1'-4" x 4" (600 mm x 400 mm x 100 mm) deep with five longitudinal and two transverse ribs, each block completely enclosing four grass cells. The area available for grass at the upper surface shall not be less than 56%, and the area of concrete available to transmit load to the underlying layers shall not be less than 90% of the total block area.
 - c) Grasscrete pavers shall be placed closely together on a 10-20 mm. layer of

sharp sand for leveling, spread on the compacted sub-base composed of 6 ins (150 mm) of quarry waste or similar approved unwashed material of 3 ins (75 mm) down size containing fine soil or loam.

- d) Clean friable soil or soil with a peat mixture should be leveled off 1 1/4" (32 mm) below the top surface, sown with grass seed and covered with a thin layer of fine soil and leveled with a hard broom. The level shall be about 3/4" (75 mm) below top surface. Seed shall be sown while soil is still loose after filling.

79.0 SANDSTONE

1. Stone paving, shall be cut stone, mill finished to specific sizes, squared to dimensions each way. Slightly textured finish.
2. Pool edges to be as per details shown on the drawings. Curves and corners to be mitred. Inside and outside edges at corners and changes in direction to curved to eliminate acute angles.
3. Sizes:
 - i) Lengths and widths of Stone pavers, and special shapes shall be as shown on Drawings.

80.0 MORTAR AND CONCRETE MATERIAL

1. Ordinary Portland cement to B.S. 12. Use non stating type for stonework.
2. Sand to be clean, sharp, angular, free from alkali, silt or organic matter. Comply with BS 1198-1200.
3. Course Aggregate refer to Section 3300 Cast-in-Place Concrete.
4.
 - a) Color pigment for pavers shall be as described under Section 4200 Unit Masonry.
 - b) Color pigment for stone paving and pre-cast concrete flag shall be added at Engineers discretion or as described under Section on Unit Masonry.

81.0 GRANULAR BASE

1. Aggregate to be 1/2 in. (12 mm) to 2 ins (50 mm) size crushed stone rock or broken stone, evenly mixed, approved by Engineer.

82.0 CAULKING

1. Refer to Section 7900 Sealants for caulking materials.

83.0 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of items in this Section, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

EXECUTION

84.0 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

85.0 EXCAVATION

1. The natural sub-grade shall be prepared in accordance with the cross-section shown on the plans. Soft and yielding spots or other unsuitable material shall be removed and replaced with suitable type. The sub-grade shall be compacted and finished to a firm, smooth surface. Refer to Section 2200 Earthworks, for pertinent data.

86.0 BASE COURSE

1. Apply a base course to areas receiving paving and flags on grade.
2. For paving on concrete sub-base this article does not apply. Concrete sub-base is described under Section 2510 Concrete Walks, Roadways, Curbs and Gutters.
3. When laying base course the alignment shall be controlled by an approved method, from Engineer.
4. Install 6 ins (150 mm) minimum thickness of crushed rock aggregate to B.S. 63 and roll the surface to a smooth and uniform texture, free from lumps, rock pockets, soft spots and spongy areas. Compact with a smooth wheel roller having a weight of 120 lbs per in. width to density specified in Section 2200 Earthworks.
5. Place 1-1/2 ins (37 mm) blinding concrete over crushed rock base under paving adjacent to roadways. Bring to an even surface. Mix to be 1:4:8 or as specified in the Structural Specification.

87.0 MIXES

1. Mixes general:
 - a) Use the same manufactured brands and sources for mortar material to ensure uniformity of mix.
 - b) Mix mortar ingredients thoroughly in quantities needed for immediate use. Mixing shall be done by machine.
 - c) Mix mortar in mechanical mixer until materials are homogeneously blended but not less than three (3) minutes after materials are in the mixer.
 - d) Add color pigment where exposed mortar joints occur, as required by Engineer.
 - e) Refer to pertinent parts of this Section for mix types.

88.0 CEMENT TILE PAVERS

1. This part is pertinent to laying different sizes of cement tile pavers in patterns as shown on Drawings.
2. Mortar to be a semi-dry mix for pavers laid on horizontal surfaces. Mix to consist of one part Portland cement to 3 parts sand aggregate with color pigment added to match face tile work joints.
3. Units shall be laid out so that at end conditions no unit have to be cut to a dimension less than 3 ins. (75 mm). Mortar joints shall be according to the detail shown on the drawings.
4. Spread and place mortar mix to at least 1-1/2 ins (37 mm) thickness. Use hand rake, making sure mix does not become compressed. Place units in bonding pattern, as indicated on Drawings, working from hard edge. Pavers laid on edge shall be set 1/2 in. (12 mm) above finish grade and those laid flat 1/4 in. (6 mm) above finish grade. Sweep joints full of mortar mix. Tamp units by an approved method, to attain finish grade. Readjust units which may have been disrupted during tamping. Spray entire approved surface area with fine spray of water to ensure saturation of the joints and bedding material. Grout and point joints similar to face tile work, or as directed by Engineer. Finished surfaces shall be aligned to designated finish grade. Check units for evidence of rocking or movement; correct as required.

89.0 STONE PAVING

1. This part is pertinent to laying different types of Stone paving including strips and steps in patterns, where applicable as shown on Drawings.
2. Mortar mix to be 1:3 as described for cement tile pavers or as specified in the structural specifications.
3. Units shall be laid out so that at end conditions no unit shall be smaller than half size. Mortar joint as shown on the Drawings.
4. Spread and place mortar mix to at least 1 in. thickness. Use a hand rake, making sure mix does not become compressed. Place units in bonding pattern, as indicated on Drawings, working to a hard edge and set 1/4 in. (6 mm) above finish grade. Sweep joints full of mortar mix. Tamp units by an approved method to attain finish grade. Readjust units which may have been disrupted during tamping. Spray entire approved surface area with fine spray of water to ensure saturation of the joints and bedding material. Grout and point joints to 1/8 in. (3 mm) below finish grade of flags or as directed by Engineers. Finished surfaces shall be aligned with designated finish grade. Check flags with adjacent units to ensure there is no evidence of rocking or movement; correct as required.
5.
 - a) Step units to be cut to largest possible sizes, thus creating the least, if any intermediate joints.
 - b) Bed step units on 1 in. (25 mm) mortar mix, set to 1/8 in. per ft. (3mm per 300 mm) slope from back to front edge grout and point joints with mortar.

90.0 CONCRETE PAVING

1. Preparation of sub-grade

The sub-grade should be drained and protected against rain, ground water, with all drainage trenches backfilled in such a way as to be not inferior to undisturbed ground

Any unsuitable material should be removed from the sub-grade and treated or replaced with properly compacted, suitable material.

All sub-grade preparation should be completed before work starts on the sub-base.

2. Preparation of sub-base

Conventional, flexible sub-base, concrete slabs or existing roads are all suitable sub-base for concrete paving.

Where a new sub-base is to be constructed, the materials used should be one of the following:

Granular material Type 1*

Soil Cement

Cement bound granular material

Lean concrete

Wet mix macadam

Wet lean concrete

These materials should be laid in accordance with the requirements of the same Specification except for wet lean concrete, where the appropriate requirements should be followed.

Where and existing sub-base or road materials are to be employed it is important to inspect them to ensure that they are adequately drained and compacted. Any defective materials should be removed and replaced.

The top surface of the sub-base should be finished to tolerance of + 3/4" (20 mm.). It should be close-knit to prevent the loss of laying course material, and free of debris or mud.

3. Edge Restraint

Edge restraints should be provided along the perimeter of all paved areas and should be adequate to support traffic loads and to prevent the escape of laying course sand from beneath the paved surface.

The edge restraint may be in form of a kerb, combined kerb and channel, established structure or other rigid abutment, e.g. pavers fixed vertically and bedded and haunched with concrete.

4. Preparation of laying course

The laying course consists of a layer of coarse/medium sharp sand or crushed rocks fines to BS 882 which may be washed or unwashed.

It should contain no more than 3% by weight of clay or silt, and used at as constant a moisture content as possible.

The laying course should be screeded to level so that its mean thickness after compaction is 2ins (50 mm), this allows for tolerances in the sub base, although, where laid upon existing sub-bases or where close control of the surface level of the sub-base has been maintained, this compacted thickness may be reduced to 30 - 40mm.

The laying course material may be spread in one layer and screeded to the appropriate level, making due allowance for the reduction in thickness achieved during compaction.

This will normally be in the order of 1/2 in-3/4 in (15-20mm) when compacted to 2 ins (50 mm) and 9-14 mm when compacted to 30 mm.

Alternatively, the sand may be spread in two layers, the two-thirds being pre-compacted, and the blocks placed on the upper un-compacted one-third in each case, only sufficient sand for one day's work should be prepared.

5. Bond patterns

may be laid in a variety of patterns including stretcher bond, basket weaver and herringbone.

6. Laying the Pavers

Concrete Pavers will be laid by hand with joint widths of approximately 2-5mm, in the specified pattern.

Laying should commence from an existing laying face or edge restraint wherever possible. Full pavers should be laid first through the day's work area, with closure pavers and paver cutting around obstructions following afterwards. The area should be laid as far as possible on whole pavers and pieces smaller than 1/2 of a paver should be avoided. The paviour should work from pavers already placed taking care not to disturb them.

The easiest way to cut blocks is with a hydraulic or mechanical block splitter.

Careful attention should be paid to site organisation to ensure the appropriate positioning of materials, the supply of adequate quantities of pavers to the paviour, and the right balance of activity between laying course preparation, block laying, trimming, compaction and top sanding.

7. Compacting

When cutting is complete, the surface course should be compacted by 2 or 3 passes of an appropriate plate vibrator over the entire area, taking care not to vibrate within 1m to any unrestrained edge. This initial compaction will force the pavers into the laying course causing sand to penetrate the block joints from the laying course below.

After this compaction, sand should be spread over the surface and brushed into the joins before a final pass is made with the plate vibrator. The use of clean, dry sand will assist in the process. This filling and final compaction aids the development of impermeability of the surface and should be carried out as the work progresses.

8. Brushing

When this process has been completed, the paved area may be trafficked, and indeed deliveries of subsequent pavers may be made over the area.

91.0 CURING

1. Paved surfaces shall be kept moist with sprayed water for a minimum of 7 days, immediately following installation.

92.0 CAULKING

1. Install caulking material, in accordance with Section 7900 Sealants, at joints between edge of building and adjacent hard surfaces installed under this Section, and other locations shown on Drawings.

93.0 PROTECTION

1. Protection:

Cover top of completed and partially completed work not enclosed or sheltered, with water-proof coverings at end of working day. Drape cover over sides. Anchor securely in position.

94.0 TOLERANCES

1. Tolerances:

Courts and walkway surfaces shall be laid so as to provide levels and grades with rises and falls, as shown on Drawings with optical instruments. Surfaces shall be uniform and free from bulges and depressions more than 1/4 in. in 10 ft. run (6mm in 3 meters).

95.0 CLEANING

1. Upon completion of the work of this Section immediately remove debris, excess materials and smears that may remain.
2. Point or replace defective mortar to match existing, as required by Engineer.
3. Scrub surfaces to be cleaned using a cleaning solution which will not harm finished material. Check with manufacturer for acceptable solution. Clean a trial test area and obtain approval to proceed.
4. Use an abundant amount of water do cleaning in accordance with Engineer's instructions.
5. Repeat cleaning operations as often as necessary, until work is to meet Engineer's approval.

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

GENERAL FOR “ROAD MARKING”

96.0 DESCRIPTION

1. General:
 - i) This work consists of providing material for and painting of road markings in accordance with these Specifications, as shown on Drawings.
 - ii) Road marking of lane division to access roads shall be as directed by Engineer.

97.0 QUALITY ASSURANCE

1. Qualification of painters:

Use only qualified painters for the mixing and application of paint. In the acceptance or rejection of installed painting, no allowance will be made for lack of skill on the part of painters.

98.0 PRODUCT HANDLING

1. Delivery:

Deliver materials to the Job Site in original unopened containers with labels intact and legible at time of use.
2. Protection:
 - i) Store only approved material at the Job Site, and only in a designated area restricted to paint materials and related equipment.
 - ii) Ensure the safe storage and use of paint materials and prompt safe disposal of waste.
 - iii) Protect paint materials before, during, and after application and protect installed work and materials of other trades.
3. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer at no additional cost to the Employer.

PRODUCTS

99.0 PAINT

1. Manufacturer:
 - i) Material shall be first grade and meet or exceed minimum standards of reputable manufacturers, subject to approval of Engineer.
 - ii) Type:

Paint to be “Dulux Special Roadline Marking Paint”. Color to be white. Contractor may use hot plastic composition paint to BS.4147 to approval of Engineer, without additional cost to the Employer.
 - iii) Thinners:

Use only thinners recommended for this purpose by the manufacturer of the material to be thinned.

99.1 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper installation of road marking, shall be provided by the Contractor subject to prior approval of Engineer, at no additional cost to Employer.

EXECUTION

100.0 SURFACE CONDITIONS

1. Inspection :
 - i) Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - ii) Verify that the paint finish may be applied in strict accordance with manufacturer's recommendations and requirements of these Specifications.
2. Discrepancies :
 - i) In the event of discrepancy, immediately notify the Engineer.
 - ii) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

101.0 PREPARATION OF SURFACES GENERAL

- 1) Prior to surface preparation and painting operations, adequately protect adjacent surfaces not scheduled to receive paint.
- 2) Surfaces shall be prepared in accordance with paint manufacturer's recommendations.
- 3) Clean and remove foreign materials as recommended by manufacturer.

102.0 PREMARKING

- 1) For installation of lane, divisions, as directed by Engineer, pre-mark with painted dots of 1 / 2 in. diameter spaced at 10 ft. intervals. Curves shall be marked at every yard. Pre-marking shall be carried out using 100 yard ropes or other approved method.
- 2) Parking spaces shall be pre-marked by snapping chalked string lines against the surface.

103.0 APPLICATION

- 1) Lines are to be marked even and uniform with edges sharply defined without splashing, running or smudging. An error in location or application shall be corrected at the expense of the Contractor. Markings shall not deviate more than 1 / 4 in. in 10 ft.
- 2) Widths of painted lines shall be 4 ins. Lengths of lines for parking stalls shall extend 14 ft from curb to end of lines. Bay sizes for stalls be as shown on Drawings or as directed by Engineer.

- 3) Rate of application shall be regulated so as to produce an opaque film and cover the specified area of the pavement completely. Apply paint to manufacturers recommendations.

104.0 CLEANING-UP

1. General:
Prevent accidental spilling of paint materials. Remove spilled material immediately and the waste of other equipment used to clean up spill. Wash surfaces to their original undamaged condition, at no additional cost to Employer.
2. Prior to final inspection:
Upon completion of this portion of the Work inspect all surfaces and remove paint and traces of paint from adjacent surfaces.

105.0 MAINTENANCE

1. Markings which have been eroded or faded as a result of traffic or otherwise during the Maintenance Period shall be repainted by the Contractor at his own cost in accordance with these Specifications.

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

GENERAL FOR “PLAIN CEMENT CONCRETE”

106.0 DESCRIPTION

The work covered by this section of the Specifications consists of furnishing all plant, labor, equipment, all form work appliances and materials, and in performing all operations in connection with the supply and installation of plain and reinforced concrete work, complete in strict accordance with this section of the Specifications and the applicable drawings, subject to the Conditions, of the Contract.

107.0 GENERAL

1. The Contractor is responsible for setting out the work on site and for obtaining all necessary dimensions for the proper execution of the work.
2. The Contractor shall construct the work in accordance with the drawings supplied by the Consultant. The Contractor shall inform the Consultant immediately of any discrepancies discovered on the drawings and will not proceed with that work involved until the discrepancies are rectified.
3. Full co-operation shall be given to other trades to install embedded items.
4. Suitable templates or instructions, or both will be provided for setting items not placed in the forms. Embedded items shall have been inspected, and tests for concrete and other material or for mechanical operations shall have been completed and approved, before concrete is placed.

For special concrete finishes and for special methods of construction (e.g. slip forms), formwork shop drawings shall be designed and prepared by the Contractor at his own cost. Approval of shop drawings as well as that of actual samples of finished concrete shall be obtained before work is commenced.

5. Contractor shall also prepare BAR BENDING SCHEDULE, and get the same approved by the Engineer, prior to commencement of work.

108.0 RELATED SPECIFICATIONS

Latest editions of the following British and ASTM Standards are relevant to these Specifications where indicated:- (Equivalent Pakistan Standards are also applicable.)

British Standards:

B.S. 12-78:	Portland Cement, Ordinary and Rapid Hardening (in lieu of C-150).
B.S. 410:	Test Sieves.
B.S. 693:	General Requirements for Oxyacetylene Welding of Mild Steel.
B.S. 822-1201:	Concrete aggregates from Natural Sources.
B.S. 1141:	Cold Worked Steel Bars for the Reinforcement of Concrete. General Requirements for the Metal-Arc Welding of Mild Steel.
B.S. 1881:	Methods of Testing Concrete.
B.S. 3148:	Tests for Water for Making Concrete.
B.S. 4027:	Sulphate-Resisting Portland Cement.
B.S. 4449:	Carbon Steel Bars for the Reinforcement of Concrete.
B.S. 4466:	Bending Dimensions and Scheduling of Bars for the Reinforcement of Concrete.
C.P. 110:	Structural Use of Concrete.

C.P. 114:	Structural Use of Reinforced Concrete in Building.
C.P. 116:	Structural Use of Pre-cast Concrete.
C.P. 2007:	Design and Construction of Reinforced and pre-stressed Concrete structures for the storage of Water and other Aqueous liquids.
ASTM Standards:	
A 615:	Deformed Billet-Steel Bars for Concrete Reinforcement.
C 33-78:	Standard Specification for Concrete Aggregates.
C 39-72:	Compressive Strength of Cylindrical concrete Specimens.
C 42-77:	Standard Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
C 94-72:	Standard Specification for Portland Cement.
C-138-77:	Tentative Method of Test, for Weight per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete.
C 143-78:	Standard Method of Test for Slump of Portland Cement Concrete.
C 150-72:	Standard Specification for Portland Cement.
C 171-69:	Standard Specification for Sheet Materials for Curing Concrete.
C 172-71:	Standard Method of Sampling fresh Concrete.
C 173-71:	Standard Method of Test for Air Content of 71 Standard Specification for Chemical Admixtures for Concrete.
E 329-70:	Recommended practice for Inspection & Testing Agencies for Concrete & Steel as Used in Construction.
ACI-318-83:	Building Code Requirement for Reinforced Concrete
ACI-305R-77:	Hot Weather Concreting.
ACI-306R-76-	Cold Weather Concreting.
ACI-211.1-81	Standard Practice for Selecting Proportions for Normal, Heavy weight & Mass Concrete
ACI-304-73	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
ACI-304.2R-71	Placing Concrete by Pumping Methods.
ACI-309-72	Standard Practice for Consolidation of Concrete.

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.

109.0 MATERIALS

109.1 AGGREGATES

General

Aggregates for normal concrete shall conform to ASTM Designation C33-74, Petrographic examination in accordance with ASTM C295-65 shall be performed to determine the suitability of the aggregates for the intended use. The nominal maximum size of the aggregate shall not be larger than one-fifth of the narrowest dimension of the finished wall or slab, or larger than three fourths of the minimum clear spacing between reinforcing steel and embedment. These limitations may be waived if, in the judgment of the Engineer, Workability and methods of consolidation be such that the concrete can be placed without

honeycombing or voids.

Composition:

The use of natural sand or a combination of natural and manufactured sands maybe permitted provided that the fine aggregate meets the applicable requirements of the Specifications herein for particular use intended. Coarse aggregate shall consist of gravel, crushed gravel or a combination thereof.

Source:

The Contractor shall obtain concrete aggregates from deposits of natural sand and gravel or shall produce crushed aggregate from approved deposits. The Contractor shall be responsible for obtaining all necessary rights and permits and for ascertaining the extent of work including type of equipment requirement and amount of waste involved in producing a sufficient quantity of acceptable aggregate from the source finally selected by him and approved by the Engineer. The Contractor may alternatively obtain the aggregate from any of the quarries which produce the aggregate meeting with the Specifications contained herein as approved by the Engineer.

Sampling and Testing:

During construction, aggregates will be sampled as delivered to the mixer to determine compliance with Specifications provisions. The Contractor shall provide facilities as may be necessary for the ready collection or representative test samples. The Engineer will obtain and test such samples, using appropriate standard test methods. Testing of concrete aggregates by the Engineer shall not relieve the Contractor of his responsibility to maintain control, to ensure the production, stockpiling and handling of both fine and coarse aggregate in accordance with those specifications. Materials and installed work may require testing as directed by the Engineer at any time during the process of the work. The Contractor will pay for all these sampling and tests. No extra payment will be made for this item. The cost will deemed to be included in the Bill of Quantity Rate of Plain and Reinforced Concrete.

The aggregate shall be stockpiled for a period before use so as to drain nearly to constant moisture content (as long as Site and other conditions permit, preferably for at least a day). The grading of the coarse and fine aggregate shall be tested at least once for every 50 tons or about 1000 cft supplied to ensure that the grading is uniform and the same as that of the samples used in the preliminary tests.

Processed Aggregates:

Aggregates, as delivered to the mixer shall consist of clean, hard and uncoated particles. Light weight elements (chalk, clay, coal) will be separated by segregation under water by vibration (vibro-floatation process). Where required, fines shall be removed from the coarse aggregate by adequate washing. The coarse aggregate shall be rescreened just prior to delivery to the concrete mixing machine, loading hopper.

All fine and coarse aggregates shall be clean and free from clay, loam, silt, and other deleterious matter. If required, Engineer reserves the right to have them washed by the Contractor at no additional expenses. Coarse and fine aggregates shall be delivered and stored separately at Site. Aggregates shall not be stored on muddy ground or where they are likely to become dirty or contaminated.

All aggregates shall be subject to the approval of the Engineer. Any aggregates not found to 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.

Fine Aggregate:

Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings and shall conform to requirements of ASTM C-33.

The grading and uniformity of fine aggregates as delivered to the mixers shall conform to ASTM C33-74 Standard.

Sieve Designation	Square Mesh	Percent Passing
U.S. Standard		
3/8 inch	(9.5mm)	100
No.4	(4.75mm)	95 to 100
No.8	(2.36mm)	80 to 100
No.16	(1.18mm)	50 to 85
No.30	(600 um)	25 to 60
No.50	(300 um)	10 to 30
No.100	(150 um)	2 to 10

The Fineness Modules shall range between 2.31 & 2.51 Coarse Aggregates:

Special fine gravel of 1/2" maximum size or finer shall be used in concrete members thinner than 2" or if and where called for on the Drawings or as directed by the Engineer.

The grading of the coarse aggregates with the separate size groups shall conform to the following requirements as delivered to the mixer.

Coarse aggregate shall be gravel or broken stone or hard, durable material free from laminated structure and conforming to ASTM C-33 graded as follows for use in mass concrete such as in foundations:

TOTAL PASSING	PERCENT BY WEIGHT
2" B.S. Sieve (50.00 mm)	100
1-1/2" Sieve (38.10 mm)	95 -100
3/4" Sieve (19.00 mm)	35 - 70
3/8" Sieve (9.50 mm)	10 - 30
No. 4 Sieve (4.75 mm)	0 - 5

Coarse aggregate for all cast-in-place concrete other than mass concrete and thick (7" or more) fair faced cast-in-place concrete shall be graded with the following limits:- (ASTM-C-33 Size 67).

TOTAL PASSING	PERCENT BY WEIGHT
1" Sieve (25.00 mm)	100
3/4" Sieve (19.00 mm)	90 -100
3/8" Sieve (9.50 mm)	20 - 55
No. 4 Sieve (4.75 mm)	0 - 10
No. 8 Sieve (2.36 mm)	0 - 5

Coarse aggregate for thin (6" to 4" thickness) fair faced cast-in-place concrete shall be graded as follows: (ASTM-C-33 Size 8).

TOTAL PASSING	PERCENT BY WEIGHT
1/2" Sieve (12.50 mm)	100
3/8" Sieve (9.50 mm)	85 -100
No.4 Sieve (4.75 mm)	10 - 30
No.8 Sieve (2.36 mm)	0 -10

The nominal maximum clear distance between reinforcing bars or between bars and form.

- i. One-fifth of narrowest dimension between forms.
- ii. One-third of depth of slab.
- iii. Three-fourth of clear distance between bars.
- iv. 1/2" (12.5 mm).

The nominal maximum size of the aggregate for normal weight precast concrete shall be smallest of the following:-

- i. One-fifth of narrowest dimension between forms.
- ii. One-third of depth of slab.
- iii. Three-fourth of clear distance between bars.
- iv. 1" (25mm).

110.0 CEMENT

- i) Cement shall conform to ASTM C - 150.
- ii) Only one brand of each type of cement shall be used for concrete in any individual member of the structure. The brand of cement will not be changed before prior approval of the Engineer.
- iii) Cement which Engineer considers has become stale or unsuitable through absorption of moisture from the atmosphere or otherwise shall be rejected and removed immediately from the site at Contractor's expense. Cement reclaimed from cleaning of bags or from leaky or damaged containers shall not be used.
- iv) Contractor shall provide and erect, at his own cost, in a suitable place, dry, well ventilated, and water proof shed of sufficient capacity to store the cement.
- v) The cement shall be used as soon as possible after delivery.
- vi) Cement shall be used in the sequence of receipt of shipment, unless otherwise directed. There shall be sufficient cement at Site to ensure that each section of work is completed without interruption. If the cement is supplied by Employer, Contractor shall inform Engineer of his requirements at least 30 days before its use in construction.
- vii) The mixing together of different types of cement shall not be permitted.
- viii) Sampling and Testing
The Contractor shall supply to the Engineer at fort nightly intervals, test certificates, form the manufacturers or approved standard laboratory with the dates of such test showing that the cement complies with the appropriate British Standard and ASTM Standards.

111.0 WATER

Clean and clear water which does not have sweet, saline or brackish taste to be used for mixing and curing of concrete. Where doubt exists, the strength of mortar sample made with questionable water is compared with mortar sample produced with acceptable water (like distilled water). The questionable water may be accepted if the sample yields concrete strength of at least 90% of the sample made with acceptable water.

Water contaminants under no circumstance shall be greater than following limits:-

Oil	0.00 ppm.
Chlorides	1000 ppm.
Sulphates	1000 ppm.
Turbidity	2000 ppm.
Acids	10,000 ppm.

Potassium and NaOH 0.5 to 1.0% by weight of cement.

The water for curing concrete should not have pH value lower than 4 and shall not contain impurities which cause discoloration of concrete.

Sea water shall not be used for any reinforced concrete Works or where concrete is later required to be plastered, painted or otherwise decorated.

The Engineer reserves the right to order the analysis of water samples from time to time and to prohibit the use of water found unsuitable, and shall be subjected to tests in order to confirm that it has no adverse effect on the strength and durability of concrete. The test will be carried out at the total expense of the Contractor at an independent laboratory approved by the Engineer.

112.0 REINFORCEMENT

- i) Reinforcement for concrete shall conform to the respective British, ASTM or other standards as specified in the Drawings and CONTRACT Documents or as may be specified by Engineer.
- ii) Unless otherwise specified, all reinforcing bars shall comply with the requirements of B.S. 4449 for carbon rods steel bars and shall have a minimum yield stress of 36 ksi, (248 N/mm²) for plain and 66 ksi/RM (460 N/mm²) for deformed.
- iii) Unless otherwise specified, all deformed reinforcing bars shall comply with the requirements of B.S. 4461 for deformed cold Worked steel bars and shall have minimum characteristic stress of 66 ksi, (460 N/mm²). with minimum elongation of 12%.
- iv) Reinforcement shall be obtained only from the manufacturer approved by the Engineer. If and when required Contractor shall provide all necessary facilities to Engineer for the selection of test pieces and shall cause these to be prepared and submitted where directed for tests at Contractor's cost.
- v) If the reinforcement is to be supplied by Employer, Contractor shall inform Engineer of his requirements at least 30 days before its use in construction.
- vi) Contractor shall report immediately on receipt of any consignment, having any deviation in the standard weights of the reinforcing bars beyond those allowed in standards mentioned in respective clause.

113.0 EXPANSION JOINT FILLER

Expansion Joint Filler shall be an approved bitumen impregnated fibreboard, conforming to ASTM C 208 or as shown in the drawing.

114.0 SURFACE HARDENER

Surface Hardener shall be used on all exposed concrete slabs, and consist of 4 parts of commercial magnesium fluosilicate to one part of zinc fluosilicate, 2 lbs to one gallon of water. This shall be impact and abrasion resistant too.

115.0 NON SKID SURFACE

Abrasive Surface Finish shall be used on exposed concrete at stairs and pedestrian ramps, and consist of a crushed, ceramically bonded aluminium oxide, or other approved equal.

116.0 WATER STOP

Waterstop 9" (225 mm) dumbbell (end bulb) type, made of extruded virgin Super cast Rear guard-R-polyvinyl chloride.

117.0 COLOR

Integral Coloring Additive: Approved pure metallic pigments, limeproof, alkali-resisting, and fast which will not reduce the concrete strength or durability.

118.0 CONCRETE MIX PROPORTIONS

118.1 GENERAL

The proportions of ingredients shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the work, but without permitting the materials to segregate or excessive free water to collect on the surface.

The proportions of ingredients shall be selected in accordance with Section 5.7 to produce the proper placeability, durability, strength and other required properties.

118.2 PROPORTIONING

The proportions of all materials entering into the concrete shall be as directed by the Engineer. The proportions will be changed whenever such change is necessary to maintain the standard of quality required for the structures covered by these specifications and to meet the varying conditions encountered during construction. The Contractor will be entitled to no compensation additional to that included in the prices for the applicable tender items in the Bill of Quantities because of such changes.

All materials entering into the concrete shall be measured by weight or by volume as instructed by the Engineer.

The cement content of concrete for various parts of the structure shall be established by trial mixes depending on the structural equipment, water cement ratio, size type and gradation of aggregate used. If at a particular place there is so large quantity of steel that it

becomes difficult to get the concrete well around and between it then the specified batch of the concrete consisting of small size of aggregate and increased quantity of cement shall be used as instructed by the Engineer so as to achieve the same strength as for normal concrete.

118.3 AGGREGATE CONTENT

The maximum size of aggregate to be used in the various parts of the structure shall be as shown on the drawings and, where not shown, shall be as directed by the Engineer. Concrete mixes shall be designed to use the larger size and maximum amount of coarse aggregate practicable in accordance with Clause 4.1 of these Specifications.

118.4 WATER CEMENT RATIO

In general, the Contractor submitted mix design will provide for water cement ratio by weight (exclusive of water absorbed by the aggregates), which will be determined on the basis of producing concrete having suitable Workability, density, impermeability, durability, and the required strength without the use of excessive amounts of cement. The concrete work will commence only after the approval of the mix design by the Engineer.

118.5 CONSISTENCY

The amount of water used in concrete will be regulated as required by the Engineer to secure concrete of proper consistency taking into account the effect of use of the specified admixtures and any variation in either or both the moisture content or grading of the aggregates as they enter the mixer. Addition of water to compensate for stiffening of the concrete before placing will not be permitted. Uniformity in concrete consistency form batch to batch will be required.

118.6 STRENGTH

The Specified compressive strength of the concrete cylinder, shall be 3750 psi, (25 N/mm²) except where otherwise noted on Drawings. The equivalent cube strength shall be at least 25% higher than the specified cylinder strength. Strength requirements shall be based on the sampling and testing methods of ASTM C 39-72 (and BS 1881 for cube).

118.7 DURABILITY

Maximum permissible water-cement ratios for concrete in severe exposures to be as follows, unless lower water-cement ratio is required to meet specified strength limits:

Type of Structure	Structure wet continuously or frequently & exposed to freezing and thawing*	Structure exposed to sea or sulphates.
i. Thin sections & sections with less than 1" cover over or from leaky or damaged containers shall not be used.	0.45	0.40**
ii. All other Structures	0.50	0.45**

* Concrete should be air-entrained.

** If S.R. Cement is used, Permissible W/C Ratio may be enhanced by 0.05

118.8 SLUMP

Unless otherwise permitted or specified, the concrete shall be proportioned and produced to have a slump of 4" (100 mm) or less. A tolerance of upto 1" (25 mm) above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated. The slump shall be determined by the "Test for slump for Portland Cement Concrete" (ASTM C-143).

118.9 ADMIXTURES

If required or permitted, admixtures used shall be in accordance with the manufacturer's instructions except as otherwise specified herein. The cost of admixture used as plasticizers, to achieve high early strength or required workability, for all concrete Works will be borne by the Contractor.

118.10 MIX DESIGN

For concrete of normal weight, mix proportions to provide the desired characteristics shall be developed using the methods/procedure covered by the latest edition of Recommended Practice for Selecting Proportions for Normal Weight Concrete ACI 211.1.

Trial mixtures having proportions and consistencies suitable for the work shall be made based on ACI 211.1, using at least three different water-cement ratios which will produce a range of strengths encompassing those required for the work. Trial mixes shall be designed to produce the specified slump. The temperature of concrete used in trial batches shall be reported.

For each water-cement ratio, compression test of cylinder/cube shall be made, cured, and tested in accordance with "ASTM C - 39 or BS 1881". From the results of these tests a curve shall be plotted showing the relationship between the water-cement ratio and compressive strength. From this curve, the water-cement ratio to be used in the concrete shall be selected to produce the required/specified design strength. The cement content and mix proportions to be used shall be such that this water-cement ratio is not exceeded when slump is the maximum permitted. Control in the field shall be based upon maintenance of proper cement content and slump.

119.0 FORM WORK

Forms used, where necessary, to confine the concrete and shape it to the required dimensions, within the specified tolerances, forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete.

Form-work shall also conform to the requirements of the special architectural finishes of the in- situ, Plain and Reinforced Concrete specified/or shown on the Drawings. Shop drawings of such form shall be subject to the approval of the Engineer prior to its use.

Earth cuts shall not be used as forms for vertical surface or reinforced concrete work unless required or permitted.

Formwork shall be made of either steel, plywood, proprietary building boards and such special material, as may be shown on the drawings or approved by Engineer. All

scaffolding will be of steel pipes and steel joints Size and Specifications to be approved by Engineer.

FormWork shall be sufficiently tight to prevent loss of cement slurry.

The formwork shall be given an upward camber to ensure that the beams or slabs (especially cantilever slabs) do not have a sag when they have taken up their deflection. Camber, unless noted otherwise on Drawing, should be about $L/360$ for supported beams and slabs and $L/240$ for cantilevers.

Requirements for facing materials are given in clause 14 "Finishing of formed surface". The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be $L/240$ of the span between structural members.

Where natural plywood form finish, grout cleaned finish, smooth rubbed finish, scrubbed finish, or sand floated finish is required, forms shall be smooth (faced with plywood, liner sheets, or prefabricated panels) and true to line, in order that the surfaces produced with required little dressing to arrive at true surfaces. Where any as-cast finish is required, no dressing shall be permitted in the finishing operation.

Where as-cast surfaces, including natural plywood form finish, are specified, the panels of materials against which concrete is cast shall be arranged orderly with joints between panels planned in approved relations to opening, building corners, and other architectural features.

Where panels for as-cast surfaces are separated by recessed or otherwise emphasized joints, the structural design of the forms shall provide for locating form ties at locations approved by the Engineer.

Forms shall be thoroughly cleaned and properly coated before re-use.

The formwork may be designed so that soffits of slabs and sides of beams, columns, and wall may be removed first leaving the forms to the soffits of beams and their supports in position.

Positive means, wedges or jacks of accurate adjustment and proper removal of shores and struts shall be provided and all settlement shall be taken up during placing of concrete. Forms shall also be securely braced against lateral deflections.

Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than:

- a) twice the diameter or
- b) twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than $3/4"$ (20mm).
- c) Through bolts shall be permitted provided that they are greased to allow for easy withdrawal and the holes sub-sequently made good. Through bolts are not to be used on water-retaining structures.

At construction joints, contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by not more than 1" (25 mm). The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint and to maintain a true surface.

Runways or planks for moving labor, concrete and equipment shall be provided with struts or legs and shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

All surfaces of the embedded items shall be cleaned and any accumulated mortar or grout from previous concreting and of all other foreign material is removed cleaned and any accumulated mortar or grout from previous concreting and of all other foreign material is removed before concrete is placed in them. Clear distance between the conduits shall be at

least 1" (25 mm).

Board forms having joints opened by shrinkage of the wood shall be swelled until closed by wetting before concrete is placed. Plywood and other wood surface not subject to shrinkage shall be sealed against absorption of moisture from the concrete either by (1) a field applied, approved form oil or sealer, or (2) a factory applied non- absorptive liner. When forms are coated to prevent bond with concrete, it shall be done prior to placing of the reinforcing steel. Care shall be taken that such approved coating is kept out of contact with the reinforcement.

Where as-cast finishes are required, materials, which will impart a stain to the concrete shall not be applied to the form surfaces. Where the finished surface is required to be painted, the material applied to form surface shall be compatible with the type of paint to be used.

For reinforced concrete, in no circumstances shall forms be struck until the concrete strength has reached at least twice the stress to which the concrete may be subject at the time of striking. The strength referred to shall be that of concrete using the same cement and aggregate, with the same proportion, and cured under conditions of temperature and moisture similar to those existing on the work where possible, the formwork should be left longer, as it would assist the curing.

Unless stated otherwise on the drawings, in normal circumstances (generally where temperatures are above 68 degrees F (20 C) and where ordinary cement is used, forms may be struck after expiry of the following periods.

AREA	TIME
- Walls, columns and or as may vertical sides of beams be directed by the Engineer.	48 hours
- Slabs (Shores or props left under, removal and refixing of props not permitted).	10 days.
- Beams soffits (Shores or props left under, removal and refixing of props not permitted).	12 days
- Removal of shores or props to slabs:	
1. Spanning upto 14 ft. (4 metres)	10 days.
2. Spanning over 14 ft. (4 metres)	21 days
- Removal of shores or props of beams:	
1. Spanning upto 20 ft. (6 metres)	18 days
2. Spanning over 20 ft. (6 metres)	25 days

For rapid hardening cement 3/7 of the above period will be sufficient.

Proper allowance shall be made for the decrease in rate of hardening of concrete in cold weather and the above minimum times must be increased when the mean daily temperature is below 68° F, (20°C).

When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

Top forms on sloping surfaces of concrete shall be removed as soon as the concrete has

attained sufficient stiffness to prevent sagging. Any needed repairs or the treatment required on such sloping surfaces shall be performed at once and followed by the specified curing. All formwork shall be removed without such shock or vibration as would damage the reinforced concrete.

When reshoring or repropping is permitted or required, the operations shall be planned in advance and shall be subject to approval. While reshoring is underway no live load shall be permitted on the new construction. In no case during reshoring shall concrete in beams, slab, columns or any other structural member be subject to combined dead and construction loads in excess of the load permitted by Engineer for the developed concrete strength at the time of reshoring. Reshores shall be placed simultaneously with stripping operations are but in no case later than the end of Working day on which stripping occurs.

Reshores shall be tightened to carry their required loads without overstressing the concrete. Reshores shall remain in place at least until representative tests of the concrete being supported have reached the strength/time specified.

Floors supporting props or shores under newly placed concrete shall have their original supporting props or shores left in place or shall be reshored. The reshoring system shall have a capacity sufficient to resist the anticipated loads. The reshores shall be located directly under a shore position above unless loads. The reshores shall be located directly under a shore position above unless other locations are permitted.

The reshoring or re-propping shall extend over a sufficient number of storeys to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that the design superimposed load of the floors supporting shores or props are not exceeded. No loads, other than those permitted by Engineer in connection with the actual work in hand, shall be allowed on suspended floors until 28 days after concreting where ordinary Portland cement is used and 14 days when rapid hardening Portland cement is used.

120.0 REINFORCEMENT

1. Applicable Standards

The reinforced steel used shall be cold twisted high strength bars with physical properties conforming to BS. 4461 1978 with minimum yields stress of 60,000 psi and minimum ultimate tensile stress of 70,000 psi and a minimum elongation of 14.5% and chemical properties conforming to BS.4449-1978 or equivalent ASTM standards.

2. Cutting and Bending

Steel reinforcement may be mill or field cut and bent. All bending shall be in accordance with standard approved practice and by approved machine methods. When bending is required it shall be performed prior to embedding the bars in the concrete. In all such cases, the bars shall be cold bent. Bending or Straightening of bars partially embedded in set concrete shall not be permitted except in isolated cases where corrective action or a field change is specially approved by the Engineer. Each intersection of bars shall be adequately tied with 16 SWG annealed iron wire.

3. Spacing.
The spacing of bars shall be as shown on the drawings or as directed by the Engineer. The variation from indicated spacing, provided that the total area of the reinforcement is in accordance with the Drawings, shall not be more than 1" (25 mm).
4. Splicing
Except as otherwise shown on the drawings or specified herein all splice, lengths of laps, splice locations, placement and embedment of reinforcement shall conform to the applicable requirements of American Concrete Institute 318-83, Building Code Requirements for Reinforced Concrete. In general, splices of reinforcement are not shown on the drawings however all splices shown on the drawings shall be maintained. Additional bar splices shall be provided as required subject to the approval of the Engineer. Lapped ends of bars will be placed in contact and securely wired or may be separated sufficiently to permit the embedment of the entire surface of each bar in concrete. Splicing of the reinforcing bars by butt-welding or by approved mechanical methods such as the Cadwell splice or other type splice using positive connectors shall be adopted where indicated or directed by the Engineer. Butt-welding of reinforcement bars, where indicated or directed, shall conform to the requirements of American Welding Society's Recommended practice for Welding Reinforcing Steel, Metal Inserts and Connections, A.W.S. 12.1 Concrete shall be protected from heat during welding operations.
5. Supports
Reinforcement is to be accurately placed as shown in the Drawings, and secured against displacement by using strong black annealed wire ties or suitable slips at intersections and supported from the formwork by using concrete, metal or plastic chairs and spacers or hangers of an approved pattern. Where concrete blocks are used for ensuring the cover they shall be made of mortar not leaner than one part of cement to two parts of sand. Where the concrete surface will be exposed to the weather in the finished structure the portions of all accessories in contact with the formwork shall be galvanized or shall be made of plastic.
All reinforcement shall be secured in place by use of metal or concrete supports, spacers or ties as approved by the Engineer. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation. The supports shall be used in such a manner that they will not be exposed or contribute in any way to the discoloration or deterioration of the concrete. Concrete supports shall be manufactured of the same concrete mix as used in the structure to be concreted.
6. Embedded Items
Before placing concrete, care shall be taken to determine that all embedded items are firmly and secured fastened in place as indicated on the drawings as required. Embedded items shall be free of oil and other foreign matter such as loose coating of rust, paint and scale. The embedding of wood or other foreign materials in concrete is prohibited unless specifically authorized or directed.
7. Storage.
Reinforcement bars shall be free from all rust, oil, mill scale, concrete or mortar, before concreting operation starts. It shall be stored on racks clear of ground and shall be supported sufficiently frequently to prevent permanent bending of bars when stacked or rust.
8. Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the Schedule.
9. Tolerances

The cutting tolerance for all bars shall be ± 1 " (± 25 mm).

Bars shall be placed to the following tolerances:

- i. Concrete cover to formed surface: $\pm 1/4$ " (6.0 mm)
- ii. Minimum spacing between bars: $\pm 1/4$ " (6.0 mm)
- iii. Top bars in slabs and beams:
 - * Members 8" (200 mm) deep or less: $\pm 1/4$ " (6.0 mm)
 - * Members more than 8" (200 mm): $\pm 1/2$ " (12.5 mm)
 - * Bent-up Tolerances:..... $\pm 1/8$ "
- iv. Members more than 24" (600 mm) deep: ± 1 " (25 mm)
- v. Crosswise of member: spaced evenly within 2" (50 mm)
- vi. Lengthwise of members: ± 2 " (50 mm)
- vii. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, resulting arrangement of bars shall be subject to approval of Engineer.
- viii. Vertical bars in column shall be offset at least one bar diameter at lapped splices.
- ix. No splice of reinforcement shall be made except as shown on the Working Drawings.
- x. No bars shall be bent twice in the same place, nor shall they be straightened after bending.

Unless permitted by Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete. Bars which depend for their strength on cold Working shall not be heated for any reason (except for welding, if permitted by the Engineer). Other kinds of reinforcement larger than 1-1/2" (38.1 mm) in dia may be bent by the use of heat at (not exceeding 1500^o degree F). Bars bent shall not be cooled by quenching.

10. Welding

Welding shall be permitted for bars only under suitable conditions and with suitable safeguards in accordance with B.S 693. 1856, or AWS D 12.1, provided the type of reinforcement bars have the required welding properties. Tack welding may be used to fix in position bars that cross each other, only with prior approval of Engineer.

11. Protection

Exposed reinforcement intended for bonding with future extensions is to be effectively protected from corrosion. Protection is also to be provided to reinforcement partly built into concrete exposed part to be built into later concrete.

12. Approval

No concreting is to be carried out until the reinforcement has been checked and approved by Engineer

121.0 CONCRETE BATCHING DELIVERY AND PLACING

121.1 COMMENT

All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement may be taken as 112 lbs (50 kg) with the prior approval of Engineer.

121.2 WEIGHT MEASUREMENT

Aggregate shall be batched by weight, due allowance being made for water content. Aggregate may be batched by volume only with the prior permission of Engineer. The weighing machine shall be accurate within 2% and shall be checked for accuracy at least once a week.

Where the batching plant is of the type in which cement and aggregate are weighed in the same compartment, the cement shall be introduced into the compartment between two sizes of aggregate.

Type and Capacity:	Material	Percent
	Cement	± 1%
	Water	± 1%
	Aggregate smaller than 3/4" (18.75mm)	± 2%

121.3 VOLUME MEASUREMENT

Adequate facilities shall be provided by the Contractor for the accurate measurement and control of each of the materials entering each batch of concrete. The accuracy of the volume measurement boxes shall conform to the requirement of applicable standards selected by the Engineer for such equipment. The materials measurement boxes shall be arranged so that the Concrete mixing operator & Engineer can observe the counting of number of boxes dumped into the hopper. The boxes should be deep and narrow and fitted with handles.

121.4 WATER BATCHER

A suitable water measuring device shall be provided by the Contractor which will be capable of measuring water within the specified requirements for each batch. The mechanism for delivering water to the mixer shall be such that no leakage will occur. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

121.5 MIXERS

For all concrete that shall be produced by Concrete Mixing Machine. For the purpose, the Contractor shall provide one or more concrete mixing machines having sufficient capacity to produce concrete at such a rate as will enable the completion of monolith pours in lift heights as shown on the drawings within acceptable time limits, and will assure the completion of concrete structures in accordance with the requirements of construction schedule.

Hand-mixed concrete shall not be used, however, the Engineer may authorize the use of concrete mixed in small portable mechanical mixers for specific purposes. In the event of such a permission, the batching shall be carried out by using the dry-mix method.

Suitable mixers shall be provided by the Contractor. Each mixer shall be capable of combining the materials into a uniform mixture and of discharging this mixture

without segregation. Mixers shall not be charged in excess of the capacity recommended by the manufacturer and shall not be recharged before completely discharging the previous batches. Excessive oversizing requiring additions of water will not be permitted. The mixers shall be operated at a drum speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition and mixer drums shall be kept free of hardened concrete. Mixer blades shall be replaced when worn down more than 10 percent of their depth.

Mixing Time:

The mixing periods specified below are predicted for proper control of the speed of rotation of the mixer and of the proper introduction of the materials into the mixer. The mixing time will be increased when such increase is necessary to secure the required uniformity and consistency of the concrete. The mixing time for each batch after solid materials are in the mixer drum, provided that all the mixing water is introduced before one-fourth of the mixing time has elapsed, shall be as follows:

Capacity of Mixer	Mixing Time
0.25 to 1.52 Cum	1-1/2 minutes
1.53 to 2.28 Cum	2 minutes

121.6 TESTING AREA

There shall be provided in the Concrete Mixing Machine Platform a satisfactory room to house the control testing equipment and to provide Working space for the Inspector and in an area adjacent to or in the concrete mixing platform a space suitable for use in the slump testing of concrete and the moulding of concrete test specimens. The size and arrangement of this room will be subject to approval by the Engineer. The Contractor shall provide utilities (electricity, air, water) as required for use in control testing.

121.7 TRANSPORT

- i) The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means which will prevent segregation or loss or addition to ingredients. It shall be deposited as nearly as practicable in its final position so as to avoid rehandling or flowing. All skips, vehicles, or containers used for transporting the concrete shall be thoroughly cleaned.
- ii) During hot or cold weather, concrete shall be transported in deep containers, to reduce the rate of loss of water by evaporation during hot weather and the loss of heat during cold weather.
- iii) Any wet batch hopper through which the concrete passes shall be conical in shape.
- iv) There shall be no vertical drop grater than 900mm except where suitable equipment is provided to prevent segregation and where specifically authorized. Belt conveyors, chutes, or other similar equipment will not be permitted for conveying concrete except where the use of such equipment is approved in writing by the Engineer, in advance of any use.

121.8 PLACING

No concrete shall be placed until all form work reinforcement, installation of parts to be embedded, bracing of forms and preparation of surfaces involved in the placing and the method of placement have been approved by the Engineer. Approval of method of placement proposed will not relieve the Contractor of his responsibility of its adequacy and he shall remain solely responsible for the satisfactory construction of all work under the Contract. Before concrete is placed, all surfaces upon or against which concrete is to be placed shall be free from standing water, mud, debris or loose material. All surfaces of forms and embedded material that have become encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed. The surfaces of absorptive materials against or upon which concrete is to be placed shall be moistened thoroughly so that the moisture will not be drawn from the freshly placed concrete. Concrete shall be worked into the corners and angles of the forms and ground all reinforcement and embedded items without permitting the material to segregate. Concrete shall be deposited as close as possible to its final position in the forms. The depositing of concrete shall be regulated so that the concrete may be effectively compacted with a minimum of lateral movement into horizontal layers approximately half meter in thickness. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited in the structure nor shall retamped concrete be used. The surfaces of construction joints shall be kept continuously wet for at least eighteen hours during the twenty-four hours period prior to placing concrete except as otherwise directed by the Engineer. All free water shall be removed and the construction joints shall be completely surface dry prior to placement of concrete. All concrete placing equipment and methods shall be subject to approval. Concrete placement will not be permitted when, in the opinion of the Engineer, weather conditions prevent proper placement and consolidation.

Before placing of concrete over or within the clean and dry spaces of formwork, all embedded items shall be kept in position and approved by the Engineer.

No concrete is to be placed into the foundation trenches until the ground to receive the same has been examined and approved by Engineer for this purpose.

Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as shown in the drawings or as approved by Engineer. Placing shall be carried out at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or has been contaminated by foreign materials shall not be deposited.

The actual sequence of construction proposed by Contractor shall be subject to ENGINEER's approval before construction starts on any part of the structure, and this sequence shall not be varied without ENGINEER's prior approval.

The concrete shall be placed after it has been mixed as soon as is practicable. Once the concrete has left the mixer no more water shall be added, although the concrete may be mixed or agitated to help maintain Workability.

The Time between mixing and placing should be reduced if the mix is richer or the initial Workability of the mix is lower than normal, if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere. Contractor shall ensure that the delay between mixing and placing does not exceed 45 minutes under any circumstances. Any concrete which does not

satisfy this requirement shall not be used.

The Concrete shall be deposited as nearly as possible in its final position to avoid rehandling. In no circumstances may concrete be made to flow along the forms by the use of vibrators. Concreting shall be carried out as a continuous operation using methods which shall prevent separation or loss of ingredients.

The free fall of concrete shall not be allowed to exceed eight feet and where it is necessary for the concrete to be lowered more than eight feet, it is not to be dropped into placed in layers approximately 18ins (450 mm) thick. Vibrator heads shall extend into the previously placed layer.

For massive concrete, concrete shall be placed in layers approximately 18ins (450 mm) thick. Vibrator heads shall extend into the previously placed layer.

Prior to the laying of concrete on load bearing masonry walls, bearing plates and at other points, as may be directed by Engineer, the surface will be brought to a true, hard smooth, level using a cement sand mortar in the ratio of 1 volume of cement to 3 volumes of sand. Two layers of approved building paper weighing will then be laid flat to separate the concrete from the surface on which it is to laid.

Prior to the laying of concrete on load bearing masonry walls, bearing plates and at other points, as may be directed by Engineer, the surface will be brought to a true, hard smooth, level using a cement sand mortar in the ratio of 1 volume of cement to 3 volumes of sand. Two layers of approved building paper weighing will then be laid flat to separate the concrete from the surface on which it is to be laid.

121.9 TIME INTERVAL BETWEEN MIXING AND PLACING

Concrete mixed in stationary mixers and transported by non-agitating equipment shall be placed within thirty minutes after it has been mixed unless otherwise authorised. The concrete shall be placed within 30 minutes after it has been discharged.

The concrete shall be placed after it has been mixed as soon as is practicable. Once the concrete has left the mixer no more water shall be added, although the concrete may be mixed or agitated to help maintain Workability.

The time between mixing and placing should be reduced if the mix is richer or the initial Workability of the mix is lower than normal, if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere. Contractor shall ensure that the delay between mixing and placing does not exceed 45 minutes under any circumstances. Any concrete which does not satisfy this requirement shall not be used.

121.10 PLACING TEMPERATURE

Adequate cooling facilities shall be provided to ensure that the temperature of concrete when discharged from the mixer is sufficiently low to meet the temperature requirements as specified in relevant Clause. Cooling mixing water, ice, pre-cooled aggregate or any other arrangement may be used to accomplish the pre-cooling of the concrete, subject to the approval of the Engineer but approval shall not in any way relieve the Contractor of his responsibility of placing concrete at temperatures at or below and within the specified limits.

Concrete shall be delivered to the forms at the appropriate temperature which is practicable to produce under current conditions but in no case at a temperature in excess of 38°C. except or otherwise determined by the Engineer.

121.11 LIFTS IN CONCRETE

Concrete shall be installed in lifts of depths as shown on the Drawings. The placement of concrete shall be carried on at such a rate and in such a manner that formation of cold joints is prevented. Slabs shall be placed in one lift unless otherwise authorised or directed. In walls, lifts shall terminate at such levels as will conform to structural details. Where slabs and beams are placed continuously with walls and columns, the concrete in walls and columns shall have been in place for at least two hours, or for a longer period when directed by the Engineer, before placing concrete in the slabs and beams. The top surface of vertically formed lifts shall be generally level. The concrete in columns shall be placed in one continuous operation unless otherwise authorised.

121.12 ELAPSE OF TIME BETWEEN PLACEMENT OF LIFTS

Except as otherwise approved on the basis of lift drawings submitted by the Contractor, a minimum of 72 hours shall elapse between the placing of successive lifts of walls and thin sections.

121.13 PLACING CONCRETE THROUGH REINFORCEMENT

In placing concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On the bottom of beams and slabs, where the congestion of steel near the forms makes placing difficult, a layer of mortar of composition compatible with the required concrete strength as directed shall be first deposited to cover the surface to a depth of approximately 3/4in (20mm).

121.14 CONSTRUCTION JOINTS

1. Concreting shall be carried out continuously upto construction joints, the position and arrangement of which shall be pre-determined by Engineer.
2. Joints not shown on the Drawings shall be so made and located as to least impair the strength of the structure and shall need prior approval of Engineer. Joints in walls and columns shall be at the underside of floors slab or beams, and at the top of footings. Beams, brackets, columns, capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.
3. All reinforcing steel shall be continued across joints. Key and inclined dowels shall be provided as directed by Engineer. Longitudinal keys at least 1-1/2in (40 mm) deep shall be provided in all joints in walls and between walls and slabs or footings.
4. When the work is to be resumed on a surface which has hardened, such surface shall be roughened in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface. The surface shall then be dampened.
5. The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in un-exposed walls and all others not mentioned below shall be dampened (but not saturated) immediately prior to placing of fresh concrete.
6. The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout of

similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surface and at least 1/2in (12.5 mm) thick on horizontal surface. The fresh concrete shall be placed before the grout has attained its initial set.

7. Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brush, care being taken to avoid dislodging of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 6ins (150 mm) in thickness, and shall be well rammed against old work, particular attention being paid to corners and close spots.
8. Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in the concrete with prior written approval of Engineer. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement. Wood strips inserted for architectural treatment shall be kerfed to permit swelling without pressure on the concrete.

122.0 EMBEDDED ITEMS

122.1 P.V.C. WATERSTOPS

Polyvinyl Chloride water stop shall be provided where indicated on the drawings. Unless otherwise indicated, the width of PVC water stop and expansion joint shall equal to thickness of the slab or 9ins (225 mm) whichever is greater.

PVC water stops shall be properly secured in position and jointed in accordance with the manufacturer's instructions along with all necessary moulded or prefabricated intersection pieces, filler material and water sealing compound. Wherever the Contractor chooses to use a construction joint, the location and detail of the water stop will have to be approved by the Engineer.

Cost of all PVC water stops which the Contractor uses in construction at joints will be deemed to be part of the BOQ rates of concrete. No additional payment for any PVC water stop will be made by the Employer.

All expansion joints shall be provided with PVC water stops along with joint filler described in detail in the relevant title. The water stop shall be installed so that they are securely held in their correct position during the placing of the concrete, which should be fully and correctly compacted around the water-stops so that no voids or porous areas are left. Where reinforcement is present, adequate clearance between this and all water stops should be left to permit proper compaction of the concrete. No holes are to be made through any water stop. Jointing other than by vulcanizing will not be permitted.

Unless otherwise shown on drawing all water stop shall be of dumb-bell type comprising three bulbs. Rear guard type water stops shall be provided in the expansion joints of raft slab laid underneath and held in position by the weight of concrete. The underlying surface shall be plane, smooth and free of dust.

The material, design and location of water stops in joints shall be as indicated in the Drawings. Each piece of pre-moulded water stop shall be of maximum practicable length in order that the number of end joints will be held to a minimum.

Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used (e.g. Vulcanizing for PVC and welding for

steel etc.). Joints shall develop effective water tightness fully equal to that of the continuous water-stop material, and shall permanently develop not less than 50% of the mechanical strength of the parent section, and shall permanently retain their flexibility.

122.2 CONDUITS

Electric conduits and other pipes which are planned to be embedded shall not, with their fittings, displace more than four percent of the area of the cross section of a column. Sleeves, conduits, or other pipes passing through floors, walls, or beams shall not be of diameter greater than 1/3 thickness of slab beam or wall unless approved by the Engineer or shown on the drawing.

122.3 OTHERS

All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

Expansion joint material, water stops and other embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

123.0 CONSOLIDATION

1. All concrete shall be consolidated by vibration, so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Internal vibrators shall have a minimum frequency of 800 vibrations per minute and sufficient amplitude to consolidate the concrete effectively.
Use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at points approximately 18ins (450mm) apart. At each insertions, the duration shall be sufficient to cause consolidation, generally from 5 to 15 sec. A spare vibrator shall be kept on the Site during all concreting operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process.
2. If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall be modified to affect an improvement in the quality of the concrete to the satisfaction of Engineer.
3. Vibrators shall not be allowed to contact the formwork for exposed concrete surface.

124.0 CURING AND PROTECTION

1. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury, and shall be maintained with minimal moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval of Engineer.
2. For concrete surfaces not in contact with forms, one of the following procedure shall be applied immediately after completion and finishing:
 - Pounding or continuous sprinkling.
 - Application of absorptive mats or fabric kept continuously wet.
 - Application of water proof sheet materials approved by Engineer.
 - Application of other moisture retaining covering as approved.
 - Application of curing compound conforming to ASTM C 309.The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheen which develops after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from the area to receive bonded applications.
3. Moisture loss from surface placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the limit prescribed herein.
4. Curing shall be continued for at least 14 days in the case of all concrete except concrete with Rapid hardening Portland cement for which the period shall be at least 6 days.

Alternatively if tests are made with cylinders/ cubes kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the minimum specified Works strength. If one of the first four curing procedures is used initially, it may be replaced by one of the other procedures any time provided the concrete is not permitted to become surface dry during the transition.
5. When the mean daily outdoor temperature is less than 41° F (5° C) then temperature of the concrete shall be maintained between 50-68° F (10-20 °C) for the required curing period. When necessary arrangements for heating, covering, insulation or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.
6. When necessary, provision for windbreak, shading for spraying, sprinkling, ponding or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.
7. Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5° F (28° C) in any one hour or 50° F (28° C) in

any 24 hour period.

8. During the curing period, the concrete shall be protected from damaging due to mechanical disturbances, such as load stresses, heavy shock and excessive vibration. All finished concrete surfaces shall be protected from shock and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods of application of curing procedures, and by rain or running water, self-supporting structures shall not be loaded in such a way as to overstress the concrete.

125.0 WORKS IN EXTREME WEATHER

125.1 COLD WEATHER

1. Unless adequate protection is provided and approval is obtained concrete shall not be placed during rain. Rain water shall not be allowed to increase the mixing water nor to damage the surface finish.
2. When the temperature of the surrounding air is expected to be below 40° F (4.5° C) during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed shall be no lower than 50° F (10° C) for any other sections. When necessary, concrete materials should be heated before mixing and carefully protected after placing; in general, heating or mixing water alone to about 140° F (60° C) may be sufficient for this purpose. Admixtures to prevent freezing may only be used with prior written permission of Engineer. All concrete damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 5.5 gallons per bag of cement (25 liters). If water or aggregate is heated above 100° F (38° C) the water shall be combined with the aggregate in the mixer before cement is added.

125.2 HOT WEATHER

During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90° F (32° C). For massive concrete this temperature should not exceed 70° F (21° C). When the temperature of the concrete exceeds 90° F (32° C), precautionary measures approved by Engineer shall be put into effect. When the temperature of the steel is greater than 122° F (50° C) steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water if, due to high temperature, low slump.

Other precautions as recommended by ACI standard 305 and 306 shall also be adopted.

126.0 TESTING

126.1 GENERAL

Contractor shall provide proper facilities for obtaining, making, curing and testing specimens in accordance with the specifications. All test shall be carried out at the site, by an independent testing agency approved by the Engineer, at the cost of the Contractor.

126.2 TEST OF CONCRETE SAMPLES

Strength test of concrete obtained during the course of the work will be performed under the direction of the Engineer and at the expense of the Contractor and shall be done by a testing agency approved by the Engineer. The Contractor shall assist the Engineer in obtaining, control purposes, such number of cylinder/cubes and beams as the Engineer may direct, but in general conduct strength tests on at least one test sample per 50 cubic yds. (38 cu. meters) of concrete with a minimum of one sample per pour. Each test sample shall consist of no less than six concrete test cylinders/cubes made from a single sample of concrete from random selected batch of concrete, taken at point of discharge of mixer or truck, cured under standard conditions, The cylinder/cube form each sample shall be tested, two at age 3 days, two at age 7 days and two at the end of the 28th day, it is of most important to ensure that test cubs are similar as possible in all respects to the actual concrete used in the work, the Engineer may if required request for additional samples. Test cylinders/cubes should be clearly marked with respect to the day of casting and identification no, and other particulars.

A test sample data sheet for record purposes will be prepared for each set of samples, with appropriate identification number of the sample.

Cylinders and cubes (beams if requested by Engineer) will be tested in accordance with the applicable requirements of ASTM Designation C39-72 and ASTM Designation C78-64.

In case of concrete mix, the appropriate strength requirement shall be considered to be satisfied if none of the strengths of the specimen is below the specified strength or if the average strength of the three specimens of the same age is not less than the specified strength and the difference between the greatest and least strengths is not more than 20% of that average.

When the results of tests show that the strength of any concrete is below the minimum specified, Engineer may give instructions for the whole or part of the work concerned to be removed and be replaced at the expense of Contractor. Contractor shall bear the cost of any other part of his, or any other Contractor's work, which has to be removed and replaced as a result of the defective concrete.

126.3 SLUMP

In general, the slump of the concrete, after concrete has been deposited but before it has been consolidate, shall not exceed the values specified below for the structures and/or parts thereof unless otherwise directed by the Engineer. Check slumps shall be taken at the Concrete mixer platform and at other locations as directed by the Engineer. The Engineer may order the placement of concrete having a less slump provided it can be consolidated readily into place by means of the specified vibration. The use of buckets, chutes, hoppers or other equipment of types that will not readily

handle and place concrete of such lesser slump will not be permitted. The slump will be determined in accordance with ASTM Designation C-143-74. Standard Method of Test for Slump for Portland Cement Concrete.

The grading and uniformity of fine aggregates as delivered to the mixers shall conform to ASrd point loading. The test result will be based on the average of the strength of the test specimens except that if one specimen in a test of the shows manifest evidence of improper sampling, moulding, or testing, the test result will be based on the average of the remaining two specimens. If two specimens in set of three show such defects, the results of the set will be discarded and average strength determined from test results of the other two sets. The standard age of test will be 28 days, but 3 and 4 day tests may be used at the discretion of the Engineer, based on the relation between the 7-day and 28-days strengths of the concrete as established by tests for the materials and proportions used. If the average of the strength test of the specimens cured under laboratory controls, for any portion of the work, fails below the minimum allowable compressive or flexural strength at 28 days required for the class of concrete used in that portion, the Engineer may change the proportions of the constituents of the concrete, as necessary to secure the required strength for the remaining portion of the work. If the average strength of the specimens cured under actual field conditions as specified herein before falls below the minimum allowable strength, the Engineer will make such changes in the conditions for temperature and moisture under which the concrete Works being placed and cured as my be necessary to secure the required strength.

Concrete Uses	Slump
Beams, slabs, floors and foundations	50mm (2ins) to 75mm (3ins)
Walls, columns, parapets, curbs etc.	75mm (3ins) to 100mm (4ins)

126.4 NON DESTRUCTIVE TESTING

Where the results of the strength tests of control specimens indicate that the concrete as placed does not meet specifications requirements of where there is other evidence that the quality of the concrete is below specification requirements, core-bearing tests will be made by the Engineer in accordance with the applicable requirements of obtaining and testing drilled cores and sawed beams of concrete. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be immersed in water for at least 48 hours and tested wet. In the event that the core boring test indicates that the concrete placed does not conform to the drawings and specifications, measures as prescribed by the Engineer shall be taken to correct the deficiency. However, the Engineer shall have the authority to prescribe such corrective measures (and the Contractor shall take such measures) if in the Engineer's opinion the results of the test specimens, without coring, warrant such action. An independent testing agency approved by the Engineer will perform all tests. The test may not be limited to core test, other non-destructive and load tests maybe adopted if there is reasonable doubt that the specified concrete strengths has not been achieved. The Contractor shall pay for all such tests. The cost will be deemed to be included in the Contractor's Bill of Quantities rate for Plain and Reinforced Concrete. If a strength or characteristic deficiency is found, the Contractor shall reserve all work relating to such test failures and replace all faulty concrete with new concrete & reinforcement where specified and as directed by the Engineer. The Contractor shall pay for all such test and replacing & redoing of all the faulty material. The Contractor shall also be responsible for any time loss due to these tests and replacement

activities. Non-destructive test may also be made to verify the insitu strength of the concrete. The Contractor shall bear all expense if the concrete is found to be below the required strength and quality.

126.5 LOAD TEST OF STRUCTURES.

The Contractor shall carry out the load test at his own cost in the following manner if the Engineer is not satisfied with a part or whole of the structure to help Engineer determining the acceptability.

This test will be carried out after the expiry of 56 days of effective hardening of the concrete. The structure will be subjected to superimposed load equal to 1.25 times the designed load and this load is maintained for 24 hours. If within 24 hours of removal of load the structure doesn't show recovery of minimum of 75% of the deflection shown during the Test Period, the test loading will be repeated. The structure will be considered to have failed to pass the Test if the recovery after the second test is not at least 75% of the maximum deflection shown during the second Test. ASTM's and ACI's Code of requirements for load tests will govern these tests.

127.0 FINISHING OF FORMED CONCRETE

127.1 GENERAL

1. After removal of forms the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Drawing or as specified in Clause of this section.
2. When finishing is required to match a small sample furnished to Contractor, the sample finish shall be reproduced on an area at least 100 square feet in a location designated by Engineer.

127.2 AS CAST FINISHES

1. Rough Form Finish:
2. Smooth Form Finish:
To secure a smooth hard uniform texture on the concrete.
The form facing material shall produce a smooth hard uniform texture on the concrete
It may be plywood, coated-hardboard, metal, plastic paper, 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. Defective material which will impair the texture of the concrete surface shall not be used.

127.3 ARCHITECTURAL FINISHES

1. Textured Finishes:
Textured form liners may be of formed plastic sheet, wood, sheet metal, or other material designated in Drawings as approved by the Engineer. Liner panels shall be secured in forms by cementing or stapling. Edges of textured panels shall be sealed to each other.
2. Applied Finishes:
When finishes of plaster or similar trowelled materials are to be applied, the

surface of the concrete shall be prepared to ensure permanent adhesion of the finish. The surface may be roughened mechanically or by etching with dilute hydrochloric acid. After roughening, the surface shall be washed free of all dust, acid, chemical retarder, and other foreign material before the final finish is applied.

127.4 RUBBED FINISHES

The following finishes shall be produced on concrete with a smooth form finish. Where smooth rubbed finish is to be applied, the forms shall have been removed and necessary patching completed as soon after the placement of the concrete as possible without compromising any structural requirements.

1. Smooth Rubbed Finish:

Smooth rubbed finish shall be produced on newly hardened concrete not later than a day following form removal.

Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process.

2. Grout Cleaned Finish:

No cleaning operations shall be undertaken until all contiguous surfaces to be cleaned are completed and accessible. Cleaning as the work progresses shall not be permitted.

Mix 1 part Portland Cement (grey and/or white) and 1-1/2 part fine sand and coloring additive with sufficient water to produce a grout having the consistency of thick paint.

Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with a brush or a spray gun. Immediately after applying the grout, scrub surface vigorously with a cork float or stone and fill all air bubbles and holes. After the surface whitens from drying (about thirty minutes at normal temperature) rub vigorously with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.

3) Cork Floated Finish:

i) Remove forms at an early stage, within 2 to 3 days of placement where possible.

ii) Remove ties, and all burrs and fins.

iii) Mix one part portland cement (grey and/or white) and one part fine sand with sufficient water to produce a stiff mortar.

iv) Dampen surface.

v) Apply mortar with firm rubber float or with trowel, filling all surface voids.

vi) Apply a small amount of water with a fog spray to prevent too rapid drying of compressed mortar.

vii) Produce the final texture with a cork float using a swirling motion.

128.5 UNSPECIFIED FINISHES

If the finish is not designated in the Drawings, the following finishes shall be used as applicable:

a) Rough Form Finish:

For all concrete surface not exposed to public view.

- b) Smooth Form Finish:
For all concrete surfaces exposed to public view.

128.6 RELATED UNFORMED SURFACES

Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

129.0 REPAIR OF SURFACE DEFECTS

129.1 GENERAL

Concrete with surface beyond tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of Engineer shall be removed and replaced at CONTRACTORS's expenses. Only in case of minor surface defects, Engineer may approve a surface treatment in accordance with the clause.

Concrete that is damaged from any cause, concrete that has honeycombed, fractured has nor other defects, and concrete which because of excessive surface depressions, must be excavated and built up to bring the surface to the prescribed lines, shall be removed and replaced with dry pack, mortar or concrete as hereinafter specified. Repair of concrete shall be performed only by skilled Workmen and within 24 hours or removal of forms. The Contractor shall keep the Engineer advised as to when repair of concrete will be performed. Unless inspection is waived in each specific case, repair of concrete shall be performed only in the presence of the Engineer. Repair shall be made in accordance with procedures approved by the Engineer.

129.2 MATERIALS

All material used in the repair of concrete shall conform to the applicable requirements of the Specifications stated in previous clauses of "Concrete Plain and Reinforced".

The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete. White portland cement shall be substituted for a part of the grey portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch.

129.3 DRY MORTAR FILLING

Dry pack mortar shall be used for filling holes having a depth nearly equal to or greater than the least surface-dimension, for narrow slots cut for repair of cracks, for grout pipe recesses as specified. Dry pack mortar shall not be used for filling behind reinforcement of filling holes that extend completely through a concrete section. If removal of the ends of form ties results in recesses, the recesses shall be filled with dry pack mortar provided filling of recess in surfaces upon or against which fill material or concrete is to be placed will be required only where the recesses are deeper than 25mm in walls less than 300mm thick.

129.4 HONEY COMBED

All honeycombed and other defective concrete shall be removed down to sound concrete. The area to be patched and area at least 6" (150 mm) wide surrounding it shall be dampened. Wait until surface water has evaporated. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand and shall then be well brushed into the surface.

129.5 WATER

The quantity of mixing water shall be not more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

129.6 MORTAR

When the bond coat begins to loose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface to permit initial shrinkage; it shall be left undisturbed for at least one hour before being finally finished to give desired effect. (The patched area shall be kept damp for 7 days).

129.7 TOLERANCE

Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as-cast concrete surfaces shall not exceed 2 square ft. (2 sqm) in each 1000 square feet (1000 sqm) of as-cast surface.

Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces.

129.8 TIE AND BOLT HOLES

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar.

129.9 PROPRIETARY MATERIALS/ COMPOUNDS

If permitted or required by Engineer proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures in accordance with the manufacturer's recommendation.

130.0 CONCRETE CONSTRUCTION TOLERANCE

Where tolerances are not stated in the Specifications or Drawing for any individual structure or feature, maximum permissible deviations from established lines, grades and dimensions shall conform to the following. These allowable tolerances shall not relieve Contractor of his responsibility for correct fitting of indicated materials. These tolerances are not cumulative.

1. Variation from the plumb (or levels, or, Variation from the levels or the grades indicated on Drawings:

- i) In the lines and surfaces of columns, piers and walls/also in floors, ceilings, beam soffits, and in arises.
 - * In any 10 ft (3 m) of length or height: 1/4" (6 mm)
 - * In any storey/bay or 20 feet (6 meters) Max: 1/4" (6 mm)
 - * Maximum for the entire length or height: 3/4" (20 mm)
- ii) For exposed corner columns, control joint grooves and other conspicuous lines, also for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines.
 - * In any bay or 20 feet (6 meters) maximum: 1/4" (6 mm)
 - * Maximum for the entire length or height: 1/2" (12.5mm)
- 2. Variation of the entire building lines from established position in plan and related position of columns, walls and partitions.
 - i) In any bay or 20 feet (6 m) maximum: 1/2" (12.5mm)
 - * Maximum for the entire length: 1" (25 mm)
- 3. Variation of the size and locations of sleeves, floors openings and wall openings: 1/4" (6 mm)
- 4. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls.
 - Minus: 1/4" (6 mm)
 - Plus : 1/2" (12.5mm)
- 5. Footings:
 - i) Variations in dimensions in plan.
 - * Minus : 1/2" (12.5mm)
 - * Plus (plus variation applied to concrete only, not to bars dowels) 2" (50 mm)
 - ii) Misplacement or eccentricity.
 - * 2 percent of the footing width in the direction of misplacement but not more than (Applies to concrete only, not to reinforcing bars or dowels): 2" (50 mm)
 - iii) Reduction in thickness
 - * Minus 5 percent of specified thickness.
- 6. Variation in Steps
 - i) Rise: 1/8" (3 mm)
 - Tread: 1/4" (6 mm)
 - ii) In Consecutive Steps
 - Rise: 1/16" (1.5mm)
 - Tread: 1/ 8" (3 mm)
- 7. Tolerance for Pre-cast Concrete:

The dimensions of the pre-cast product be within the following limits at the time of placement of these units in the structure, unless otherwise noted on ENGINEER's Drawings.

 - i) Overall dimensions of members per 10 ft (3 m): ± 1/16" (1.5mm)
 - ii) Cross-sectional dimensions
 - Section less than 3" (75mm): ± 1/16" (1.5mm)
 - Section over 3" (75mm) less than 18" (450mm): ± 1/ 8" (3 mm)
 - Section over 18" (450mm): ± 1/ 4" (6 mm)
 - iii) Deviations from straight lines in long sections. Not more than 1/8 inch (3mm) 10 ft (3m).
 - iv) Deviation from specified camber ± 1/16" (1.5 mm) per 10 ft (3m) of span. Maximum differential between adjacent units in erected position 1/4 inch (6mm).

8. Tolerance for Pavements:
 - i) Ramps
 - * Departure from established alignment $\pm 1/2$ inch (12.5mm).
 - * Departure from established longitudinal $\pm 1/4$ " (6mm) grade on any line.
 - * Departure from transverse template contour except at transverse joints $\pm 1/8$ inch (± 3 mm).
 - * Departure from transverse template control at transverse joints $\pm 1/4$ " (6 mm) in width of one traffic lane.
9. Pavements for Parking Areas:

Twice values listed for ramp pavements.

131.0 ACCEPTANCE OF STRUCTURE

131.1 GENERAL

1. Completed concrete work which meets all applicable requirements will be accepted subject to the other terms of the CONTRACT Documents.
2. Completed concrete work which fails to meet one or more requirements and which has been repaired to bring it into compliance will be accepted subject to the other terms of the CONTRACT Documents.

131.2 DIMENSIONAL TOLERANCES

1. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances as Section 16 considered potentially deficient in strength and subject to the provisions of Section 17.4.
2. Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of Section 16 may be rejected and the excess material shall be subject to removal. It shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.

131.3 APPEARANCES

1. Architectural concrete with surface defects shall be removed in accordance with this Section.
2. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely effected or misplaced items interfere with other construction.
3. Inaccurately formed concrete surfaces exceeding the limits specified earlier and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.
4. Concrete not exposed to view, but of defective appearance, may be accepted at the discretion of the Engineer.

131.4 STRENGTH OF STRUCTURE

1. The strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions:

- i Concrete strength requirements not considered to be satisfied in accordance with Section 13.
 - ii Reinforcing steel size, quantity, strength, position or arrangement at variance with the requirements of Section 7.
 - iii Concrete which differs from the required dimensions or location in such a manner as to reduce the strength.
 - iv Curing less than that specified.
 - v Inadequate protection of concrete from extreme temperature during the early stages of hardening and strength development.
 - vi Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
 - vii Poor Workmanship likely to result insufficient strength.
2. Additional structural analysis and/or testing including core tests may be required at the cost of the Contractor when the strength of the structure is considered potentially deficient.
 3. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with ACI Standard 318.
 4. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction, if so directed by Engineer or shall be replaced, at the CONTRACTOR's expense.
 5. The Contractor shall pay all costs incurred in providing the additional testing and/or analysis required by this Section.

132.0 METHODS OF MEASUREMENT OF CONCRETE WORKS

132.1 GENERAL

1. Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of as stated in section 1 (scope), but not limited to, the following:
 - a) All fixtures and all costs in connection therewith for pre-cast Works.
 - b) Waste of materials, and Square cutting.
 - c) Establishment charges, overhead charges and profit.
 - d) All other expenses, charges and taxes specified in Conditions of CONTRACT.
 - e) Works shall be measured net as fixed in position as per drawings and instructions of Engineer. Each measurement shall be taken to the nearest 1/2" (12 mm). This rule shall not apply to any dimensions stated in descriptions.

132.2 CONCRETE

1. Concrete shall be measured as executed but no deduction shall be made for the following:
 - i Volume occupied by water pipes, conduits etc, not exceeding 4 square inch (2500 sqmm) each in cross-sectional area and reinforcing bar.
 - ii Voids not exceeding 1 square foot in work given in square feet and 0.1 sq meter in work given in Sq meters.
 - iii Voids not exceeding 1 cubic foot in work given in cubic feet, 0.03 cubic meter in work given in cubic meter.

2. Junctions between straight and curved Works shall in all cases be deemed to be included with the work in which they occur.
3. Concrete work shall be classified and measured separately as follows unless otherwise described elsewhere:-
 - i Buildings, foundation beams, foundation slabs, footings, bases of columns, machine foundations, mass concrete etc, in cubic feet (Cu Meter).
 - ii Floor slabs on ground with floor beams in cubic feet (Cubic Meter).
 - iii Walls in foundations, plinth and superstructure in cubic feet (Cubic Meter) stating thickness.
 - iv Columns, piers, pilasters, pillars etc, in cubic feet (Cubic meter).
 - v Lintels, beams and brackets in cubic feet (Cubic Meter).
 - vi Suspended floors, roofs and stair landings in square feet (sqm), Cft, Cum stating thickness.
 - vii Stairs (including landing) in cubic feet (Cubic Meter).
 - viii Railings in cubic feet (Cubic Meter), square feet (Sq. Meter), or linear feet (Meter) stating description.
 - ix Parapets, purdees and the like in square feet (Cubic Meter) stating thickness.
 - x Jali, blocks in square feet (Sq. Meter) stating thickness & description.
 - xi Pre-cast concrete items shall each be enumerated except if otherwise shown in the Bill of Quantities, separately stating the description.
4. Measurement of walls shall be taken between attached columns, piers or plasters, if any. Columns shall be measured from the top of footings/beams or floor surfaces to the under side of beams or slabs as the case may be. Where the width of the beams is less than the width of columns, the extra width at the junction shall be included in the beam.

The depth of the beams shall be measured excluding the depth of the slabs.

132.3 FORM WORK

1. Formwork (if separate and extra payment is specifically stated in the Bill of Quantities) shall be measured in square feet (Sq. M) as the actual surface of the finished structure which required to be supported during the deposition of the concrete, including the upper surfaces to the work sloping more than 15 degree from the horizontal. No allowance shall be made for overlaps and passings at angles and no deduction shall be made for the following:-
 - i Voids not exceeding ten square feet (1 Sq. M).
2. Formwork shall be deemed to be inclusive of, but not limited to items detailed in section 12.1 and the following:-
 - i Batten, struts, reversed cut strings, bolting, oiling, wedging, easing, striking, removing and making good exposed faces of concrete after removal of formwork. Also yokes, wales, sheathing, jack rods, jacks, Working platforms and finishers, scaffolds, etc.
3. Temporary stop ends for constructed joints shall not be measured and paid for.
4. Formwork to throats, grooves, chases, rebates, chamfers over 2" wide (50mm) splayed internal angles over 1/2" wide (12.5mm) mouldings and the like shall each be measured separately in linear feet stating the size.

132.4 RATE OF REINFORCEMENT

1. The rate tendered for any type of reinforcement by the Contractor shall also be inclusive of the cost of binding wire wastages, and the cost of concrete, metal or plastic chairs and spacers or hangers, etc.
2. All reinforcement shall be provided in length shown in Drawings and as per Specifications. Should the Contractor provide lengths of reinforcement which are greater than shown on the Drawings no payment of extra length shall be made.
3. The Contractor shall be paid for reinforcement by weight computed from linear measurements of reinforcements actually used at Site as per the Drawings, Specifications and instructions of Engineer. Contractor shall not claim for the difference in the actual weights of bars and their standard weights given in ASTM/BSS standards. For the purpose of this tender 1 tonne shall be taken as (1000 kgs).

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

GENERAL FOR “PRE-CAST CEMENT CONCRETE”

PART 1 GENERAL

133.0 DESCRIPTION

1. Work included:
Pre-cast concrete units required for this Work are indicated on the Drawings. Included are provision and installation of items to both interior and exterior conditions such as, but not limited to, copings, sills, jalties, gargoyles and lintels, window units, architectural fascades, panels, slabs units, fascades, panels, slabs etc.
2. Related work:
 - a) Pre-cast concrete flag paving and steps for external work are described under Section 2515 Unit paving.
 - b) Pre-cast concrete drain trench units, curbs, curb gutters, posts, etc. are described under Section 2510 Concrete Walks, Roadways Curbs and Gutters.
 - c) Tiles for roofing are described under Section 7400 Roofing.

133.1 QUALITY ASSURANCE

1. Qualifications of workmen:
 - a) For the forming, casting and placing of pre-cast concrete units, use only skilled masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.
 - b) In acceptance or rejection of pre-cast concrete units, no allowance will be made for lack of skill on the part of workmen.
 - c) Provide one skilled supervisor who shall be present at all times during execution of the Work of this Section and who shall personally direct the execution of this portion of the Work.

133.2 SUBMITTALS

1. Samples:
 - a) Within 120 days after award of Contract, and before any materials for this Section are delivered to the Job Site, submit one set of Shop Drawings and samples of the proposed units to the Engineer for approval in accordance with these Specifications.
 - b) Shop Drawings must indicate general arrangement, construction and anchorages.

133.3 PRODUCT HANDLING

1. Protection:
Protect concrete materials before, during, and after installation and protect the installed Work and materials of other trades.
2. Replacements:
In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to the Employer.

134.0 PRODUCTS

1. Concrete:

134.1 MATERIALS

- a) Concrete shall conform to pertinent requirements of Section 3300: Cast-in-Place Concrete.
 - b) Mixes for exposed items such as jallies, copings, sills window units, architectural fascades and panels and gargoyles slabs etc. shall be according to structural specification.
 - c) Concealed items such as lintels shall be according to structural specifications.
 - d) Works crushing strength of units shall be as specified in the structural specifications.
2. Formwork:
Formwork for pre-cast concrete units to conform with Section 3300 of these Specifications and Structural Drawings, however all formwork will be of steel.
 3. Reinforcing:
Reinforcing for pre-cast concrete units to conform with Section 3300 of these Specifications, unless otherwise indicated on Shop Drawings.
 4. Mortar:
Material for setting pre-cast units in masonry shall be of similar mix described in Section 4200 Unit Masonry.
 5. Pigmentation of units:
Mineral pigment compatible with cement for pre-cast concrete units shall conform to B.S. 1014. Colors shall be resistant to alkalis, lime, heat and light. Color to be approved by Engineer.
 6. Jointing:
Sealants and backing materials required for jointing shall be approved by Engineer. Refer also to section 7900 Sealants.

134.2 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of precast concrete units, shall be as provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

135.0 EXECUTION

135.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to installation of precast units described in this Section, carefully inspect installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - b) Verify that unit masonry may be completed in accordance with pertinent codes and regulations and the original design.

2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

135.2 FABRICATION

1. Design and cast units to permit handling and installation and to bear weights and stresses to be encountered in completed building.
2. Thoroughly mix pigment with cement in proportions not exceeding 5% by weight of cement or to manufacturer's specifications, both to prior approval of Engineer.
3. Refer to details for shapes and jointing.
4. Ensure a minimum cover of concrete over reinforcement as indicated on Drawings, or as specified in the structural specifications.
5. Cure pre-cast concrete units as per specifications.

135.3 INSTALLATION

1. Ensure that units are not cracked, chipped or stained before, during, or after installation.
2. Install units in accordance with Drawings. Ensure a sound, durable, stable installation suitable to receive following work.
3. Seal joints between parapet copings and flashing copings at roofs with sealants, using recommended procedures and backing materials.
 - a) Units unless specified elsewhere shall be jointed with mortar materials.
 - b) Continuous exposed units shall have mortar tinted to match pre-cast concrete.
4. Pre-cast window units, architectural fascades and panels will be lifted in place by a tower crane. The method of lifting of these units will be submitted to the Engineer for approval.
5. Shop drawings for anchorage of pre-cast window units, architectural fascades and panels will be submitted for approval to the engineer. Proper and durable anchorage of these units will be the total responsibility of contractor.

135.4 CLEANING

1. General:
 - a) Do not allow the accumulation of scraps and debris arising from the work of this Section. Maintain the area in a neat and orderly condition at all times. In the event of spilling or splashing material on to other surfaces, immediately remove spilled or splashed material and traces of residue to the approval of the Engineer.
 - b) Clean surfaces of pre-cast concrete units.
 - c) Upon completion of work of this Section, promptly remove from the Job Site broken units, debris arising from the work of this Section, tools and equipment, leaving all areas in a neat and orderly condition to the approval of the Engineer.

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

GENERAL FOR “MASONRY”

136.0 GENERAL

136.1 DESCRIPTION

1. Work included:

Unit masonry required for this Work is indicated on the Drawings and includes the provision and installation of Concrete blocks, Clay bricks, brick work, coping units and related material both inside and outside the building.

136.2 QUALITY ASSURANCE

1. Qualifications of workmen:

- a) For the actual cutting and placing of masonry units, use only skilled masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.
- b) In acceptance or rejection of installed masonry units, no allowance will be made for lack of skill on the part of workmen.
- c) Provide one skilled mason who shall be present at all times during execution of the work of this Section and who shall personally direct the execution of this portion of the Work.

2. Samples and Mock-ups:

- a) Within 60 days after award of Contract, and before any masonry materials are delivered to the Job Site, submit six samples of the proposed masonry units and color samples of mortar to the Engineer for his approval in accordance with these Specifications.
- b) At Engineer's or Consultant's direction, construct mock-ups required as part of this Contract:
 - i) Construct built-in lighting niches of various types for review of maintenance, appearance and light dispersal.
 - ii) Construct other special light fixtures in block or brick forms for review.
 - iii) Construct external and internal facade/facing of building with all edges, details niches etc. as shown on drawings and instructed by Engineer.

136.3 PRODUCT HANDLING

1. Protection and Storage:

- a) Protect masonry materials before, during, and after installation and protect installed work and materials of other trades.
- b) Masonry units and packaged material shall be placed on planks raised from the ground, covered with a waterproof tarpaulin and kept well ventilated until time of use. No material shall be allowed to become wet. Use only quantities of blocks/bricks required for immediate use. Do not stock pile units on the structure. Sand or loose material shall be stored so that it will not be contaminated from dirt or other extraneous material from the ground.

2. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to the Employer.

137.0 PRODUCTS

137.1 CONCRETE BLOCKS

1. Block sizes shall be 16 ins. by 8 ins by 1 1/2 ins, 4 ins, 6 ins and 8 ins. (400x200 mm by 50, 100, 150, and 200 mm) thickness including a 3/8 in. (10mm) allowance for jointing. Physical requirements of blocks shall comply with B.S. 6073.
2. Solid concrete blocks have a minimum crushing strength of 1,200 psi. per average of 3 units tested, or 1,000 psi. per individual unit tested, based on gross section area.
3. Hollow concrete block units wherever specified shall have cores with cross sectional area atleast equal to the percent of gross area of block given below:

8 ins (200 mm)	38 percent
6 ins (150 mm)	30 percent
4 in. (100 mm)	no requirement
4. Minimum shell wall thickness 1-1/4 in. (30 mm)
5. Permissible tolerance in size of block shall be 1/8 in. (3 mm) each way.
6. Block Making:
 - a) Blocks shall be machine moulded.
 - b) Blocks shall be continuously water cured for a minimum of 10 days and covered between sprinkling operations with a 4 mm. thick polyethelene sheet or hessian cloth. After the curing period blocks shall be air dried. Blocks shall not be installed until completely dry.
 - c) Cured concrete blocks shall be stored off the ground so as to allow air circulation.
 - d) Blocks cast on different days shall be stacked separately and shall be labelled showing the date on which they were cast.
 - e) Properties of blocks not specified here shall conform to BS 6073.
7.
 - a) The Contractor shall provide test certificates proving the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test certificates shall be provided as required by the Engineer to ensure that all batches of blocks have the minimum crushed strength specified. The Block strengths are to be determined in accordance with BS 2028.
 - b) The test shall be carried out by a laboratory approved by the Engineer. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The Engineer will require to periodically test samples of blocks, & the Contractor shall make any necessary arrangements. The method of sampling for all tests shall be in accordance with BS 2028.
 - c) All properties of specifications of blocks not explained in these specifications or BS 2028, shall comply with the requirements of P.S. 419, as directed by the Engineer.
8. ABSORPTION RATE
The Contractor shall at his own cost, satisfy the Engineer that the absorption rate of the block when determined in accordance with BS 3921 does not exceed 20g/mm²/min. or that the Contractor is able to adjust it so that it does not exceed this value on site.

9. SOLUBLE SALT CONTENT

For exposed Block work, the contents, by weight percent of soluble sulphate, calcium, magnesium potassium and sodium radicals, shall not exceed respectively 0.30, 0.10, 0.03, and 0.03, per cent when ascertained in accordance with BS 3921 at the cost of the Contractor.

137.2 FACE BRICKS

1. a) Clay bricks to be of first quality, and comply with pertinent data of B.S. 3921.
- b) Brick sizes shall be generally 9 ins by 4-1/2 ins by 3 ins. (230 x 115 x 75mm). A small size of 9 ins by 2-1/4 ins by 1-1/2 ins shall be used where shown on Drawings. Non Standard sizes and shapes shall be as shown on Drawings. Dimensions include a 3/8 in. (10 mm) allowance for jointing.
- c)
 - i) Bricks shall be sound, hard and well burnt with uniform size, shape and color, homogeneous in texture and free from flaws and cracks.
 - ii) A fracture surface should show a uniform compact structure free from holes, lumps or grit.
 - iii) Arises should be square, straight and sharply defined.
 - iv) Brick dimensions shall not vary more than 1/8 in. (3 mm) from standard size.
 - v) Bricks shall give a metallic ring when struck with a small hammer or another brick.
 - vi) Surface should be hard enough to prevent scratching by a finger nail.
 - vii) Bricks should not break when struck against another brick or dropped flat from a height of 3 to 4 ft. (1 to 1-1.5 meters) on a solid surface.
 - viii) Bricks shall not absorb water more than 1/16th of their own weight when dry.
 - ix) Non-standard shapes shall be of same texture, color etc. as described for standard units.

137.3 MASONRY BRICKS

1. All bricks shall be of first class quality made from good brick earth, free from saline deposits and shall be sand moulded. They shall be thoroughly burnt with out being vitrified shall be regular, uniform in shape and size with sharp and square edges parallel faces and of deep red or copper color. First class bricks shall be homogenous in texture and emit a clear ringing sound when struck, and shall be free from flaws, cracks, chips, stones and modules of lime. First class brick in an oven dried condition shall not absorb more than 1.5 of its weight of water when immersed one hour in water of 21 to 27 degrees centigrade and shall show no signs of efflorescence on subsequent drying. The average compressive strength of five representative first class brick shall be not less than 8.5 N/mm^2 (1200 psi) for an individual brick.
2. All bricks shall be manufactured by the Trench Kiln Method or other standard methods approved by the Engineer. The earth used in manufacturing bricks shall be carefully selected and shall be free from objectionable quantities of lime,

gravel coarse sand, roots, or other organic matter. Salts shall not exceed 0.3 percent and calcium carbonate shall not exceed 2.0 percent.

3. The mould used in the manufacture of bricks shall be thoroughly sanded before each use and shall be sufficiently large than the size of the bricks being manufactured to allow for shrinkage in drying and burning. Over-size irregular and worn moulds shall be destroyed. Each finished brick for brick masonry shall be 225mm by 114mm by 75mm in size and weight between 3.2 to 4.2 kilograms. All bricks shall have a "frog" 5mm deep on one face.

137.4 GLASS BLOCKS

1. Glass blocks used for decorative purposes are described under section 4270 of the specifications.

137.5 MORTAR

1. Mortar for unit masonry shall achieve a compressive strength of 1500 psi in 28 days, and consist of:
 - a) Portland Cement to BS 12-78.
 - b) Aggregate: damp loose sand to BS 1200, Table 10 graded 3/16 in. down.
 - c) Water: clean and clear water which does not have sweet, saline or brackish taste to be used for mixing and curing of concrete. Conform to B.S. 3148 is essential.
 - d) Mortar coloring: finely ground, first quality, sun-proof, lime-proof, high purity mineral pigment with a specific gravity similar to cement, conforming to B.S. 1014.
 - e) Additives where used, shall be proprietary products used in the proportions and manner recommended by the manufacturer. The additives, shall in no way adversely affect the mortar strength or contain chemicals which may be harmful to other buildings materials. To add gypsum to cement is strictly forbidden.

137.6 REINFORCEMENT STEEL

1. Reinforcement steel required for masonry units shall be as described in Section 4250 Masonry Accessories.

137.7 GROUT

1. Grout shall consist of Portland cement, sand, pea gravel and adequate water to produce a concrete of approximately 10 inches (250 mm) slump, and shall have an ultimate compressive strength of 1500 psi in 28 days.

137.8 CONCRETE

1. Concrete for infill between top of masonry walls and underside of structure shall be 1:3:6 mix by volume of 2000 psi compressive strength in accordance with Section 3300 Cast-in-Place Concrete.

137.9 ADMIXTURES

1. Admixtures may be used only with the written approval of the Engineer.

137.10 WALL TIES

1. Wall ties as described in Section 4250 Masonry Accessories.

137.11 INSULATION

Insulation to be inserted into the cavities or applied to faces of brick work or block work shall be correctly executed in accordance with the manufacturer's instructions. Where foam insulation is to be inserted into cavities, holes and openings shall be sealed prior to injection to prevent seepage of the foam.

Loose fill insulation shall be poured into cavities from the top of each wall section completed, where required, and shall be allowed to form its natural density, and shall not be tamped

Where insulation boards are specified, proper anchorage to walls is essential. Refer to Section 7200: Building Insulation of these specifications, type and installation procedures.

137.12 SCAFFOLDING

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate for masonry items.

Damage to masonry form scaffolding or from any other subject shall be repaired by the Contractor at his own cost.

137.13 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper installation of unit masonry, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

137.14 TESTING

The Contractor will submit samples of all materials such as bricks, blocks, metal wall ties, rawal plugs etc. along with their technical data, catalogue cuts, testing results etc. etc. for the approval of the Engineer who may require to get the material tested by an independent Testing Laboratory to be approved by the Engineer. Blocks and Bricks will be required to be tested as and when delivered to the site. All testing will be carried out at the Contractor's cost. Periodical testing of Blocks will be in accordance to BS 2028. Blocks and bricks will be tested for compressive strength, efflorescence, dimensions, water absorption, manufacturing process, density, surface texture, moisture movement, cement, aggregate and water.

138.0 EXECUTION

138.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to work of this Section, carefully inspect installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - b) Verify that unit masonry can be completed in accordance with pertinent codes and regulations and the original design.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been completely resolved.
3. Environmental Conditions:

During hot weather protect masonry construction from direct exposure to wind and sun when erected in an ambient air temperature above 32 C (90 F) in the shade with a relative humidity less than 50%.

138.2 COORDINATION

1. Carefully coordinate with other trades to ensure proper and adequate interface with them and the work of this Section.

138.3 MIXING MORTAR

1. General:
 - a) Use a mechanical mixer of one sack minimum capacity. Hand mixing will be permitted provided quantities of materials and water are accurately controlled, and that method of mixing is approved by Engineer.
 - b) Mix mortar at least three minutes after materials have been added.
 - c) Mix only as much mortar as can be used in one hour after water has been first mixed into the batch.
2. Retempering:

Do not retemper mortar.
3. Mortar Mixes:
 - a) Mix proportions by volume:
 - i) Interior and Exterior work
1:4-5 (cement sand)
 - b) Use cement mortar for parapets and stacks.

138.4 INSTALLATION

1. General:
 - a) All masonry laid plumb, true to line, with level and accurately spaced courses and reveals, with corner plumb and true, and with each course breaking joints with the course below. Bond shall be kept plumb throughout. Units with greater than 12 percent absorption shall be wetted before laying.
 - b) Concrete blocks for wall construction at jambs to openings and at piers to

- be grouted.
- c) Block walls of 8 ins (200 mm) and brick walls of 9 ins (230 mm) thickness exceeding 24 feet (8 meters) length shall be supported at intermediate points, not exceeding 12 feet, (4 meters) with two 12 ins by 12 ins (300mm x 300mm) masonry piers bonded to wall. Install a continuous vertical mortar joint between piers.
 - d) Gaps of less than 8 ins between tops of masonry and underside of structure shall be completed with cut masonry units or built flush with concrete.
 - e) The methods and equipment used for transporting the masonry units and mortar shall be such as will not damage the units nor delay the use of mixed mortar. Units shall not be placed during rains sufficiently heavy or prolonged to wash the mortar from the brick. Mortar already spread which becomes diluted by rain shall be removed and replaced before continuing with the work. All brick to be used in brick masonry shall be moistened with water from three to four hours before they are used by a method which will ensure that each brick is thoroughly and uniformly wetted. All bricks shall be free from water adhering to their surface when they are placed in the brick masonry.

2. Laying up:

- a) Place units in mortar with full trowelled bed and head joints.
- b) Align all vertical cells to maintain a clear, unobstructed system of flues, or shafts. Clean out as work proceeds.
- c) Mortar work to be in accordance with B.S.CP 121 section 4.4.
- d) When laying fresh units to set or partially set masonry, clean surfaces of those previously installed and remove loose mortar prior to laying fresh units.
- e) The masonry work shall be carried up in uniform manner and no portion shall be carried out more than one meter above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and leveled around each floor.
- f) Bricks shall be laid "frog" upward with mortar joints and in English bond as shown on the drawings or as directed by the Engineer. Both bed and vertical joints shall be 6mm in thickness completely filled with cement mortar as specified herein, and each brick shall be added firmly tapping with the handle of the trowel. All horizontal joints shall be parallel and all vertical joints in alternate courses shall be directly over one another. Excess mortar at the outer edges shall be removed and joints drawn straight with the edge of a trowel and a straight edge. All anchors and similar work required to be embedded in the brick masonry shall be installed as the work progresses. At the completion of the work all holes or defective mortar joints shall be cut out and re-pointed.
- g) The exterior faces of the walls shall be finished by striking the joints as the work proceeds. The joints shall be struck by raking the green mortar after the brick work has been laid and finishing the joint with a pointing tool. Horizontal joints shall be struck to form a weathered joint and vertical joints shall be struck with a V notch.
Care shall be taken that the striking tools do not develop a cutting edge as the object of striking the joint is to compress the mortar into the joints.

3. Built-in Work:
 - a) Work required to be "built-in" and/or incorporated in any masonry construction as work progresses, includes all anchors, expansion joint shields, barrier fins, loose lintels, bearing plates, structural steel bucks, door and window frames, access doors and frames, wall plugs and flashing etc.
 - b) Avoid cutting and patching unless directed by Engineer.
 - c) Set hold-fasts, anchors and other items required by this and other parts of these Specifications.
 - d) Solidly grout spaces around items and backs of metal door frames.
 - e) Build-in pipe chases as required by Other Contractors. Cutting of masonry after laying shall be only as directed by Engineer.
 - f) Build-in short lengths of drain pipe, to walls, outside of buildings for surface water drainage transfer as described in Section 2510: Concrete Walks Roadways, Curbs and Gutters.
 - g) Masonry bases or concrete masonry units under equipment, except those built on rough slabs; and other accessories; unless specifically indicated otherwise on the Drawings, the spaces around all built-in equipment unless provided by others i.e. mechanical trades, shall be filled in solid with appropriate masonry material and/or concrete so indicated on Drawings, also all unit steel door bucks shall be filled in solidly with masonry and cement mortar.
4. Dowels and wall ties:
 - a) Install projecting reinforcing bar dowel anchors into beams, columns and slabs and grout into masonry. Bars to be drilled and grouted into structural members, as specified in the structural specification/drawings.
 - b) Embed wall ties 3 ins. (75mm) into each bearing of double skin walls, at 18 ins. (450 mm) centers vertically and 24 ins. (600 mm) horizontally, staggered pattern.
5. Damproofing:

Damp proof courses shall be laid on an even mortar bed, free from projections which may puncture the materials. Where the damp-proof course is to be stepped only flexible membranes shall be used. Damp-proof course unless otherwise specified shall consist of Class 'C' (3000 psi) Cement Concrete 2ins (50mm) thick, mixed with approved quality water proofing compound as per manufacturers specifications and shall be laid at required level as per drawings and instructions of the Engineer. The D.P.C. shall be tamped, consolidated, leveled and edges and corners made to the requirements of drawings and shall include finishing and curing. The cost of D.P.C will be assumed to be part of cost for unit Masonry.

Install vertical damp-proof membrane and horizontal damp-proof course as described in Section 7100 Tank Lining, Damproofing & Water Proofing.
6. Joints and weep holes:
 - i) Joints for block work shall be flush.
 - ii) Vertical joints for Brick work will be tooled to receive 'V' notch and Horizontal joints to be flush
 - iii) Install weep holes as shown on Drawings.
7. Tolerances:

Unit masonry shall be erected plumb and true to line and level with a maximum variation of 1/8 in. (3mm) in 10 ft.(3 m).

138.5 GROUTING

1. Timing:
Do not grout until masonry has cured at least 24 hours.
2. Consolidate grout at time of pouring by puddling and filling cells of masonry, and then reconsolidating later by puddling before the plasticity is lost.

138.6 CURING AND REPAIRS

1. All unit masonry shall be watered cured and shall be kept wet for at least seven days, by an approved method which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements of these Specifications for water used in the manufacturer of masonry units.
2. If, after the completion of any masonry work, the units are not in alignment or level, or does not, conform to the lines and grades shown on the drawings or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the Engineer grants permission, in writing, to patch or replace the defective area.

138.7 CLEANING & PROTECTION

1. Inspection:
Upon completion of the Work of this Section, make a thorough inspection of installed unit masonry and verify that units and joints have been installed in accordance with the provisions of this section; make necessary adjustments.
2. Protection:
 - a) Protect sills, ledges and surrounding work from mortar drippings or other damage during masonry construction. Remove misplaced mortar or grout immediately.
 - b) Wrap wood mullions and other built-in wood items with 4 mm. Polythene sheeting and remove at completion of work.
 - c) Cover tops of uncompleted walls with non-staining waterproof coverings when work is not in progress.
3. Cleaning:
 - a) Clean surfaces of unit masonry as required for proper application of the specified finishes.
 - b) Cut out and re-point defective joints.
 - c) Upon completion of Work to this Section, promptly remove from the Job Site mortar droppings, broken units debris arising from the work of this Section, and tools and equipment, leaving all areas in a neat and orderly condition to the approval of the Engineer.

139.0 MEASUREMENT AND PAYMENT

139.1 GENERAL

Except otherwise specified herein or elsewhere in the Contract Document, 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 there of shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

1. Chiselling of masonry, wherever required.
2. Providing and fixing all joint reinforcing bars and dovetail anchors.
3. Providing and filling class 'D' concrete in the cavity of hollow block masonry.
4. Providing and laying damp proof courses, horizontal and vertical water proofing/damp-proofing insulation where directed.
5. Providing and installing expansion joint in masonry, units.

139.2 SOLID BLOCK MASONRY

1. Measurement:

In case of different thickness of slab/beams/columns in different areas or rooms or for any other reasons, whatsoever, if chiselling of masonry is required, the Contractor shall do so at his own cost. Where for any reason whatsoever, the height of the wall is short of ceiling height, the actual height shall be made good with class 'C' (3000) nominal mix concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under the item of wall masonry. Similarly where the lintel heights are such that the contractor has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiselling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate of masonry.

Measurement for acceptable completed works of solid block masonry will be made on the basis of number of Sft (sq. meter) provided and installed in position as shown on the drawings or as directed by the Engineer. Each measurement shall be taken to the nearest 1/2 in. (10mm.). All openings and lintel left in the masonry wall will be deducted.

2. Payment:

Payment will be made for acceptable measured quantity of solid block masonry work on basis of unit rate per sq. meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

139.3 HOLLOW BLOCK/BRICK MASONRY

1. Measurement:

Measurement for acceptable completed works of hollow block masonry wall will be made on the basis of number of sq. meter provided and installed in position as shown on the Drawings or as directed by the Engineer. Each measurement shall be made to the nearest 10mm. All openings left in the masonry will be deducted. Solid block masonry around openings and lintel shall not be measured separately. It shall be included in the measurement of hollow block masonry for payment.

2. Payment:

Payment will be made for acceptable measured quantity of hollow block masonry works on the basis of unit rate per sq. meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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

GENERAL FOR “UNIT WALLS”

GENERAL

140.0 DESCRIPTION

1. Work included:
Supply and install masonry accessory materials not specifically described in other Sections of these specifications but required for the construction of masonry unit walls indicated on the Drawings.
2. Items:
Steel dowels indicated as being steel bars similar to plain or deformed types, normally used for the reinforcement of concrete.

140.1 SUBMITTALS

1. Within 35 days after award of Contract, and before any material is delivered to the Job Site, submit to the Engineer complete samples of masonry accessories proposed to be furnished and installed.

140.2 PRODUCT HANDLING

1. Protection:
Protect these materials before, during, and after installation and protect the installed work and materials of other trades.
2. Replacements:
In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to the Employer.

141.0 PRODUCTS

141.1 MATERIALS

1. Where masonry accessories are required, and no material or thickness is indicated on the Drawings, furnish and install the highest quality.
2. Masonry accessories:
 - a) Control joint filler: Preformed rubber, neoprene or polyvinyl chloride materials of size and shape indicated on Drawings. Refer to Section 7900 Sealants.
 - b) Steel dowels for tying masonry shall be 3/8 in. dia. deformed reinforcing bar, coated with liquid galvanising, in accordance with Section 3300 Concrete Reinforcement.
 - c) Wall ties: mild steel wire 1/2 in. by 1/2 in. mesh 3 ins wide, galvanised to B.S. 729 after fabrication or galvanised butterfly type.
 - d) Rope made of jute for weep-hole vents.
 - e) Wall base Flashing: See Division 7.

- f) Anchors:
 - i) Plate type: minimum 1/8 in. galvanized steel, of shapes and sizes to suit purpose.
 - ii) Wire type: 1/4 in. galvanized wire of shapes and sizes shown.
 - iii) Anchor bolts: including nuts, washers, studs, ferrules, and related items, of galvanized steel or brass, as detailed.

142.0 OTHER MATERIALS

- 1. Materials and methods not specifically described but required for proper installation of items in this Section shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

143.0 EXECUTION

143.1 INSTALLATION

- 1. Build-in anchors, plugs, lintels, ties, frames, inserts and other equipment or materials to be embedded in masonry work, as indicated on Drawing or specifications in section 4200.

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

GENERAL FOR “IRON & STEEL”

144.0 GENERAL

144.1 DESCRIPTION

1. Work included:
 - a) Supply and install miscellaneous iron and steel items and those not specifically described in other Sections of these Specifications but required for a complete and operable facility, as implied or shown on Drawings.
 - b) Work included in this Section is generally pertaining to concealed or semi-concealed metal items required to frame, support or retain various elements, described in other Sections of these Specifications, such as steel angles for supports and framing, anchor plates, straps, ties, bolts and anchoring devices.
 - c) Examine other Sections of these Specifications and all Drawings for relating work of this Section, and of other trades.

144.1 QUALITY ASSURANCE

1. Qualifications of welders:

Use only certified welders and shielded arc or spot process for welding performed in connection with the Work of this Section.

144.2 SUBMITTALS

1. Shop Drawings:
 - a) Within 90 days after award of Contract, and before any miscellaneous metal is delivered to the Job Site, submit Shop Drawings to the Engineer for approval in accordance with these Specifications.
 - b) Show locations, markings, quantities, materials, sizes, and shapes and indicate methods of connecting, anchoring, fastening, bracing, and attaching to the work of other trades.
2. Proof of compliance:

Upon completion of this portion of the Work, and as condition of its acceptance, deliver to the Engineer a letter signed by the contractor that miscellaneous metal was furnished and installed in complete accordance with this Section of these Specifications.

144.3 PRODUCT HANDLING

1. Protection:

Protect miscellaneous metal before, during, and after installation and protect the installed work and materials of other trades.
2. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to the Employer.

145.0 PRODUCTS

145.1 STEEL

1. Steel shall be mild steel, new, free from rust, and conform to BS 4360.

145.2 BOLTS AND NUTS

1. Bolts and nuts shall be new, free from rust, and conform to B.S. 4395.

145.3 WELDING ELECTRODES

1. Arc and spot welding electrodes used shall be only those specifically recommended for the purpose.
2. Oxy-acetylene welding shall comply with BS 693 and 2937. Welding shall be continuous except where tack welding is permitted and exposed welds shall be ground smooth. Arc welding and electrodes for metal shall conform to BS. 639 and 5135.

145.4 SHOP PAINT & GALVANISING

1. Hot dipped galvanizing conforming to BS 729 (Part 1). These items may be fabricated in sections. Joint welding after galvanizing is permitted only if area around joints is liquid galvanized.
2. One coat of zinc rich primer.

145.5 DOWELS & ANCHORS

1. Steel, galvanized as per Article 2.4.

145.6 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of miscellaneous metal, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

146.0 EXECUTION

146.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where fabrication and installation of the Work of this Section may properly commence.
 - b) Make measurements in the field to ensure proper and adequate fit of miscellaneous metal items.
 - c) Verify that miscellaneous metal may be fabricated and installed in strict accordance with the original design and the approved Shop Drawings.

2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with fabrication or installation in areas of discrepancy until they have been fully resolved.

146.2 FABRICATION

1. Compliance:
 - a) Fabricate miscellaneous metal in strict accordance with approved Shop Drawings.
 - b) Build work square, true, straight and accurate to size, with joints closely fitted and properly secured.
 - c) Fabricate item from steel unless otherwise noted.
 - d) Use self-tapping shake-proof countersunk flat headed screws on items required to be assembled by screws or as indicated.
2. Prefabrication:

Shop prefabricated items complete and ready for installation.
3. Welding:
 - a) Preparation shall be in accordance with B.S.C.P. 3012.
 - b) Unless otherwise indicated on Drawings, weld shop connections.
 - c) Make joints and intersections of metal tightly fitting and securely fastened.
 - d) Make work square, plumb, straight, and true.
 - e) Exposed welds to be continuous for length of each joint, and are to be filed or ground smooth and flush.
4. Holes:
 - a) Drill or punch holes required for the attachment of work of other trades and for bolted connections.
 - b) Burned holes are not acceptable.

146.3 SHOP PAINTING

1. Preparation:
 - a) Thoroughly clean metal as described in Section on Painting.
 - b) Provide required protection for metal to be encased in concrete to prevent accumulation of deleterious foreign material.
2. Painting:
 - a) Apply one shop coat of primer to metal item, with exception of stainless steel, aluminium, and those to be galvanised or encased in concrete.
 - b) Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7⁰ C.
 - c) Shop Paint all steel except:
 - i Steel to be encased in concrete;
 - ii Surfaces to be welded;
 - iii Contact surfaces to be high strength bolted; and
 - iv Steelwork which will be concealed by interior finish.
 - d) Steel items (including bolts etc.) exposed to the atmosphere inside and outside of construction shall be hot dipped galvanised.

146.4 PAINTING

1. Fabricated ferrous items shall receive a priming coat of paint. Surfaces which cannot be reached for painting after erection shall receive two coats of paint before installation.
2. Clean surfaces to be field welded; do not paint. Conform to B.S.C.P. 3012.

146.5 ERECTION

1. Coordination:
Coordinate installation schedule with the schedules of other trades to ensure orderly and timely progress of the total Work.
2. Compliance:
Erect and install miscellaneous metal in strict accordance with the Drawings, and the approved Shop Drawings, aligning straight, plumb, and level within a tolerance of one quarter of one percent.
3. Anchoring:
 - a) Supply anchorages and other miscellaneous metal, not specified in other Divisions, or shown on Drawings, but required to complete the work.
 - b) Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts, etc.
4. Touching up:
 - a) After the erection and installation is complete, touch- up shop priming coats damaged during transportation and erection, using the priming paint specified for shop priming.
 - b) Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection.
 - c) Touch-up galvanized surfaces with zinc primer where burned by field welding.

146.6 MISCELLANEOUS WORK

1. Miscellaneous Work: Supply other metallic items such as steel angles around openings, angles and plates, joint covers etc., which are specified on Drawings and not specified in other Divisions.

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

GENERAL FOR “ORNAMENTAL METAL”

147.0 GENERAL

147.0 DESCRIPTION

1. Work included:
 - a) Supply and install ornamental metal items and those not specifically described in other Sections of these specifications but required for a complete installation as implied or shown on Drawings.
 - b) Examine other Sections of these Specifications and all Drawings for relating work of this Section and of other trades.
 - c) Work under this Section may include, but is not necessarily limited to entry gate, and access gates, floor and wall expansion joint covers, wall guards, cover plates, ladders, step irons, handrails, drain grills and cattle grate.
 - d) This Section does not include louvers and grills required for Mechanical Works.
2. Related work:

For miscellaneous metal required to support or retain items of this Section refer to Section 5100 Miscellaneous Metal.

148.0 QUALITY ASSURANCE

1. Qualifications of welders:

Use only certified welders and shielded arc or spot process for welding performed in connection with the Work of this Section.

149.0 SUBMITTALS

1. Shop Drawings:
 - a) Within 90 days after award of Contract, and before any ornamental metal is delivered to the Job Site, submit Shop Drawings to the Engineer for approval in accordance with these Specifications.
 - b) Show locations, markings, quantities, materials, sizes, and shapes and indicate methods of connecting, anchoring fastening, bracing, and attachment to the work of other trades.

150.0 PRODUCT HANDLING

1. Protection:

Protect ornamental metal before, during, and after installation and protect the installed work and materials of other trades.

151.0 PRODUCTS

151.1 STEEL

1. Unless specifically approved otherwise by Engineer, metal used for this work shall be sheet steel or bars, cut, cleaned and welded in conformity with the applicable clauses of this Section of these Specifications.
2.
 - a) Steel to be mild steel, new, free from rust, and conform to B.S. 4360.
 - b) Steel plate, sheet and strip to B.S. 1449 Part 1 and B.S. 970 Part 1.
 - c) Steel tubes, hollow sections and angles to be B.S. 1775 and B.S. 4848 Part 2 and 4 and B.S. 2994.

151.2 STAINLESS STEEL

1. Stainless steel shall be austenitic type 302S17 of 18/8 chromium - nickel group conforming to B.S. 1449 Part 2.
2. Use B.S. 970 Part 4 for blooms, billets bars and forgings; B.S. 1449 Part 2 for plate, sheet and strip and; B.S. 3014 for tubes.
3. Finish shall be polished finish as listed in schedule, surface finishes of B.S. 1449 Part 2.

151.3 CAST IRON

1. Cover plates and frames:
 - a) Castings to be good grey metal, sound, free from flaws with smooth surfaces and true pattern.
 - b) Fabricate to size and design shown on Drawings and conform to BS 497.

151.4 ALUMINIUM

1. Aluminum shall conform to BS 1474. Surfaces in contact with concrete, mortar or masonry shall be painted with yellow chromate.

151.5 WELDING & ELECTRODES

1. Arc welding shall comply with the following standards:
 - a) Aluminum to B.S. 3571 Part 1.
 - b) Austenitic stainless steel to B.S. 4677.
 - c) Carbon and carbon manganese steel to B.S.5135.
2. Electrodes for welding shall comply with B.S. 639 and B.S. 4215.
3. Filler materials shall comply with B.S. 1453.
4. Filler rods shall comply with the following parts of B.S. 2901:
 - a) Austenitic stainless steel to Part 2.
 - b) Aluminum and alloys to Part 4.
5. Seam welding of mild steel shall be in accordance with B.S. 2937.
6. Oxy-acetylene welding of mild steel to B.S. 693.
7. Tungsten - arc welding shall comply with the following parts of B.S. 3019:
 - a) Wrought aluminum and alloys to Part 1.
 - b) Austenitic stainless steel to Part 2.
8. Welding preparations to be in according with B.S.C.P. 3012.

151.6 BOLTS AND NUTS

1. Bolts and nuts shall be new, free from rust, and conform to BS 4395.

151.7 GALVANIZING

1. Where specified on Drawings, items (including bolts etc.) shall be hot dipped galvanized conforming to BS 729 (Part 1). Items requiring galvanizing may be fabricated in sections. Welding of joints after galvanizing will be permitted only if the area around joints is liquid galvanized.

151.8 SHOP PAINT

1. Steel members except galvanized items, shall receive one coat of zinc rich primer in the shop.

151.9 BIRDSCREENS

1. Bird screen to be 3/8" galvanized flat diamond mesh expanded metal lath as detailed on Drawings.

151.10

OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of items in this Section, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

152.0 EXECUTION

152.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where fabrication and installation of the Work of this Section may properly commence.
 - b) Make measurements in the field to ensure proper and adequate fit of ornamental metal items.
 - c) Verify that ornamental metal may be fabricated and installed in strict accordance with the original design, the approved Shop Drawings, and the applicable Sections of these Specifications.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with fabrication or installation in areas of discrepancy until they have been fully resolved.

152.2 FABRICATION

1. Compliance:
 - a) Fabricate ornamental metal in strict accordance with approved Shop Drawings.
 - b) Build work square, true, straight and accurate to size, with joints closely

- fitted and properly secured.
- c) Fabricate item from steel unless otherwise noted.
- d) Use self-tapping shake-proof countersunk flat headed screws on items required to be assembled by screws or as indicated.

2. Prefabrication:
Shop prefabricated items complete and ready for installation.

- 3. Welding:
 - a) Unless otherwise indicated on Drawings, weld shop connections.
 - b) Make joints and intersections of metal tightly fitting and securely fastened.
 - c) Make work square, plumb, straight, and true.
 - d) Exposed welds to be continuous for length of each joint, and are to be filed or ground smooth and flush.
- 4. Holes:
 - a) Drill or punch holes required for the attachment of work of other trades and for bolted connections.
 - b) Burned holes are not acceptable.
- 5. Step irons and ladders:
 - a) Step irons shall conform to B.S. 1247. Steps shall be according to the details as shown on the drawings. Top step iron shall be 18" below the manhole cover and the lowest not more than 12 ins above the bottom level. Step irons to underground storage tank shall be of stainless steel. Other step irons where required shall be galvanized mild steel.
 - b) Ladder for swimming pool shall be of stainless steel.
 - ii Tubing/handrail shall be as per detail shown on the drawing, formed with smooth wrinkle - free bends and gentle radii.
 - iii Treads shall be as per detail secured with stainless steel, rounded head bolts. Underside of bolt head and ends of treads shall be curved to fit the O.D. of the tubing/handrail. Step shall be of flat section with down turn lips front and rear. Edges shall be rolled - back. Steps surface shall be knobbled or similar non-slip design.
 - iv Accessories shall include escutcheon plates at pool deck, covering brass anchor sockets with lockable wedge. Sockets shall be deep as specified on the drawings. Ladder bumpers shall be of non - marking rubber.
 - v Pool ladder detail as shown on the drawings.

6. Manhole covers:
Covers shall be of sizes and types indicated on Drawings and shall be bedded to the exact finished floor, paving or ground level. Covers shall be watertight and lockable.

152.3 SHOP PAINTING

- 1. Preparation:
 - a) Thoroughly clean metal as described in Section 9.5 Painting of these Specifications and in accordance with B.S.C.P. 3012.
 - b) Provide required protection for metal to be encased in concrete to prevent accumulation of deleterious foreign material.

2. Painting:
 - a) Apply one shop coat of primer to metal item, with exception of stainless steel, aluminum, and those to be galvanized or encased in concrete.
 - b) Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7^o C.
 - c) Shop prime all steel except:
 - Steel to be encased in concrete;
 - Surfaces to be welded;
 - Contact surfaces to be high strength bolted; and
 - Steelwork which will be concealed by interior finish.
 - d) Items (including bolts etc.) exposed to the atmosphere inside and outside of construction shall be hot dipped galvanized.

152.4 PAINTING

1. Fabricated ferrous items shall receive a priming coat of paint. Surfaces which cannot be reached for painting after erection shall receive two coats of paint before installation.
2. Clean surfaces to be field welded; do not paint. Conform to B.S.C.P. 3012.

152.5 ERECTION

1. Coordination:

Coordinate installation schedule with the schedules of other trades to ensure orderly and timely progress of the total Work.
2. Compliance:

Erect and install ornamental metal in strict accordance with the Drawings, and the approved Shop Drawings, aligning straight, plumb, and level within a tolerance of one quarter of one percent.
3. Anchoring:
 - a) Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts, etc. required by other sections of these Specifications.
 - b) Install anchors and inserts required for attachment of metal items in this Section in accordance with Drawings and manufacturer's requirement of such items.
4. Touching up:
 - a) After the erection and installation is complete, touch- up shop priming coats damaged during transportation and erection, using the priming paint specified for shop priming.
 - b) Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection.
 - c) Touch-up galvanized surfaces with zinc primer where burned by field welding.

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

GENERAL FOR “*FINISHED CARPENTRY*”

153.0 DESCRIPTION

1. Work included:

Supply and installation of wood trim, ceiling slats and panels, architraves, stair handrails, valences, counter fascias, shaft panels, trim, skirtings, palmets, ornamental panelling, carving and facing, jallie work, suspending ceilings, wood flooring and other items not specifically described but necessary to complete the work of this and other section of these specifications.

153.1 QUALITY ASSURANCE

1. Qualifications of workmen:

For cutting and fitting of trim and finish material, use only skilled finishing carpenters who are thoroughly trained and experienced for the work required, completely familiar with the requirements of this work.

2. Rejection:

In the acceptance or rejection of finish carpentry, no allowance will be made for lack of skill on the part of workmen. Any rejected item shall be removed from the site of works, at Engineers discretion.

Submit data for each product and process specified as work of this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation or submit Mock-Ups for each and every item for Engineer's approval.

153.2 SUBMITTALS

1. Samples:

Within 120 days after award of contract and before any material is delivered to the job Site submit three samples of proposed material to the Engineer for his approval. Samples shall include characteristic data described in this section.

Submit Wood Preservative Treatment Data and chemical treatment manufacturer's data and instruction for application.

Also submit the following samples:

Lumber 6 ins x 3/4 in x 18 ins, for each species, finished on one side and one edge.

Wood veneer faced panel products 8 ins x 10 ins.

153.3 PRODUCT HANDLING

1. Protection:

Protect the materials of this section before, during, and after installation and protect installed work and materials of other trades.

2. Replacement:

In the event of damage, immediately make repairs and replacements to approval, at no additional cost to the Employer.

154.0 PRODUCTS

154.1 TIMBER

1. Wood shall be first quality and conform to the applicable requirements and B.S. 1186.
 - a) Use Oak, Teak, Sheesham pine and sound local Deodar, or as shown on the Drawings or as approved by Engineer, free from defects that impair its strength and durability. Knots if any, in Deodar only, shall not be over 1/2 in (12mm.) Wood to be well seasoned in an approved manner.
 - b) Moisture content shall not exceed 12% by weight for interior use and 17% for exterior use.
 - c) Unless otherwise noted on Drawings or described in other sections of these specifications use oak, sheesham and pine wood for paint finish items and Teak for transparent finish. Back-up or exposed members requiring planed finish shall be Deodar.

154.2 PRESERVATIVE TREATMENT

1. Preservative treatment:

Following basic fabrication liberally apply preservative in flood coats to all surfaces requiring treatment to ensure maximum absorptions. Use a coarse, low pressure spray wherever possible. Allow each coat to soak in, but not to dry before applying further coats. The preservative shall be an organic solvent type, with a water repellent component. This treatment should be provided after seasoning. Materials should be cut and machined before treatment wherever possible. Where material is cut, drilled or machined after treatment, the areas so cut, drilled or machined, should be treated by brush or spray application of the same preservative. Treated timber shall be able to receive glue, paint, putty, neoprene or PVC gaskets and standard sealants with no adverse effects to either materials.
2. Manufacturer: Subject to compliance with requirements provide products of:- Solignum Limited, U.K.

Discard treated lumber which does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discoloured, or otherwise damaged or defective lumber.

154.3 BLOCKBOARD

- 1a) Plywood blockboard (batten board) for paint finish shall be of best quality to B.S. 344 and as approved by Engineer. b) Bonding shall be with urea resin adhesive to BS 1203, 1204. Use WBP (weather-proof and boil-proof) for exterior use and MR (moisture resistant) for interior use.
 - b) Grade 2/2
 - c) Face veneer: commercial ply or teak as indicated on Drawings.
 - d) Edge treatment: solid Deodar band
 - e) Thickness as shown on Drawings.
- 2a) Plywood blockboard or transparent finish shall be of best quality to B.S. 3444 and as approved by Engineer.
 - b) Bonding shall be with urea resin adhesive as described for paint finish blockboard.

- c) Grade 1/1
 - d) Face veneer: Burma Teak (*Tectona Grandis*) as indicated on Drawings.
 - e) Thickness 1 1/2 ins. minimum
 - f) Edge treatment : solid Teak band to match face veneer type.
3. Face grading of plywood blockboard:
- a) Grading is described front face and rear face respectively.
 - b) Grades are as follows:
 - i) Grade 1 veneer shall be of one or two pieces of firm smoothly cut veneer. When of two pieces, the joint shall be approximately at the centre of the board. Veneer shall be free from knots, worm and beetle holes, splits, dots, glue stains, filling or inlaying of any kind or other defects. No end joints are permissible.
 - ii) Grade 2 veneer shall present a solid surface free from open defects. Veneers when jointed need not necessarily be matched for colour or be of equal width. A few sound knots are permitted with occasional minor discoloration and slight glue stains, isolated pin holes not along the plane of the veneer. Occasional splits not wider than (0.8 mm) and not longer than one-tenth of the length of the panel or slightly opened joints may be filled with a suitable filler. This grade shall admit neatly made repairs consisting of inserts of the same species as the veneer which present solid level hard surfaces and are bonded with an adhesive equivalent to that for bonding the veneers. No end joints are permissible. Standard hardboard shall be type 'S' in accordance with B.S. 1142 part 2.

154.4 CUSTOM FALSE CEILING

1. Comply with the following requirements:-
Type of Construction : Wood framing with particle board panels.
Framing : Deodar wood.
2. Plywood for painted finish : Any species, Density not less than 35 lbs/cft.(at 12% moisture content) of minimum 3 ply or of thickness as indicated in drawings.
Face Pattern: Plain
Backing Veneer Species Same as face species or any hardwood compatible with face species.
3. Particle Board for Painted Finish: Minimum density 40 lbs/cu.ft. blockboard/chipboard with any species ply veneer of density not less 35 lbs/cft. (at 12% moisture contents) veneered to both faces.
Face Pattern: Plain
4. Paint: Synthetic Enamel Paint refer Section-9900 "Painting"

154.5 FINISH FASTENINGS

- a) Nails for Interior Trim Round lost head to and Finish: B.S. 1202
- b) Nails for External Work: Steel to B.S. 1202 Galvanised to B.S.729
- c) Screws for External Work: Brass raised counter-sunk to B.S.1210
- d) Screws for Interior Work: Brass flat head to B.S. 1210

154.6 ADHESIVES

1. For joining members shall be a urea resin or an approved equal to BS 1203,1204. Use WBP (weather- proof and boil-proof) for exterior members and MR (moisture-resistant) for interior work. Interior members placed in damp or humid areas shall be joined with WBP type.
2. Alternatively use 'Calatac WD-30' PUA adhesive by I.C.I. OR for Granolith by HOECHST for all conditions.

154.7 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of finished carpentry, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

155.0 EXECUTION

155.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to work of this section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - b) Verify that finished carpentry may be completed in strict accordance with the original design to the approval of Engineer.
 - c) Condition woodwork to average prevailing humidity, condition installation areas prior to installing.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

155.2 WORKMANSHIP

1. Carpentry shall be in accordance with B.S. 1186 "Quality of timber and workmanship in joinery". Entire responsibility for seasoning of wood, prevention of warping, cracking or other defects found in finished material will rest with contractor.
2. Wooden members found warped, bent, cracked or defective, during construction period or in duration of maintenance period, shall be rejected by Engineer and be replaced by contractor at his own cost and risk.
3. Finished carpentry to have joints true, tight, and well nailed with members assembled in accordance with the Drawings.
4. Moulding and ornamental work shall be worked from full size details prepared by the contractor from Architectural Drawings. Shapes shall be worked from solid pieces unless otherwise noted or approved by Engineer.
5. Jointing:
 - a) Make joints to conceal shrinkage; mitre exterior corners; cope interior corners; mitre or scarf end-to-end joints.
 - b) Install trim in pieces as long as possible, jointing only where solid support is obtained.

6. Fastening:

- a) Install items straight, true, level, plumb, and firmly anchored in place. Where blocking or backing is required, coordinate with other trades to ensure placement of backing and blocking in a timely manner.
- b) Nail trim with finish nails of proper dimension to hold the member firmly in place without splitting the wood.
- c) Nail exterior with galvanized nails, making joints to exclude water, setting them in waterproof glue or caulking described in these specifications.
- d) On exposed finish work, set nails for putty.
- e) Do not drive, all wood screws except that they may be started by driving and then screwed home.

155.3 INSTALLATION OF OTHER ITEMS

1. Install other items in strict accordance with the Drawings, anchoring firmly in place at the prescribed location, straight, plumb, level, and anchored for long life under hard use.

155.4 FINISHING

1. Sandpaper finished wood surfaces thoroughly as required to produce a uniformly smooth surface, always sanding in the direction of the grain. Do not sand wood which is designed to be left rough. No coarse grained sandpaper mark, hammer mark, or other imperfection will be accepted.

155.5 CLEANING UP

1. General:

Keep the premises in a neat, safe, and orderly condition at all times during execution of this portion of the work. Prevent accumulation of sawdust, cut-ends, and debris.

2. Sweeping:

- a) At the end of each working day, or more often if necessary, thoroughly sweep surfaces where refuse from this portion of the work has settled.
- b) Remove the refuse to the area of the job site set aside for storage.
- c) Upon completion of this portion of the work, thoroughly broom clean surfaces.

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

GENERAL FOR “WATER PROOFING”

156.0 DESCRIPTION

1. Work included:

Under this Section includes the supply and installation of waterproofing tank lining, vertical damp-proof membranes and damp-proof courses as indicated on Drawings and as follows:

- a) Vertical damp-proofing:
To the exterior faces of concrete walls to water tank, swimming pools, concrete planters, pool machine rooms, lift pits, exterior walls below grade at basements and to outer faces of inner skins to external walls.
- b) Horizontal damp-proof course:
To base of exterior wall above grade, over lintels, at parapets to exterior wall and under copings but not limited to same.
- c) Waterproof membrane:
To areas like roof/attic slab, terraces, planters and gutters underground water reservoirs, swimming pool and where floor drains are indicated on Mechanical or Architectural Drawings or as directed by Engineer.
- d) Swimming pool membrane:
To interior faces of outer concrete walls and slabs of swimming and wading pools.

156.1 QUALITY ASSURANCE

1. Qualifications of installers:

- a) The installer shall be currently approved by the manufacturer of the selected membrane material.
- b) For installation of membranes use only competent and skilled tradesmen completely familiar with the products, and the manufacturer's current recommended methods.

2. Manufacturer's certification:

Prior to start of installation of the Work to this Section, engage at the Job Site, a representative of the manufacturer of the damp-proofing membrane material and the tank liner to inspect and certify that:

- a) Surfaces to which the membrane is to be applied are in a condition suitable for this application.
- b) Materials to be installed comply with the requirements of this Section of these Specifications.
- c) Materials to be installed are in complete accordance with the manufacturer's current recommendations.

156.2 SUBMITTALS

1. Within 90 days after the award of Contract and before any material is delivered to the Job Site submit to Engineer, for approval in accordance with these Specifications, complete design data for inner water tank liner and pool membrane. Describe and illustrate details of application including jointing, special junctions with adjacent materials, mixing, curing and special preparatory measures.

2. Manufacturer's certification:
Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer 2 copies of the certification described in Article 1.2.2, each copy signed by an officer of the firm manufacturing the membrane materials.
3. Guarantee:
Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer a written guarantee signed by the Contractor and endorsed by the damp-proof membrane and tank liner materials manufacturers guaranteeing that the installed materials will remain intact and free from leaks for a period of at least 10 years following date of installation.

156.3 PRODUCT HANDLING

1. Protection:
Protect membrane materials before during and after installation and protect the installed work and materials of other trades.
2. Repair:
In the event of damage immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

157.0 PRODUCTS

157.1 DAMP-PROOF MEMBRANE

- a) Damp-proofing and Waterproofing Asphalt Primer: priming oil shall be made by the manufacturer of the bitumen compound.
- b) Bitumen: "Hycarb AHS" by National Petrocarbon Ltd., Karachi.

157.2 HORIZONTAL DAMP-PROOF COURSE

1. Same material as article 2.1 of this Section.

157.3 TANK FINISH

1. Cement Plaster (if required) use flexible Brushcrete or as approved by the Engineer.

157.4 WATERPROOF MEMBRANE

1. Use Acrylic reinforced cementitious, flexible coating. Acceptable products are:
Brush Bond by FOSROC
Brush Crete by FEB
flexible Slurry Brushcrete, by FEB concrete material, supplied by Silver Streak corporation, Karachi, Lahore, Rawalpindi.

157.5 POOL MEMBRANE

1. Same material as Article 2.4 of this Section.

158.0 EXECUTION

158.1 PREPARATION

1. Concrete shall have full 28 day cure prior to application of membrane.
2. Concrete and masonry surfaces shall be free of roughness, voids and projections. Voids shall be grouted in accordance with Section on Cast-in-Place Concrete.
3. Remove laitance, loose aggregate, form release agents or other surface treatments as well as dust, oil, grease or other contaminants which would affect complete bonding of fluid applied membrane to concrete and/or masonry surfaces.
4. Do not apply material to wet surfaces, unless directed otherwise. Ensure areas adjacent to surfaces of application are kept dry. Dewater in accordance with Section 2200 : Excavation and Earthwork.
5. Do not apply bitumen when its temperature is above 205 C (401 F). It shall be kept from being heated in excess of 245 C (473 F), or as recommended by the manufacturer.

158.2 DAMP-PROOF MEMBRANE

1. Install damp-proof membranes as follows:
 - a) Prime surface with a uniform coating of asphalt primer at the rate of 5 litres (1.1 gals) per 10 sqm (12 sq.yds), or as recommend by the manufacturer.
 - b) Apply vertical Damp-proofing to a thickness of 90 mil. or 1/16 in. with 6 ins lap at joints where end of previous application is dry. Apply 2 coat fillets at internal angles and overlaps at horizontal damp-proof courses. This work to be protected or covered after deemed complete by Engineer.
 - c) Embed and joint insulation boards tightly butted and with staggered joints into final layer of bitumen. For this process bitumen shall not exceed 266 F (130^o C).

158.3 HORIZONTAL DAMP-PROOF COURSE

1. Install damp-proof courses as follows:
 - a) Ensure full grouting and projecting reinforcement is complete before primer is applied.
 - b) Primer coat as Article 3.2.
 - c) Uniform layer of P.B.4 to a total thickness of 120mil. or 1/8" applied in 3 coats. Apply 2 coat fillets at internal angles, and at base angles.
 - d) Set D.P.C. 1/2 in. back from outer face of wall to allow for pointing, and extend 6" minimum up or over vertical adjacent surface.

158.4 TANK FINISH

1. Apply cement plaster (if required) as described in Section 9200: Plaster works. Use Flexible Slurry Barralastic or as approved by Engineer.

158.5 WATERPROOF MEMBRANE

1. This membrane shall be installed directly to the unfinished concrete floor, walls and ceilings or on the plastered surfaces (if required). Prepare in accordance with Article 3.1.
 - a) All concrete and metal surfaces such as drains, pipes, etc. shall be cleaned of oil rust, scale and other foreign matter. Rough area and honeycombed concrete must be repaired prior to installation.
 - b) Absorbent surface (concrete, plaster) have to be pre- wetted with clean water, the surfaces to be moist but free of puddles.
 - c) At joints (and cracks) structural specifications to be followed.
 - d) Add component 'A' and 'B' and mix it until mixture is homogeneous and free of lumps.
 - e) Spray the well mixed Brushcrete on prepared surfaces at the rate of 2 kg/m² in 2 layers (1kg - 1 layer).
 - f) The applied surfaces should be protected against heavy wind and intense sunshine, curing is required for atleast 3 days.

158.6 POOL MEMBRANE

1. Install pool membrane as follows:
 - a) This membrane shall be installed directly over inner of outer pool wall. Preparation shall be in accordance with Article 3.1.
 - b) Same as Article 3.5.1a of this Section.
 - c) Same as Article 3.5.1b of this Section.
 - d) Same as Article 3.5.1c of this Section.
 - e) Same as Article 3.5.1d of this Section.
 - f) Same as Article 3.5.1e of this Section.
 - g) Same as Article 3.5.1f of this Section.

158.7 CLEANING & PROTECTION

1. Upon completion of Work to this Section, promptly clean shed surfaces of debris, stains and equipment, leaving areas in a neat and orderly condition to approval of Engineer.

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

GENERAL FOR “*BUILDING INSULATION*”

159.0 DESCRIPTION

1. Work included:
Building insulation required for this Work includes, but is not necessarily limited to:
 - a) All External Walls: (If shown on Drawings)
 - b) Building Roof.
 - c) Refrigerated Refuse room walls, ceiling and door.

159.1 PRODUCT HANDLING

1. Protection:
 - a) Deliver materials to the Job Site and store in a safe dry place with all labels intact and legible at time of installation.
 - b) Protect building insulation materials before, during, and after installation and protect the installed work and materials of other trades.
 - c) Do not leave insulation exposed to sunlight. Keep covered with clear or light colored waterproof material. Apply finish material soon after installation of the insulation. Brush off any sunlight degraded surface material prior to adhering insulation.
2. Replacements and acceptability:
Panels chipped, cracked or squashed shall be rejected. In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

160 MATERIALS

160.1 INSULATION

1. Type 1
 - a) Expanded polystyrene moulded bead board type of minimum density 2 lbs. per cu. ft (32-35 kg/m) density, 2 ins. (50 mm) thickness, roofs, terraces/planters, 1 1/2" for external walls, cavity wall and for refrigerated refuse room according to the specifications.
 - b) Materials shall be 21 days old before installation.
 - c) Use “Stroking” sheets as manufactured by Household Products (Pakistan) Limited, Karachi, or equal.
2. Type 2
Flexible bonded mineral wool in rolls with reinforced foil and fire resistant craft backing extending 2” at longitudinal edges. 3-1/2” thickness, for refrigerated refuse room ceiling and wall applications. Conform to U.S. Federal Spec. HH-1-521E Type II and III.
3. Type 3
Flexible bonded, shot-free coarse-fibred, unfaced mineral wool in rolls. Thicknesses as shown on Drawings. For packing behind door jambs to insulated rooms.
4. Type 4
Rigid resin-bonded, shot-free, fine mineral-fibred, unfaced boards of 3 lbs per cu. ft. (48 kg/m³) density. 2 ins thickness for refrigerated refuse room door applications. Conform to U.S. Federal Spec. HH-1-558B Form A, Class 1 and 2.

5. Type 5
Extruded polystyrene rigid foam with skin, shiplapped edges, 50 mm. and 35 mm. thickness.

160.2 FASTENINGS

1. Flexible faced insulations shall be fastened with staples.

160.3 ADHESIVES & TAPES

1. Polystyrene Type Insulations:
Bedding and jointing material as described in other Sections of these Specifications.
2. Flexible Faced Insulations:
Foil tape for joints and punctures as recommended by insulation manufacturer.
3. Rigid Mineral-Fibred Boards:
Bedding and jointing adhesive as recommended by insulation manufacturer.

160.4 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper installation of building insulation, shall be provided by Contractor subject to prior approval of the Engineer at no additional cost to Employer.

170.0 EXECUTION

170.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - b) Verify that building insulation may be installed in accordance with the original design and the manufacturer's recommendations.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

170.2 INSTALLATION

1. Roof:
Refer to Section 7400 Roofing.
2. Refrigerated Refuse Room:
Refer to Section on Refrigerated Refuse Room.
3. Insulation facing flanges shall be stapled to framing material and foil taped to form complete seal. Tape any punctured facing material.
4. Refrigerated Refuse Room Doors:
Cut, bed and joint insulation boards within doors in adhesive.

170.3 INSPECTION

1. Upon completion of the installation, visually inspect each area and verify that insulation is complete and properly installed.

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

GENERAL FOR “*ROOF DECK*”

171.0 DESCRIPTION

1. Work included:
 - a) Work under this Section includes the supply and installation of all materials under the finished concrete roof deck, slab, terraces/planter, as indicated on the drawings but subject to the restrictions described in item 1.2.
 - b) The metal seam roof is referred to in this Section of these Specification as uninsulated roofs.
2. Work not included:

Sheet metal flashings around curbs to mechanical equipment and over pads to same. Refer to Mechanical Works Contract.

171.2 QUALITY ASSURANCE

1. Restrictions of Specification:

Use only the methods and materials described in this Section of these Specifications to fulfil the requirements of this contract.
2. Qualifications of installers:
 - a) The roofing installer shall be currently approved by the manufacturer of the selected roofing.
 - b) For installation of membrane roofing, use only competent and skilled roofers completely familiar with the products, and the manufacturer’s current recommended methods of installation.
3. Manufacturer’s Certification:

Prior to start of installation of the Work of this Section, engage at the Job Site, a representative of the manufacturer of the membrane roofing, to inspect and certify that:

 - a) Surfaces to which the membrane roofing is to be applied are in a condition suitable for this application.
 - b) Materials to be installed comply with the requirements of this Section of these Specifications.
 - c) Materials to be installed are in complete accordance with the manufacturer’s current recommendations.

171.3 SUBMITTALS

1. Manufacturer’s certification:

Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer 2 copies of the certification described in this Section, each copy signed by an officer of the firm manufacturing the membrane roofing system.
2. Guarantee:

Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer a written guarantee signed by the Installer and endorsed by the membrane roofing manufacturer guaranteeing that the installed membrane roofing will remain intact and free from leaks for a period of at least seven years following date of installation.

3. Samples:
Submit samples of roofing material for quality of the product for approval complete with manufacturer's specification data.

171.4 PRODUCT HANDLING

1. Protection:
Protect roofing materials before, during, and after installation and protect installed work and materials of other trades
2. Replacements:
In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.
3. Shipping and Storage:
Roofing material shall be packed in hay and shipped in crates adequately to prevent shifting. Once on the site, they shall be stored on wood sleepers near the point of intended use. Roofing membranes shall be in their original packing and stored in a dry place till the time of installation.

172.0 PRODUCTS

172.1 MATERIALS

1. Roof membranes:
 - a) Membrane to roofs over slab, and terraces/planters shall be flexible Bituthene 2000 applied as per manufacturer's recommendations.
 - b) Bituthene 2000 manufactured by Grace.
2. Sand and Cement to requirements of Section for Cast in Place Concrete.
3. Mortar materials and colour for cement tiles shall be same specified by the Engineer.
4. Insulation: Extruded polystyrene board, as described in Section for Insulation.
5. Roofing Tiles:
 - a) Locally made cement roof tiles 8" by 8" by 1" (200x200x25 mm) min. thick of durable quality suitable for roof application. Color to match approved sample.
 - b) Ingredients: Cement tiles shall consist of cement, fine sand and water all in measured amounts.
 - c) Moulding: Tiles shall be shaped by inserting into moulds. Irregular surfaces shall be finished by hand tooling, provided such tooling has no visible effects after firing.
 - d) Defects: Deformed items shall be discarded. Rough surfaces may be ground smooth with written agreement of the Engineer. Tolerances up to 1/16" total variation in any dimension will be allowed.
 - e) Color: To match approved sample. Discoloration will be a basis of rejection for any cement tile.
 - f) Formula: A written description of the process for making approved cement tiles shall be given to the Engineer.
6. Concrete and mix design for up stand curbs at attic perimeters and around roof penetration shall be the same as pertinent data of Section on Cast-in-place Concrete. Use ordinary Portland cement.

172.2 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper installation, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

173.0 EXECUTION

173.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

173.2 LAYING SEQUENCE

1. General roof areas:
 - i) Sand and cement sloping screed.
 - ii) Roof membrane: Bituthene 2000
 - iii) Insulation
 - iv) Sand and cement sloping screed.
 - v) Cement tiles with mortar bed.

173.3 ROOF MEMBRANE TYPE BITUTHENE 2000

1. Membrane materials shall be applied only to surfaces that are clean but not when temperature at Job location is lower than 5 C (41 F). It shall not be applied when its temperature is above 205 C (401 F) or as recommended by the manufacturer.
 - a) All concrete and metal surfaces such as drains, pipes etc. shall be clean of oil, rust, scale and other foreign matter. Rough area and honeycombed concrete must be repaired prior to installation.
 - b) Absorbent surface (concrete, plaster) have to be pre-wetted with clean water, the surfaces to be moist but free of puddles.
 - c) At joints (and cracks) structural specifications to be followed.
 - d) Add component "A" and "B" and mix it until mixture is homogenous and free of lumps.
 - e) Spray the well mixed brushcrete slurry on prepared surfaces at the rate of 2 kg/m² in two layers (1 kg - 1 layer)
 - f) The applied surfaces should be protected against heavy wind and intense sunshine, curing is required for at least 3 days.

173.4 ROOF MEMBRANE TYPE 2

General roof areas and uninsulated roofs:

Roofing shall be applied only to surfaces that are clean but not when temperature at job location is lower than 5° C (41° F). It shall not be applied when its temperature is above

205° C (401° F) nor shall it be heated above 245° C (473° F) or as recommended by the manufacturer.

- a) Prime sloping screed surface with a uniform coating of asphalt primer at the rate of 5 litres (1.1 gals) per 10 square meters (12 sq. yds.).
- b) Apply uniform coating of hot bitumen P.B. 4 to a minimum thickness at 1/8 in. or 25 lbs. per 100 sq. feet into which, while hot, embed 3 ply felt. Felt shall be laid from low points terminating at high points of slopes with 3 ins (75 mm) minimum side laps and 6 ins (150 mm) end laps. Continue felt around scuppers and up abutments. Roll out felt rubbing and pressing the sheet, into the bitumen, from the centre to the edges to ensure thorough adhesion and a form surface free from wrinkles or buckles.
- c) Apply uniform coating of P.B. 4 to min. thickness of 3/16 in.
- d) Reinforcement of edges, angles and recesses:
Edges, angles and recesses coming into contact with the watertight membrane must be rounded off, or rounded out to standard bottle cylinder size (bottle fillets) by Contractor. Bottle fillets are to be reinforced with an additional layer strip of roofing felt applied with a coat of P.B.4. to the under finish and overlapping on either side along the fillet by 6 ins. (150 mm) Likewise, it should overlap on either side along the edges.

173.5 INSULATION

1. Lay boards staggered and with easily butted joints unbonded to roof membrane. Entire surface of roof area shall be flush with edges aligned.
2. Do necessary cutting around protrusions and upstands.
 3.
 - a) Prevent disfigurement and damage to insulation boards from point loads during installation and afford same protection while subsequent materials are placed on top.
 - b) Damaged or dented boards shall be replaced with new ones.
 - c) Do not leave boards exposed to sunlight or uncovered at the end of the day.

173.6 SAND/CEMENT BASE LAYER

1. Mix to consist of one part Portland cement to six (6) parts sand aggregate to Engineers approval.
2. Wet sand and cement sloping screed before installing mortar mix.
3. Spread and place mortar mix to conform with slopes indicated on Drawings, minimum thickness of 1 in. (25mm). Apply in alternate bays not exceeding 250 Sft. (25 Sqm). Form canted fillets at up-stands
4. Screeding and tamping shall be done immediately after spreading to achieve prescribed slopes.
5. Mix shall then be smoothed and consolidated to a uniform close textured surface with a wood float, to remove high and low spots exceeding 1/4 in. (6 mm) in 10 ft. (3 m). Avoid excessive floating.
6. Showing signs of laitence will be subject to rejection by the Engineer. These faulty areas shall be replaced at no additional cost to the Employer.
7. Screed layer shall be cured for a minimum of 7 days after finishing as described in Section for Cast-in-place concrete.
8. Allow sufficient time for material to thoroughly harden and ensure surface is dry before allowing other work to be carried out.

173.7 ROOF FINISH

1. Lay cement roof tiles, where indicated over mortar mix.
 - a) Lay tiles with joints butted and aligned in both directions but not coincidental with those of the insulation. Set out tiles to roof areas so that dimensions remaining at perimeter walls, to receive half size.
 - b) Cut tiles square to face to a tolerance of 1/8 in. Cutting shall be kept to a minimum.
 - c) Mortar shall be a mix of one (1) part cement to three (3) parts sand.
 - d) Apply sufficient mortar under unit to allow for tamping and leveling.
 - e) Ensure alignment is correct with adjacent tiles and evidence of movement or rocking is eliminated.
2. Following setting of flags and tiles poured, concrete edging/up-stands shall be installed reinforced with expanded metal lath, lapped and secured under pre-cast copings. Ensure that lathing is well supported and set back 1/2 in. from finished face of concrete. Profile of edging up-stand shall be as shown on Drawings including canted fillet.

173.8 ROOF SCUPPERS

1. At general roof areas and un-insulated roof areas with roof scupper outlets apply expanded metal pebble stops and pebbles as shown on Drawings.
 - a) Expanded metal pebble stops shall be shaped and liberally coated with bitumen prior to installation.
 - b) Embed pebble stops into a coating of hot bitumen, over ply roofing felt, extending bitumen 6 ins beyond area to be covered by metal. Ensure no sharp edges are protruding through surface of roofing.
 - c) After completion of general roof finishes lay pebbles into areas designated for same as shown on Drawings.

173.9 TOLERANCES

1. Deviations exceeding 1/4 in. in 10 ft applied in all directions will not be accepted.

173.10 CLEANING

1. Upon completion of the work of this Section immediately remove debris, excess materials and smears that may remain.

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

GENERAL FOR “CAULKING”

174.0 DESCRIPTION

1. Work included:

The purpose of caulking in this Work is to provide a positive barrier against penetration of air and moisture at joints between items where caulking is essential to continued integrity of the barrier. Caulking will normally be performed under the work of various Sections of these Specifications but shall be performed in strict accordance with the provisions of this Section. Following locations shall require caulking.

- a) Periphery of wood and metal frames in exterior and interior walls including doors and windows.
- b) Joints between cement plaster and dissimilar materials.
- c) Joints between concrete or masonry and dissimilar materials.
- d) Joints between glass and glazing beads to exterior windows.
- e) Internal angles as follows:
 - i) Wall and floor finish joints with bathtubs.
 - ii) Wall and floor finish joints with WC's and squat toilets
 - iii) Wall to wall and floor to wall junctions in showers.
- f) Concrete road joints.
- g) Other locations as directed by Engineer.

174.1 QUALITY ASSURANCE

1. Qualification of applicators:

Installation of caulking shall be performed only by workmen thoroughly skilled and specially trained in the techniques of caulking, and who are completely familiar with the published recommendations of the manufacturer of the caulking material being used.

2. Rejection of installed caulking:

Indication of lack of skill on the part of caulking installers shall be sufficient grounds for the Engineer to reject installed caulking and to require its immediate removal and complete re-caulking at no additional cost to the Employer.

174.2 SUBMITTALS

1. Samples submit manufacturous technical data for product required:

Within 90 days after award of the contract and before any sealants are delivered to the Job Site submit 3” (75 mm) strips of each specified type in available colors for selections by Engineer, applied to pieces of hardboard, concrete, and aluminium Supply also a small sample in a sealed container.

1. Protection:

- a) Deliver materials with each container bearing an unbroken seal and manufacturer's label.
- b) Protect caulking materials before, during, and after installation and protect installed work and materials of other trades.

2. Replacements:

In the event of damage, immediately make repairs and replacements necessary to the approval of Engineer, at no additional cost to the Employer.

3. Storage:
 - a) Store caulking materials and equipment under conditions recommended by its manufacturer.
 - b) Do not use materials stored for a period of time exceeding the maximum recommended shelf-life of the material.

175.0 PRODUCTS

175.1 CAULKING MATERIALS

1. Caulking Sealants: These shall be non sagging type, non staining, neutral or other colour approved by Engineer where exposed to view, and shall be as follows or specifically approved type by Engineer:
 - Type 1
Silicone low modulus one part, 'NITOSEAL 125 by FOSROC or equivalent to periphery of wood and metal frames in exterior walls including windows, doors, etc. Also to pre-cast concrete unit jointing, vertical exterior expansion joints, but not limited to same.
 - Type 2
Acrylic emulsion based one part, 'NITOSEAL 100/105 by FOSROC or equivalent for joints around window and door frames, brickwork and block work.
 - Type 3
Silicone elastomeric one-part, mildew resistant, moisture curing to showers, toilets and bathtubs or equal approved. Use NITOSEAL 130 by FOSROC, or equivalent.
 - Type 4
Polyurethane multi part, 'NITOSEAL 225/240 by FOSROC equivalent to interior masonry expansion joints, joints between interior framed units and their openings, behind door frames to refrigerated refuse room and where sealant is required to receive paint.
 - Type 5
Liquid Polysulphide Polymer, two part, 'THIOFLEX 600 by FOSROC, or equivalent, for structural expansion and others relief joints.
2. Joint backing:

Where indicated on Drawings and/or directed by Engineer use closed cell foam rod polyethylene, expanded polyurethane neoprene or butyl rubber round solid rod joint backing, in joints over 1/8 in.(3 mm), circular in section, capable of being installed under at least 25% compression or equal as approved in advance by Engineer.
3. Bond breaker:

Polyethylene tape or Pressure sensitive plastic tape or masking tape placed between sealant and joint backing which will not bond to sealant, where required.

175.2 CAULKING EQUIPMENT

1. Caulking equipment to be as recommended by the manufacturer of the caulking material being installed.

175.3 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper installation of items in this Section, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

176.0 EXECUTION

176.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - b) Verify that caulking may be installed in accordance with the manufacturer's recommendations.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

176.2 PREPARATION

1. Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.
2. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
3. Remove oil, grease and other coatings from non-ferrous metals with solutions to Engineer's approval.
4. Prepare concrete, masonry, glazed and vitreous surfaces to sealant manufacturer's instructions.
5. Examine joint sizes and correct to achieve depth ratio 1/2 of joint width.
6. Install joint backing to achieve correct joint depth. Where joints exceed 1/8" (3 mm) width use rod type backing.
7. Where necessary to prevent staining, mask adjacent surfaces with tape prior to priming, if required, and caulking.
8. Apply bond breaker tape where required to manufacturer's instructions.
9. Prime sides of joints to manufacturer's instructions immediately prior to caulking, where required.

176.3 BACK-UP MATERIALS

1. Verify the compatibility of joint backing material with caulking before installation.

176.4 APPLICATION

1. Carefully study the Drawings, furnishing and installing proper caulking at each point where called for and at other points where caulking is essential in maintaining the continued integrity of the watertight barrier.
2. Install caulking in strict accordance with the manufacturer's recommendations, taking care to produce beads of proper width and depth, to tool as recommended by the manufacturer, and to immediately remove all surplus caulking.
3. Apply sealants, primers, if required, joint backing and/or bond breakers to manufacturer's instructions. Apply sealant using a gun with proper size nozzle. Use sufficient pressures to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
4. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air

- pockets, embedded impurities. Neatly tool to within 1/16". (2mm) of the surface.
5. Apply sealant to around perimeter joints between exterior windows/door frames to adjacent building components, to control joints in masonry walls, interior corners to showers, around all edges of bathtubs, WC. fixtures and elsewhere indicated on Drawings. Apply sealant to glazing conditions as described in Section 8.5 of these Specifications.

176.5 CLEANING

1. Clean adjacent surfaces immediately and leave work neat and clean. Remove excess and droppings, using recommended cleaners as work progresses. Remove masking tape after tooling of joints.

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

GENERAL FOR “WOODEN DOOR & FRAMES”

177.0 DESCRIPTION

1. Work included:
Wood doors and metal and/or wood frames including sidelights required for this Work are indicated on the Drawings and Schedules.
2. Related Work:
 - a) Refer to Section Ornamental Metal for gate material.
 - b) Refer to Section Finished Carpentry for architraves and mouldings.
 - c) Refer to Section Sealants (Pointing Mastics) for caulking.
 - d) Refer to Section for installation of Finish Hardware and to Consultant’s Hardware Schedule or ironmongery and weatherstripping.
 - e) Refer to Section for Glass and Glazing.

177.1 QUALITY ASSURANCE

1. Qualifications of fabricators and installers:
For fabrication and installation of doors and frames use only skilled carpenters and installers completely familiar with recommended methods of fabrication and installation and requirements of this Work.

177.2 SUBMITTALS

1. Shop Drawings:
Within 120 days after award of Contract, and before any doors and frames are fabricated submit Mock-ups to Engineer for approval in accordance with these Specifications.
2. Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to Engineer a letter signed by Contractor certifying that the materials delivered to the Works and fabricated items comply in all respects with provisions of this Section of these Specifications.

177.3 PRODUCT HANDLING

1. Protection:
Protect materials and fabricated items before, during, and after installation and protect installed work and materials of other trades.
2. Replacements:
In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

178.0 PRODUCTS

178.1 WOOD

1. Timber shall be of first quality and conform to the applicable requirements and B.S. 1186.
 - a) Timber shall be Teak, Sheesham, or Sound local Deodar as shown on Drawings and schedules, free from defects that would affect its strength and durability. Knots, only in Deodar, shall not be over 1 in. in their

- greatest dimension and be sound and tight. Timber to be well seasoned.
- b) Moisture content shall not exceed 7% by weight for interior use and 12% for exterior use.

178.2 PRESERVATIVE TREATMENT

1. Timber shall be treated by dipping in pentachlorophenol conforming to B.S. 3842. Metal shall be painted with a primer coat.

178.3 SOLID CORE LEAVES

1.
 - a) Flush doors shall be solid core type with Teak or Commercial ply veneer as specified on Drawings or schedules and conform to B.S. 459 (part 2) "Flush Doors" with veneer faces ready to receive transparent or paint finish.
 - b) Doors to be factory made and the product of an approved manufacturer. Glue used for bonding shall be first quality waterproof, specially manufactured for same. Door leaf shall be well seasoned core of solid block board with facing ply on each side. Minimum thickness of ply facing to be 1/8 in. Face veneers to be (1 mm), hot pressed bonded to core. Door leaf shall have well seasoned wood border framing of 2-1/2 ins on all sides, except for doors with panic exit devices which shall have 9 ins edge bands. Door leaf thickness shall be as indicated on Schedule.
2. Face veneer species: Teak ply as shown on Schedule or Drawings.

178.4 PANELLED LEAVES

1.
 - a) Panelled doors shall comply to B.S. 459 (panelled, glazed and wood doors) and be of solid Teak wood as per Drawings and approved by Engineer for transparent finish or paint grade.
 - b) Members shall be single thickness. Gluing to build-up members shall not be allowed.

178.5 WOOD FRAMES

1. Door frames shall be of Teak or Sheesham with applied or integral stops as detailed on Drawings, paint or stain grade, dado-jointed, assembled, and thoroughly braced.

178.6 METAL FRAMES

1. Door Frames shall be made of mill quality cold rolled steel exterior frames shall be galvanized steel.

178.7 FASTENINGS

1. Wrought iron hold anchors for securing frame to walls 1-1/2 ins by 1/8 in. Refer to Section Finish Carpentry for other interior finish fastenings.

178.8 ADHESIVES

1. Use adhesives for wood members as described in Section Finished Carpentry.

178.9 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of doors and frames, shall be supplied by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

179.0 EXECUTION

179.1 FABRICATION

1. Wood doors and frames:
 - a) Fabricator to verify total rough openings allowing for floor finish and wall finish thicknesses before fabricating.
 - b) Fabricate wood doors and frames to BS 1186 and in strict accordance with the highest standards for the grades specified. Wood work shall be neat and true. Joints to be tenon and mortice. Heads of nails, screws etc. shall be sunk and puttied. Wood door frames shall conform to BS 1567.
 - c) Frames shall be secured to masonry by at least six iron holds or with expansion bolts.
 - d) Doors to be square and true with maximum tolerance of plus or minus 1/16 in. for units with a diagonal measurement of 6 ft. or less and plus or minus 1/8 in. for units with a diagonal measurement over 6 ft.
2. Pressed steel frames:
 - a) Fabricator to verify total rough openings allowing for floor finish and wall finish thicknesses before fabricating frames.
 - b) Door frames shall be extend down to structural slab with reinforcing at floor.
 - c) Contours and arises shall be true and sharp as can be produced in the thickness of material required.
 - d) Construction joints of steel work shall be welded to full depth and width, or with equivalent splice plates welded on unexposed faces of frames. Exposed surfaces of welded joints shall be dressed and ground smooth to produce invisible connections.
 - e) Finished work shall be strong and rigid, neat in appearance and free from defects. Plain surfaces shall be smooth and free from wrap or buckle. Moulded members shall be clean, straight and true. Fastenings shall be concealed where practicable.
 - f) Reinforcement and stiffener shall be welded to inside of frame surfaces. Provide 3/16 in. thick reinforcement for hinges and 1/8 in. thick for lock and strike. For openings less than 48 ins wide fabricate with 16 gauge steel. Over 48 ins in width use 14 gauge. Heads of frames to openings wider than 48 ins shall have 10 gauge steel continuously welded to head with 1 in. legs turned upwards.

- g) Hardware cut-outs to be located according to hardware manufacturer's approved schedule.
- h) Frames shall be secured to the structure with strong wrought iron hold fasts. Hold fasts shall be a minimum 2 ins wide by 1/4 in. thick and shall be screwed to frames. Attachment shall be concealed.
- i) Exterior frames, anchors, reinforcing and related items shall be fabricated from hot-dipped galvanised steel, conforming to B.S. 729, Part 1. Following fabrication, touch up welds with liquid zinc.
- j) Surfaces of frames, hold fasts and related items shall be cleaned followed with a bonderising or phosphating process. Apply one coat of zinc chromate or synthetic resin primer in a light grey color.

179.2 INSTALLATION

1. Surface conditions:

- a) Prior to installation of doors and frames, carefully inspect installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
- b) Verify that doors and frames may be installed in accordance with the original design and pertinent codes and regulations.
- c) In the event of discrepancy, immediately notify the Engineer.
- d) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

2. Installation:

- a) Install doors and frames in strict accordance with pertinent codes and regulations, and original design, hanging square, plumb, and straight and firmly anchored into position for long life under hard use.
- b) Install finish hardware in strict accordance with manufacturer's recommendations, eliminate hinge-bound conditions make items operate smoothly, and firmly anchor into position.
- c) Doors shall be hung so that clearance with frame at top and lock side is 1/8 in. and at hinge side 1/16 in. Jamb stile shall have an 1/8 in. in 2 ins bevel across thickness to prevent back edge of lipping rubbing door frame or adjacent meeting stile. Double swing door shall have rebated meeting stiles.
- d) Refer to Section Sealants for mastic pointing between exterior frames and finished masonry openings.

3. Touching up:

- a) Using fine-grained sandpaper, completely eliminate scratches and abrasions in finished wood surfaces.
- b) Set nails and fasteners for putty; firmly putty holes; leave finished wood surfaces ready for painting or staining.

179.3 CLEANING AND PROTECTION

1. Installed units shall be adequately protected from dust, dirt and paint and other extraneous materials. Prevent disfigurements and immediately prior to hand-over of building thoroughly clean.

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

GENERAL FOR “ALUMINIUM FRONT”

180.0 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of third section.

180.1 SUMMARY

- 1 Extent of aluminium entrances and store fronts is indicated on drawings and schedules.
- 2 Aluminium entrances required for the project are of ‘Premium’ or ‘Deluxe’ quality and include:-
 - Aluminium Exterior Glazed Doors.
 - Aluminium Interior doors.
 - Interior Doors.
 - Frames for Exterior Doors.
 - Frames for Interior Doors.
- 3 Glazing: Refer to “Glass and Glazing” section of Division-8 for glazing requirements for aluminium entrances and store fronts.

180.2 SYSTEM DESCRIPTION

- 1 Performance Requirements: Provide aluminium entrance assemblies that comply with specified performance characteristics.
- 2 Thermal Movement: Provide systems capable of withstanding thermal movements resulting from an ambient temperature range of 120 F (67° C), that could cause metal surface temperature range of 180° F (100° C) within the framing system.
- 3 Wind Loading: Provide assemblies capable of withstanding a uniform test pressure of 20 psf inward and 20 psf outward.
- 4 Water penetration (for exterior doors and glazed panels only): provide units with no water penetration when tested.

180.3 SUBMITTAL

- 1 Product Data: Submit manufacturer’s product specifications, technical product data, standard details, and installation recommendations for each type of entrance and store front product required. Include the following information:-
 - Hardware.
 - Accessories.
- 2 Mock up: Submit Shop Drawings (1m x 1m) mock-up of each type (sliding/pivoted) of door and fixed glazing combination of exterior type using standard components in required finish including glazing, gaskets, flyscreening and all specified hardware for the approval of the Engineer.

180.4 QUALITY ASSURANCE

- 1 Manufacturer and Installers Qualification: Arrange supply and installation of Aluminium Entrances and Store front system by a firm/s which can demonstrate successful experience in supplying and installation similar in type, quality and quantity to the required in this project.
- 2 Design Criteria: Drawings indicate sizes, spacing of members, profiles and dimensional requirements of entrance and store front work. Minor deviations will be accepted in order to utilize manufacturer's standard products when, in the Architect's sole judgement, such deviations do not materially detract from the design concept or intended performances. Shop drawings to be submitted for Architect, approval, prior to commencement of manufacturing or fabrication of these units by the supplier.

180.5 PROJECT CONDITIONS

- 1 Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work. Co-ordinate fabrication schedule with construction progress to avoid delay in the work.

181.0 PRODUCTS

181.1 MANUFACTURERS

- 1 Manufacturer: Subject to compliance with requirements, provide products of one of the following:-
(Details to be provided)
European Make

181.2 MATERIALS

- 1 Aluminium Members: Provide alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish: comply with ASTM B 221 for extrusions and ASTM B 209 for sheet or plate.
- 2 Fasteners: Provide fasteners of aluminium, non-magnetic stainless steel, or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminium components, hardware, anchors and other components.
Reinforcement: Where fasteners screw-anchor into aluminium less than 0.125 in thick, reinforce the interior with aluminium or nonmagnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.
Exposed Fasteners: Except where unavoidable for application for hardware, do not use exposed fasteners. For the application of hardware, use fasteners that match the finish of member or hardware being fastened.
Provide Philips flat-head machine screws for exposed fasteners.
- 3 Concealed Flashing: Provide 26 gauge minimum dead-soft stainless steel, or 0.026 in minimum extruded aluminium of alloy and type selected by manufacturer for compatibility with other components.
- 4 Brackets and Reinforcements: Where feasible, provide high-strength aluminium brackets and reinforcements otherwise provide nonmagnetic stainless steel or hot-dip galvanised steel complying with ASTM A 386.
- 5 Concrete/Masonry Inserts: Provide concrete and masonry inserts fabricated from cast

- iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386.
- 6 Compression Weatherstripping: Provide the manufacturer's standard replaceable compressible weatherstripping gaskets of moulded neoprene or moulded PVC.
 - 7 Sliding Weatherstripping: Provide manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminium strip backing.
 - 8 Glass and Glazing Materials: Glass and glazing materials shall comply with requirements of "Glass and Glazing" section of these specifications.
 - 9 Sealant: For sealants required within fabricated units, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, non-shrinking and non-migrating. Colour shall be approved by the Engineer. See also Section 7900.

181.3 COMPONENTS

- 1 Glazed Panel, Framing Systems: Provide inside-outside matched resilient framing systems with provisions for glass replacement. Shop-fabricate and pre-assemble frame components where possible.
- 2 Aluminium Door Frames, Fabricate tubular and channel frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards; reinforce as necessary to support required loads.
Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassemble of stiles and rails. Provide snap-on extruded aluminium glazing stops, with exterior stops anchored for non-removal.

181.4 HARDWARE

- 1 Provide manufacturer's heavy-duty hardware units as indicated, scheduled, or required for operation of each door, including the following items of sizes, number, and type recommended by manufacturer for service required, finish to match door.
- 2 Pivot Sets: Provide pivot assemblies complying with ANSI A156.4, Grade 1: provide exposed parts of cast aluminium alloy or nonmagnetic stainless steel.
- 3 Concealed Floor Closers: Provide concealed floor closers complying with ANSi A156.4, grade 1: provide bottom arm, top pivot, cement case and finished floor plate or threshold, as indicated. Comply with manufacturer's recommendations for size of closer, depending on door size, exposure to weather and anticipated frequency of use. Close shall be selective hold open type.
- 4 Overhead Concealed Closers: Provide independently hung, single-acting overhead concealed closers with concealed arm and track, complying with ANSI A 156.4, grade. Comply with manufacturer's recommendations for size of closer, depending on door size, exposure to weather and anticipated frequency of use. Closer shall be selected hold open type.
- 5 Door Stop: Provide floor or wall mounted door stop, as appropriate, with integral rubber bumper.
- 6 Thumb-Turns: Provide inside thumb-turn cylinders of cast aluminium alloy.
- 7 Deadbolts: Provide mortised maximum security type deadbolts, with stainless steel strike box.
- 8 Deadlatches: Provide mortise type deadlatch with stainless steel strike box.
- 9 Lever Handles/Door Pulls: Provide aluminium alloy lever handle/Pull units.
- 10 Flushbolts: Provide stainless steel, standard edge mortised lever extension type flush bolts for inactive leaves of pairs of doors. Provide flushbolts at both top and bottom of

- doors.
- 11 Push-Pull Plates: Provide standard aluminium push-pull plate of style as per Architects design or selected by Engineer from industries standard range.

181.5 FABRICATION

- 1 General: Sizes of door and frame units, and profile requirements, are indicated on drawings. Variable dimensions are indicated, with maximum and minimum dimensions required to achieve design requirements and co-ordination with other work.
- 2 Prefabrication: Before shipment to the project site, complete fabrication, assembly, finishing, hardware application and other work to the greatest extent possible. Disassemble components only as necessary for shipment and installation. Do not drill and tap for surface-mounted hardware items until time of installation of project site.
- 3 Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements sag resistance and rigidity.
- 4 Dissimilar Metals: Separate dissimilar metals with zinc chromate primer bituminous paint, or other separator that will prevent corrosion.
- 5 Fasteners: Conceal fasteners wherever possible.
- 6 Weather stripping: For exterior doors, provide compression weather stripping against fixed stops; at other edges, provide sliding weather stripping retained in adjustable strip mortised into door edge.
Provide EPDM or vinyl blade gasket weather stripping in bottom door rail, adjustable for contact with threshold.
At interior doors and other locations without weather stripping, provide neoprene silencers on stops to prevent metal-to-metal contact.

181.6 FINISHES

- 1 Color Anodized Finish: Provide (minimum 20 microns thick) integrally or electrolytically deposited colored anodic coating.
Provide Black color.

182.0 EXECUTION

182.1 INSTALLATION

- 1 Company with manufacturer's instructions and recommendations for installation.
- 2 Inspect openings: Before installation verify that plastered masonry opening is correct and in plumb and floor is finished and level.
- 3 Set plumb level and true to line, without warp or rack of framing members, doors, or panels. Provide proper support and anchor securely in place.
- 4 Drill and tap frames and doors and apply surface-mounted hardware items. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
- 5 Set sill members to other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division-7 for sealant, fillers and gaskets.
- 6 Refer to Glass and Glazing section of Division-8 for installation of glass and other panels indicated to be glazed into doors and framing, and not pre-glazed by

- manufacturer.
- 7 Conduct on site test for water infiltration to exterior door and glazed panels only, in the presence of the windows manufacturer's representative and the Engineer. The Engineer will select the units to be tested. Test not meeting the specified requirements and units having similar deficiencies shall be corrected at no extra cost to the Employer. Testing shall be by spraying water from a hose pipe at 20 psi, pressure from a distance of 5ft.0in to check for any water infiltration continuously for 12 to 20 hours. No water infiltration is permissible.

182.2 ADJUSTING

- 1 Adjust operating hardware inside and out promptly after installation, exercising care to avoid damage to coatings.
- 2 Clean glass surfaces after installation, complying with requirements contained in the 'Glass and Glazing' section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminium surfaces.

182.3 PROTECTION

- 1 Institute protective measures required throughout the remainder of the construction period to ensure that aluminium entrances will be without damage or deterioration, other than normal weathering, at time of acceptance.

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

GENERAL FOR “ALUMINIUM WINDOWS”

183.0 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

183.1 SUMMARY

1. Extent of each type of aluminium window units required is indicated on the drawings and schedules.
Aluminium window units required are of ‘premium’ or ‘deluxe’ quality.
2. Types of aluminium window units required include following:-
 - Fixed
 - Top Hung
 - Vertical Pivoted
 - Horizontal Sliding
 - Skylight
3. Applications of aluminium windows on the project include individual units set in conventional construction.
4. Sealants for all windows are required and are specified in Section 07900

183.2 SYSTEM DESCRIPTION

1. Design wind velocity at the project site is 85 mph.
2. Water Penetration: Provide units with no water penetration when tested as defined later.

183.3 SUBMITTALS

1. Product Data Submit manufacturer’s product specification technical product data recommendations and standard details for each type of aluminium window unit required. Include the following information:
 - Fabrication methods.
 - Finishing
 - Hardware
 - Accessories
1. Mock-up: Submit a complete 3' x 3'(1m x 1m) mock-up of each type of window using standard components in specified finish, including glazing, gasket, flyscreening and all hardware for the approval of the Engineer.
The Engineer reserves the right to require additional samples, if unsatisfactory fabrication techniques, workmanship, hardware and accessories are found. Once selected, a full size exterior window will be installed by the supplier as a mock-up to the exterior of the building, at no charge.

183.4 QUALITY ASSURANCE

1. Single Source Responsibility : Provide aluminium windows produced by a same manufacturer who will produce aluminium doors and glazed panels and who is capable of showing prior production of units similar to those required.
2. Design Criteria: Drawings indicate sizes, profiles and dimensional requirements of aluminium windows. Window units having minor deviations from indicated dimensions and profiles may be accepted, subject to the Engineer's approval, provided such deviations do not materially detract from the design concept or intended performance. Submit shop drawings for approval by Architect, prior to commencement of manufacture or fabrication by supplier.
3. Field Measurements: Prior to fabrication, check actual window openings in construction work by accurate field measurement. Coordinate fabrication schedule with construction progress as directed by the Contractor to avoid delay of work. Approval of shop drawings will not relieve the contractor of deviations in field measurement and to that of actually fabricated units.

184.0 PRODUCTS

184.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:-
(Details to be provided)
Gulf Glass Industries, Sharjah, U.A.E or European Make

184.2 MATERIALS

1. Aluminium Extrusions: Provide alloy and temper recommended by the window manufacturer for the strength, corrosion-resistance, and application of required finish, but not less than 22,000 psi ultimate tensile strength and not less than 0.08" (2.0 mm) thickness at any location for main frame and sash members. Width of Sections Shall not be less than 3" x 1/2" .
2. Fasteners: Provide aluminium, non-magnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminium window members, trim, hardware, anchors and other components of window units.
Reinforcement: Where fasteners screw-anchor in to aluminium less than 0.125" (3.125 mm) thick, reinforce interior with aluminium or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet units.
Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match the finish of the member or hardware being fastened as appropriate.
3. Anchors, Clips and Window Accessories: Fabricate anchors, clips and window accessories of aluminium, non-magnetic stainless steel or hot-dip zinc coated steel or iron complying with the requirements of ASTM A 386.
4. Compression Glazing Strips: Provide manufacturer's standard replaceable compressible gaskets of molded neoprene or molded PVC.
5. Sliding Type Weatherstripping: Provide woven pile weatherstripping of wool, polypropylene or nylon pile and resin-impregnated backing fabric, and aluminium

- backing strips.
6. Sealant: For sealant required within fabricated window units, provide type recommended by the manufacturer for joint size and movement. Sealant shall remain permanently elastic, non-shrinking and non-migrating. Colour shall be clear. See also Section 7900 of these specifications.

184.3 Window Types

1. General: The following paragraphs define the operating arrangement for the types of sash required in window units and specify minimum provisions for each type. The drawings indicate which panels of each window unit are operable sash and which are fixed.
2. Top Hung windows are window units containing a swing-out, top-hung projected sash, that swings the bottom edges of ventilators outward and permits staying of ventilators at any angle upto 60 degrees from vertical, with a manually controlled locking devices. Provide units with a 'tilt-in' feature to permit inside cleaning of outside glass faces. Top Hung windows may contain one or more fixed panels. Units should have fly screens.
3. Horizontal-sliding windows are window units containing one or more horizontally operatable sash in. These windows should have fly screens or provision of fly screens if not indicated on drawings a weathering frame. Provide window units with sash that can be removed from the inside for cleaning.

184.4 HARDWARE

1. General: Except to the extent that more specific or stringent requirements are indicated, provide the manufacturer's standard hardware fabricated from aluminium, stainless steel, or other corrosion-resistant material compatible with aluminium and of sufficient strength to perform the function for which it is intended.
 - Friction Hinges: provide friction hinges for top hung windows of non-corrosive durable material.
 - Friction Shoes Provide friction shoes of nylon or other non-abrasive, non-staining, non-corrosive, durable material.
 - Window Types Provide the following equipment and operating hardware:-
 - Top Hung Windows
 - Lock : Lift type cam action lock.
 - Hinges : Friction type 2 per sash.
 - Hinges : Continuous
 - Horizontal-Sliding Windows
 - Sash Rollers: Adjustable nylon rollers.
 - Sash Lock: Cam action weep sash lock and keeper at meeting rails.
 - Spring loaded snap type lock at jambs (1 per sash).
 - Spring loaded plunger lock on meeting rail (1 per sash).

184.5 ACCESSORIES

1. General: Except to the extent that more specific or stringent requirements are indicated, provide the manufacturer's standard accessories that comply with indicated standards.

184.6 FABRICATION

1. General: Except to the extent that more specific or stringent requirements are indicated, provide manufacturer's standard fabrication that complies with indicated standards and that produces units that are re-glazable without dismantling sash framing. Include a complete system for assembly of components and anchorage of window units, and prepare sash for glazing.
2. Sizes and Profiles: Required sizes for window units and profile requirements are indicated on the drawings. Variable dimensions are indicated along with maximum and minimum dimensions as required to achieve design requirements and coordination with other work.
3. Provide weep-holes and internal water passages to conduct infiltration water to the exterior.
4. Glazing Stops: Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish glazing stops to match window units.

184.7 FINISHES

1. Coloured Anodized Finish: Provide (minimum 20 microns thick) integral or electrolytically deposited colour anodized finish as follows:
Colour : Medium/Dark Bronze

185.0 EXECUTION

185.1 INSPECTION

1. Inspect openings before beginning installation. Verify that plastered masonry opening is correct and in plumb and the sill is level.
Plastered surfaces shall be visibly dry and free of excess mortar, sand and other construction debris, and in the profile as shown in drawings to receive the aluminium frame.

185.2 INSTALLATION

1. Comply with manufacturer's specifications and recommendations for installation of window units, hardware, operators, and other components of the work.
2. Set units plumb level and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.
3. Separate aluminium and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
4. Provide Sealants Refer section-07900 joint Sealer/Expansion Joints as shown in drawings.

185.3 FIELD QUALITY CONTROL

1. Conduction-site tests for water infiltration with the Engineer and the window manufacturer's representative present. The Engineer will select units to be tested. Tests not meeting specified requirements and units having similar deficiencies shall be corrected at no cost to the Owner. Testing shall be by spraying water with a hose pipe at 20 psi pressure from a distance of 5-10" to check for any water infiltration continuously for a duration of 12 to 20 hours. No water infiltration is permissible.

185.4 ADJUSTING

1. Adjust operation sash and hardware to provide a tight fit at contact points and at weatherstripping, for smooth operation and a weathertight closure.

185.5 CLEANING

1. Clean aluminium surfaces promptly after installation of windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt and other substances. Lubricate hardware and other moving parts.
2. Clean glass of pre-glazed units promptly after installation of windows, comply with requirements of the 'Glass and Glazing' section for cleaning and maintenance.

185.6 PROTECTION

1. Initiate and maintain protection and other precautions required through the remainder of the construction period, to ensure that, except for normal weathering, window units will be free of damage or deterioration at the time of substantial completion.

GENERAL FOR “*FINISH HARDWARE*”

186.0 DESCRIPTION

1. Work included :
 - i) “Hardware groups” have been assigned to the various doors and windows required for this work, and are described in detail on Architect Schedules, attached with the BOQ.
 - ii) Arrange for and install finish hardware described in door and window Schedule and other finish hardware not described but required for a complete and operable facility included in cost of respective doors/windows.
 - iii) Fastenings such as screws nails etc. not packaged with finish hardware but required for a complete installation and operation shall be supplied at Contractor’s expense.
 - iv) Key Cabinet shall be furnished and installed by Contractor.
2. Related work :

Hardware items pertaining to Toilets are listed in Section Bath and Toilet accessories.

186.1 SUBMITTALS

1. Material list:
 - i) Within 120 days after award of Contract, and before any finish hardware is ordered for this Work, submit to the Engineer for his approval a complete list of finish hardware to be furnished for this Work, based on the Architect’s Schedules, giving manufacturer’s name, catalog number, hardware set number and door size.
 - ii) Submittal procedure shall not be construed as permitting substitutions of items for those specified.
 - iii) Submit samples of hardware contained in Schedule for approval by Engineer.
 - iv) The final selection of locking options for locksets and deadlocks and other hardware in Schedule will be exercised during the submittal phase.
 - v) Make submittals, and resubmittals if necessary, in accordance with the provisions of Division 1 of these Specifications.
2. Manufacturer’s recommendations :

Prior to installation, deliver to installing personnel complete recommendations from the manufacturers regarding installation methods

186.2 PRODUCT HANDLING

1. Packaging :
 - i) Ensure that each unit is clearly marked or numbered in accordance with Schedule.
 - ii) Pack each item complete with necessary pieces and fasteners.
 - iii) Wrap and cushion each item to prevent scratches during delivery and storage.

2. Delivery and storage :
Delivery hardware to the installers in a timely manner to ensure orderly progress of the total Work.
 - i) Store hardware in locked clean and dry area.
 - ii) Maintain inventory list with schedule.

187.0 PRODUCT

187.1 FASTENINGS

1. General:
 - i) Ensure hardware is supplied with necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.
 - ii) Ensure fastenings are supplied with expansion shields, toggle bolts, and other anchors approved by Engineers, according to the material to which the hardware is to be applied and to the recommendations of the hardware manufacturer.
2. Design:
Fastenings shall match hardware material and finish.

187.2 DOOR HARDWARE

1. Locks and cylinders shall be as mentioned in Architects Schedule.
2. Door closers for exterior doors shall be rim mounted on the interior face of the door. Generally door closer shall be mounted on door face least objectionable to view as approved by Engineer.
3. Kick plates shall be one piece aluminium 6 ins in heights, unless otherwise, noted, to suit door width. Fixing shall be by means of countersunk screws in countersunk holes so that head is flush with plate.
4. Door stops shall be wall mounted or floor mounted or incorporated within door knobs in the form of resilient bumper.
5. Door Silencers shall be rubber or vinyl tabs which snap into predrilled holes. Locate two at quarter points of jambs and one at head of pairs of doors.
6. Acoustic seals for soundproofing or lightproofing shall be closed-cell sponge / neoprene type adhered to stops at jambs, neoprene in aluminium holder recessed into stile at double door meeting stiles and neoprene drop type recessed into door bottoms, activated by door operation.
7. Weatherstripping shall be vinyl gasket in bronze or aluminium holder, at jambs and neoprene drop type recessed or surface mounted at door bottoms.

187.3 WINDOW HARDWARE

1. General :
 - i) Screws where exposed, to match hardware finish. All types to be non-rusting. Use flat head type for hinges and raised countersunk oval head for other work to B.S. 1210.
 - ii) At exterior opening lights: compressible pvc or foam rubber weatherstripping.
 - iii) Outswinging windows with sill heights lower than 2 ft. above floor to have stay bar designed to allow maximum opening of 6 ins.

2. Hardware Types :
 - a) Type 1 Out swinging windows :
 - i) Push bar with fixed settings providing locking when light is closed, or friction stay bar.
 - ii) Lever cross tongue casement fastener.
 - iii) Heavy duty hinges.
 - iv) Double leaf units without mullion shall have the addition of flush bolts to one leaf.
 - b) Type 2 In swinging windows :
 - i) Friction stay at each jamb.
 - ii) Morticed spring bolt with ring pull.
 - iii) Heavy duty hinges.
 - iv) At out-of-reach conditions which prevent operation by hand, provide separate wooden long arm with hook and push attachment.

187.4 CABINET HARDWARE

1. Cabinet work hardware includes but is not limited to the following:
 - i) Hinges : butt type for flush door leaves and cabinet type for surface mounted door leaves. Surface mounted door leaves may have self closing hinges in which case item 'b' can be omitted.
 - ii) Ball or roller catches.
 - iii) Locks : flush fitting pin tumbler cylinder cabinet locks by Yale or equal.
 - iv) Door and drawer pulls.
 - vi) Drawer glides (imported).
 - vii) Flush mounted shelf standards for adjustable shelf supports.

187.5 ACCESS PANELS

1. Pair of concealed hinges and square keyed mortice bolt with strike.

187.6 DOOR KEYING

1. Construction Keying :
Provide a method independent of the final keying system for securing the building during construction.
2. Final keying system :
 - i) Stamp keys " DO NOT DUPLICATE "
 - ii) Deliver two keys for each lock to Employer.

187.7 CURTAIN TRACKS

- i) Tracks shall be hand traverse, surface mounted extruded aluminium to B.S. 3987 with AA25 satin finish. Use single channel shape with end stop fittings and gates.
- ii) Carriers shall be ball bearing roller type with bumper feature preventing jamming and overriding. Use 4 (four) carriers per foot of track.

187.8 KEY CABINET

1. Install cabinet as direction by Engineer.

187.9 OTHER MATERIAL

1. Materials and methods not specifically described but required for proper installation of finish hardware, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

188.0 EXECUTION

188.1 DELIVERIES

1. Stockpile items sufficiently in advance to ensure their availability and make deliveries in a timely manner to ensure orderly progress of the total Work.

188.2 INSTALLATION HEIGHTS

1. Install door hardware at following heights from finished floor to centre line of item unless designated otherwise on Drawings.

Door pull	45 ins	
Push plate	45 ins	
Door push / pull bar	43 ins	
Dead lock	60 ins (2-3 / 4 ins	from edge of stile)

Alternate deadlock 1 - 1 / 2 (6 ins from edge of stile)

Panic bolt, door knob 41 ins

locks, roller, catches,
exit bolt locks

Robe hooks or 69 ins

hook and bumpe

Butt hinges as follows:

bottom hinges : 10 - 3 / 8 ins from finished floor to centre line.

top hinges : 9 - 3 / 4 ins from top of door to centre line.

centre hinges : at midpoint between top and bottom hinges.

188.3 HARDWARE SCHEDULE

1. For Door hardware refer to Article 2.3 of this Section and separate Architectural Schedule. Install as per manufacturers instructions and Architectural Drawings.
2. For window hardware refer to Article 2.4 of this Section and the Window Schedule. Install as per manufacturers instructions and Architectural Drawings.
3. For cabinet work hardware refer to Article 2.5 of this Section. Install as per

manufacturers instructions and Architectural Drawings.

188.4 HAND OF DOOR DETERMINATION

1. The hand should be specified on pin tumbler locks so that the locks can be correctly assembled by the factory or distributor to insure the keyholes being in an upright position when installed on the job.
2. On locks for Reverse Level Doors, if the finish called for is different on each side of the lock, the hand should be specified so that the face and strike furnished with the lock will match the outside finish.
3. To correctly specify the proper hand of a door, consider the door in its closed position. Then, looking at the door from the exterior or key side, the hand is determined as follows:
 - i) A door that opens inward and is hinged on the right-hand side is a Right Hand Door. (Symbol: R.H.)
 - ii) A door that opens inward and is hinged on the left-hand side is a Left Hand Door. (Symbol: L.H.)
 - iii) A door that opens outward and is hinged on the right-hand side is a Right Hand Reverse Door. (Symbol : R.H.R)
 - iv) A door that opens outward and is hinged on the left-hand side is a Left Hand Reverse Door. (Symbol: L.H.R.)

188.5 CLEANING AND PROTECTION

1. Installed hardware shall be adequately protected from dust, dirt, paint and other extraneous materials. Prevent disfigurement and immediately prior to hand-over of building, thoroughly clean and polish.

GENERAL FOR "GLASS & GLAZING"

189.0 DESCRIPTION

1. Work included:

The work covered under this section of the Specifications consists of furnishing all labour, equipment, scaffolding and providing glass, gaskets, sealants, compounds and accessories required for performing all operations in connections with the installation and setting of glass, glazing and glass blocks and butt jointed glazed partitions 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.

Glass and glazing required for this Work includes plate glass, mirrors, wired glass, and translucent glass. Refer to drawings and glazing Schedule.

2. Contractor shall also submit printed materials manufacturer's installation instruction for specified glazing gaskets, compounds, sealants and accessories including description of required equipment, procedures and precautions to be observed.

189.1 QUALITY ASSURANCE

1. Qualifications of installers:

Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the requirements of this Work, and personally direct installation performed under this Section of these specifications. Installation of glass shall be performed only by skilled glaziers.

- 2a) The glazier must examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed. Do not proceed with the glazing until unsatisfactory conditions have been corrected in a manner acceptable to the glazier.

b) Weather Conditions:

Do not proceed with installation of liquid sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.

189.2 SUBMITTALS

1. Within 120 days after award of Contract, and before any glazing is delivered to Job Site, submit three samples of each glass type 4 ft. x 4 ft. size (1m x 1m), 3 nos of glass blocks etc. and two samples of glazing accessories i.e. Sealants, gaskets, etc.
2. Contractor shall also submit printed materials manufacturer's installation instructions for specified glazing gaskets, compounds sealants and accessories including description of required equipment, procedures and precautions to be observed.

189.3 PRODUCT HANDLING

1. Protection:

Protect glass and glazing materials before, during, and after installation and protect installed work and materials of other trades.

2. Delivery materials in manufacturer's original, unopened containers clearly labelled with manufacturer's name and address, material, brand, type class and rating as applicable.

Store the materials in original unopened containers, with labels intact, protected from ground contact and from the elements.

Handle the materials in a manner to prevent breakage of glass and damage to surfaces, and shall exercise exceptional care to prevent edge damage to glass.

3. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

190.0 PRODUCTS

190.1 GLASS

1. Glass shall bear the label of its manufacturer, be clear, free of scratches and distortion-free of first quality from approved American or Belgium manufacturers or approved equal. Conform to BS 952 and BS C.P.152.
2. Subject to compliance with requirements, provide products of one of the following manufacturers
 - a) PPG Industries Inc. U.S.A.
 - b) Pilkington Glass Limited, UK/U.S.A.
3. Glass Types:
 - a) Plate tinted shall be grey tinted float, glazing quality 6 mm thick.
 - b) Wired glass shall be clear polished plate, 6 mm thick, reinforced with 25 ASW gauge steel wire grid.
 - c) Mirror glass shall be clear polished plate, 6 mm thick, selected glazing quality. Glass shall be silver coated, hermetically sealed with a uniform electroplated copper coating, protected by a coat of mineral oxide base paint. Use Belgium make or approved equal.
 - d) Translucent glass shall be either of the following:
 - i) Sandblasted glass. Plate glass with a light, even sand blasted treatment to give obscuration.

190.2 GLAZING ACCESSORIES

1. Glazing accessories shall be new, first quality of their respective kinds, and subject to the approval of Engineer.
 - a) Sealant as specified in Section 7900.
 - b) Mirror mastic as recommended by mirror glass manufacturer.
 - c) Foam glazing tape to be closed cell polyvinyl chloride tape 3/4 in. by 3/16 in. thick with pressure sensitive adhesive on one side, or equal approved by Engineer
 - d) Glazing beads shall be the same wood as for frame or sash. Refer to Section on Wood Windows.

190.3 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper installation of glass, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

191.0 EXECUTION

191.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

191.2 GLAZING SCHEDULE

1. Glass types described in this Section shall be applied to the following components:
 - a) Plate glass:
 - i) Exterior windows.
 - ii) Glazed panels and vision panels to door in Public Spaces.
 - iii) Interior windows.
 - b) Wired glass:
 - i) Interior windows to Back of House areas.
 - ii) Doors with glass panels or vision panels to Back of House areas.
 - c) Plate glass mirror:
Where indicated on Drawings.
 - d) Translucent glass:
Generally for toilet, locker room windows and wherelse indicated on Drawings.

191.3 GLAZING

1. Exterior glazing:
 - a) Set glass in a true plane, tight and straight, on setting blocks at quarter points, firmly anchor to prevent rattling and looseness, with edges cleanly cut. Do not nip or seam edges. Rebates and grooves shall be clean, dry and unobstructed at the time of glazing.
 - b) Edge clearance shall be equal all around each panel and not less than 1/8 in (3mm).
 - c) Install tape continuous to head sill and jambs of fixed stop. Ensure no voids or spaces are left in back of glazing tape.
 - d) Glazing beads shall be fabricated under Section 5.2 and installed under this Section. Attach and seat aluminium glazing beads in waterproof glue, compressing glazing tape to approximately 70% of original thickness. Trim- off excess tape, even with sight line.
 - e) Apply sealant cap bead both sides of glass, tool smooth, remove excess.
 - f) Glazing shall be wind and watertight.
 - g) Glazing work shall comply with the recommendations of the glass and glazing materials manufacturers.
 - h) Examine each piece of glass and discard and replace glass with edge damage or face imperfection.
 - i) Clean glazing channels and other framing members indicated to remove

glass. Remove coatings which are not firmly bounded to the substrate, remove lacquer from metal surfaces wherever elastomeric sealants are to be used. Apply primer and sealer to joint surfaces wherever recommended by the sealer manufacturers.

- j) Trim and clean excess glazing materials from surrounding surfaces immediately after installation and eliminate stains and discolorations.
- k) Cure glazing sealants and compounds in compliance with manufacturer's instructions, to obtain high early bond strength internal cohesive strength and surface durability.
- l) No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass.
- m) While glass operation is in progress great 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.
- n) The glass panes shall be properly cut to fit the rebates so as to have a uniform clearance of 3mm round the panes between the edges of glass and the frame. In the event that any panel is cut short so that the clearance exceeds the required dimension and renders the gaskets loose, the panel shall be replaced by the Contractor.
- o) Glass in butt-jointed installation shall be plain or tinted and of sizes and thickness as indicated in the drawings and the Bill of Quantities. The specifications of glass shall be as mentioned above for plain or tinted glass. The glass shall be installed with a uniform spacing between the leaves equal to the thickness of glass but not greater than 10mm. After the glass is placed on location and approved by the Engineer, the space in between shall be completely filled by a clear or opaque sealant manufactured by Dow Corning as required. All edges shall be marked adequately prior to sealant application.
- p) Glazing vinyl beads and gaskets shall be of suitable size and shape to fit tightly between the glass and window/door section. The installation shall be carried out in a manner that the joints are confined to corners of glass panes, and no joint in beads and gaskets are visible on any side of the glass pane after completion of installation.

2. Interior glazing:

- a) Refer to 3.2.1a.
- b) Install foam glazing tape as 3.2.1c.
- c) Glazing beads shall be fabricated under Section for Wood Windows and installed under this Section. Attach wood glazing beads compressing tape to approximately 70% of original thickness. Trim-off excess tape, even with sight line.

191.4 CLEANING UP AND PROTECTION

- 1. Upon completion of glazing, thoroughly clean glass surfaces, correct imperfections, replace damaged glass, and leave labels on the glass until they have been inspected and approved by Engineer. Remove labels immediately thereafter and clean glass. Remove all smears, labels and excess glazing sealant, leave clean inside and outside and 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 glazed surfaces shall be washed clean both inside and outside prior to final acceptance by the Engineer.

192.0 MEASUREMENT AND PAYMENT

1. General: No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein.
The cost there of shall be deemed to be included in the quoted unit rate of the relevant item of the Bill of Quantities.
2. Measurement of acceptably completed works will be made on the basis of net actual area in square metre of glazing material provided and installed in position as shown on the drawing or as directed by the Engineer.
3. Payment will be made for acceptable measured quantity of glazing material on the basis unit rate per metre or per square metre quoted in the Bill of Quantities.
The unit rate shall include the cost of glazing, sealants beads, tapes, gaskets, labour, manpower, equipment, etc. and compound for fixing the glass, all hardware fitting as per manufacturer's recommendations or as shown on the drawings. Payment shall constitute full compensation for all the works related to the item.

GENERAL FOR “EXTERNAL & INTERNAL PAINT WORK”

193.0 DESCRIPTION

1. Work included:
Work of this Section includes the supply and application of plaster materials and accessories for interior and exterior finishes indicated on the Drawings and Schedules.

193.1 QUALITY ASSURANCE

1. Qualifications of installers:
 - a) For application of coatings, use only thoroughly trained and experienced plasterers who are completely familiar with the requirements of this Work and the recommendations contained in the referenced Standards.
 - b) In acceptance or rejection of installed materials, no allowance will be made for lack of skill on the part of workmen.

193.2 SUBMITTALS

1. Samples:
Within 120 days after award of Contract, and before any material for this work is delivered to the Job Site, submit to the Engineer, in accordance with the provisions of these Specifications, mock-ups of the proposed plaster surfaces and accessories, etc.

193.3 PRODUCT HANDLING

1. Delivery and storage:
 - a) Deliver materials of this Section to the Job Site in their original unopened containers with labels intact and legible at time of use. Where material is delivered loose, store as directed by Engineer.
 - b) Store materials under cover to prevent damage and contamination. Store only the specified materials at the Job Site.
2. Protection:
Protect materials of this Section before, during, and after installation and protect installed work and materials of other trades.
3. Replacements:
In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

194.0 PRODUCTS

194.1 MATERIALS

1. Portland Cement: Ordinary and white conforming to P.S.232 or B.S. 12.
2. Sand: Clean, sharp, angular, free from alkali, silt or organic matter, to conform to B.S. 1198 - 1200 or the draft Pakistan Standard “Sand for Plaster”.
3. Water: Potable, clean, free from deleterious amount of oils, salts, alkali, organic matter and other harmful materials conforming to B.S. 3148.
4. Colour Pigment: Salt-free, inorganic. Type and amount to be approved by Engineer.
5. Marble Powder: White and same consistency as dry cement.

6. Accessories:
 - a) Expanded metal lath to be flat rib diamond mesh of 1/4" shortway type, galvanized to B.S. 729, conforming to B.S. 1369. Use BB 263, 2.25 lbs per sq. yds (1.22 Kg/m²) for external use and reinforcement of joints and BB 264, 3 lbs per sq. yds (1.63 Kg/m²) for suspended plaster ceilings. Paint lath with zinc rich primer for internal conditions.
 - b)
 - i) Running and furring channels to be 16 gauge. cold rolled steel galvanised to B.S. 729.
 - ii) Minimum weight per lineal foot: Furring channels 3/4 in. depth - 0.3 lbs. Runner channels of 1-1/2 in. depth - 0.475 lbs or 2 ins depth - 0.54 lbs.
 - iii) Minimum width of flanges 7/16 in.
 - c) Plaster stops: 26 guage. steel with 3 -1/8 in. expanded metal flanges, size to suit plaster depth, galvanized to B.S. 729.
 - d) Tie wire to be 18 ga. annealed steel wire galvanised to B.S. 443.
 - e) Ceiling hanger:
 - i) 8 ga. annealed steel wire galvanised to B.S. 443.
 - ii) 1/8 in. by 1 in. flat mild steel strip or 1/4 in. diameter steel rods, both galvanized to B.S. 729.
 - f) Fastening such as expansion bolts, galvanised nails, metal trim and other accessories to Engineer's approval.
8. Materials and workmanship for plaster not explained in these Specifications shall comply with the requirements of B.S.5262 and 5492.

194.2 ADDITIVES

1. Additives for controlling the setting and working characteristics of plaster, or for imparting anti-corrosion, fungicidal or water proofing properties, shall be added to the plaster strictly in accordance with the particular manufacturer's written instructions.

194.3 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of plaster, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

195.0 EXECUTION

195.1 SURFACE CONDITIONS

1. Inspection and Preparation:
 - a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - b) Concrete surfaces to be plastered shall be cleaned to remove grease, form oil and other impurities which will otherwise adversely affect the adhesion of plaster to the surface. Surfaces of concrete work if so required by Engineer, shall be hacked by approved means to give the required key for plastering.
 - c) Surfaces shall be washed with clean water and kept damp for 2 hours before further treatment. Surfaces thus prepared shall be treated uniformly

with a cement and sand slurry of one part cement, one part sand mix before application of plaster.

- d) Application should not be undertaken if work is exposed to dry hot winds, where temperature is above 32 C (90 F), in the shade, and relative humidity is below 50%. Extreme caution should be taken to avoid rapid setting of mixture and resultant shrinkage cracks. Refrain from excessive trowelling.
 - e) Do not apply coatings when temperature is below 4 C (39 F) or for at least 4 to 6 days following, to ensure that conditions will permit the curing treatment specified.
2. Discrepancies:
- a) In the event of discrepancy, immediately notify Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

195.2 WORKMANSHIP

1. Proportioning and mixing:
- a) Measurement of materials by volume shall be of known capacity to maintain consistent proportions. No lumpy or cracked material shall be used. Mixing equipment, boxes and tools shall be clean. Materials shall be proportioned as specified or as directed by the Engineer. Mixing shall be continuous until complete and ingredients are evenly distributed.
 - b) Only limited water shall be used for proper workability. Mortar shall be consumed within thirty minutes of mixing. Retempering will not be permitted. Mortar which has begun to stiffen shall be discarded.
 - c) Plaster ingredients shall be thoroughly mixed by hand on a clean platform or by mechanical mixer.
2. Expanded metal lath:
- a) Before plastering, wherever reinforced concrete meets block masonry at a flush condition, install 12 ins wide continuous strip of expanded metal lath, attached with galvanised nails, to both surfaces, covering joint completely, to prevent cracking.
3. Control joints:
- a) Strike 'V' depressions, where required to create controlled crack lines in finish.
 - b) Install plaster stops in ceilings to end plaster material or to create control joints.
4. Accessories:
- Use galvanised wire dowel pushed into hollow of bead to maintain true alignment at splices.
5. Internal plasterwork:
- a) Where indicated on Drawings or Schedules provide trowelled finish plaster with galvanized iron Corner Beads as per latest B.S. specification. Corner Beads will be provided to columns, wall ends, openings and joints etc. for protection of plaster work.
 - b) Installation of Ceiling Suspension Hanger wires:
 - i) Attach to hanger inserts in concrete.

- ii) Space hangers 48 ins o.c. and within 3 ins of perimeter walls. Double up hanger wire or decrease spacing of hangers at light fixtures or where additional loads are located.
- iii) Locate hangers within 3 ins of ends of main runner channels.

Main runner channels:

- i) Spacing: 48 ins o.c. or as noted otherwise on the Drawings.
- ii) Locate within 6 ins of parallel walls.
- iii) Splicing: overlap ends a minimum of 12 ins, interlock flanges, secure splice near end of each channel with tie wire.
- iv) Channels shall not be restrained by perimeter wall.

Cross furring - 3/4 in. channels:

- i) Space 16 ins o.c., wire tie to main runner channels.
 - ii) Furrings shall not be restrained by perimeter wall.
- c) Metal lath installation:
- i) Install with long dimension running perpendicular to furring channels and other supports.
 - ii) Tie to 3/4 in. furring channels with single strand of wire, spacing ties not more than 6 ins o.c. on each channel or other support.
 - iii) Lap lath with 1 ins laps. Side laps shall be tied @ 9 ins o.c.

d) Application of material:

- i) Plaster mix shall comprise of one part Portland cement and four parts sand.
- ii) Total thickness shall not be less than 1/2 in. over concrete and masonry surfaces, and 3/4 in. over metal lath backing.
- iii) Plaster shall be applied with sufficient material and pressure to form a good bond or key. Application shall be a minimum of two coats unless directed otherwise by Engineer. Surface of the first shall be scratched before second coat applied
- iv) Plaster shall be plumb, free of voids, finished smooth, with a steel trowel or finished textured with wood trowel as indicated on Schedules and Drawings, and to Engineers approval. Edges and corners shall be straight.
- v) Variation of colour and or texture on a wall will be the sole cause for rejection of entire wall by Engineer.
- vi) Work shall be cured using sprayed water for a minimum of 8 days. The ring/watering of plastered surface shall start immediately after the surface is set i.e. 4-5 hours from the time of finishing, depending upon the temperature and wind condition.

d) Tolerances:

Deviations exceeding 1/8 in. under a straight edge 10 ft. applied in all directions will not be accepted for cement plaster surfaces.

5. External plasterwork:

- a) Base coat to be one part Portland cement and five parts sand, minimum thickness of 1/2 in. Apply with sufficient pressure to completely embed. Trowel and cross scratch in horizontal direction. Ensure that base coat completely embeds expanded metal lath where applied.
- b) Maintain continuous moist for 8 days. Allow surface to dry after curing, to develop proper adherence, before applying second coat.
- c) Finish coat to be cement, sand, colour pigment and marble powder in such proportions as approved by Engineer. Moisten base coat 2 hours before application of finish coat.

- d) Tolerances shall be as described for internal plasterwork.
- 6. Plasterwork to underground water tank and swimming pool shall be as follows:
 - a) Install as per pertinent data for External Plasterwork.
 - b) Finish to be with a smooth trowel.
 - c) Apply 3/4" thickness to walls and 1 1/2" thickness to floors of water tanks (if required) and pools.
 - d) Waterproofing to be applied in accordance with manufacturer's instructions.
 - e) Colour pigment and marble powder not required for these items.

195.3 CLEANING UP

1. General:

Prevent the accumulation of scraps and debris arising from the Work of this Section. Maintain premises in a neat and orderly condition at all times. In the event of spilling or splashing material onto other surfaces, immediately remove the same and traces of residue to the approval of Engineer.

GENERAL FOR “TILING”

196.0 DESCRIPTION

1. Work included:

Ceramic tiles required for this Work are indicated on the Drawings and includes, but are not necessarily limited to, decorative applications to walls and general wall and floor finishing.

196.1 QUALITY ASSURANCE

1. Qualifications of installers:

- a) For cutting, installing, and grouting of tile, use only thoroughly trained and experienced tile setters who are completely familiar with the requirements of this Work.
- b) In acceptance or rejection of installed tiling, no allowance will be made for lack of skill on the part of tile setters.

196.2 SUBMITTALS

Samples:

1. Within 120 days after award of Contract, and before any tiles are delivered to the Job Site, submit to the Engineer in accordance with the provisions of these Specifications three Samples of available colors and patterns of tiles in the specified groups, from the manufacturer selected.
2. Grade Certificates:
Prior to opening tile containers, submit to Engineer a Grade Certificate, signed by an officer of the firm manufacturing the tiles used, and issued when the shipment was expedited, stating the grade, types of tiles, identification marks for tile containers, and name and location of the Project.

196.3 PRODUCT HANDLING

1. Delivery and storage:

- a) Deliver materials of this Section to the Job Site in their original unopened containers with all labels intact and legible at time of use.
- b) Store materials under cover to prevent damage and contamination. Store only the specified materials at the Job Site.

2. Protection:

Protect tile materials before, during, and after installation and protect installed work and materials of other trades.

3. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

197.0 PRODUCTS

197.1 WALL TILE

1. Vitreous clay ceramic tiles for wall installation shall have cushion edge, impervious

porcelain and highly glazed surface. Colors shall be as approved by Engineer and shall include trimmers, corner pieces, bullnose and other special shapes indicated or required. Wall tiles shall comply with B.S. 1281 and be free from flaws, cracks and crazing. Acquire reputable products from local manufacturer. Approval of the manufacturer does not relieve the Contractor to carry-out his own checking to ensure that only the best quality tiles are used and all defective tiles are rejected and removed from site immediately.

2. Glazed ceramic toilet tissue holder build-in unit, in color matching the ceramic tile, where indicated on the Drawings.
3. Subject to compliance with requirements, provide products of one of the following manufacturer.
 - a) National Tiles.
 - b) Karam ceramics, Karachi, Pakistan.
 - c) Forte Tiles, Karachi, Pakistan.
 - d) EMCO Industries, Lahore, Pakistan.

197.2 FLOOR TILE

1. Vitreous clay ceramic tiles for floor installation shall have square edges and impervious semi glazed, non slip surface. Floor tiles shall comply with B.S. 1286-1974 and be free from flaws, cracks and crazing.
2. Subject to compliance with requirements, provide products of one of the following manufacturer.
 - a) National Floor Tiles.
 - b) Karam ceramics, Karachi, Pakistan.
 - c) Forte Tiles, Karachi, Pakistan.
 - d) EMCO Industries, Lahore, Pakistan.

197.3 CEMENT

1. Grey and white Portland Cement. Conform to BS 12.

197.4 GROUT

1. Type:
Tile grout shall be waterproof neat white Portland cement subject to approval of Engineer. Use epoxy type grout for floor tiles as recommended by tile manufacturer.
2. Colour:
Add coloring agent to permanently tint grout to match the tile against which it is placed. Coloring pigment to conform to B.S1014. Use first quality, high purity mineral pigment, finely ground, sun-proof, lime-proof and with a specific gravity similar to Portland cement.

197.5 WATER

1. Water to be potable, clean, free from deleterious amount of oils, salts, alkali, organic matter and other harmful materials. Conform to B.S. 3148.

197.6 SAND

1. Sand shall be clean, sharp, durable bank sand, free from silt, loam, clay, soluble salts and/or vegetable matter. Comply to BS 812, 882 and 1199 or refer structural

specification.

197.7 LIME

1. Quicklime conforming to B.S. 890, slaked on site.

197.8 ACCESSORIES

1. Glazed ceramic soap dish build-in unit: refer to Section on, Toilet and Bath Accessories and Schedule.
2. Glazed ceramic toilet tissue holder build-in unit: refer to Section on, Toilet and Bath Accessories and Schedule.
3. Tile setting adhesive plaster: type as recommended by tile manufacturer. Use epoxy additive for floor tiles.

197.9 OTHER MATERIALS

1. Materials and methods not specifically described but required proper tile installation, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

198.0 EXECUTION

198.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - b) Verify that tiles may be installed in accordance with the original design, pertinent codes and regulations, and referenced Standards.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

198.2 ENVIRONMENTAL CONDITIONS

1. Maintain minimum 13 C (55 F) air temperature at tile installation area for 24 hours prior to, during and after installation.
2. Areas in which tile work is being carried out shall be closed to traffic until the installation has set or for a minimum period of 72 hours.
3. Ceramic tiles shall be soaked in clean water 24 hours before laying

198.3 INSTALLATION

1. Install tiles to manufacturer's instructions and as indicated on Drawings. Installation shall be in accordance with BS 5385 Part 1, and tile manufacturer's instructions.
2. General Wall Tiling:
 - a) Scratch coat plaster base mix shall be one (1) part Portland Cement, four parts damp sand by volume. Apply mix with sufficient pressure and thickness to completely coat the surface. Where additional thickness build-up is required to conform to indicated lines, apply as separate coats. Floor and wall surfaces to receive the tiles shall be thoroughly cleaned of all dirt, dust and oil and other objectionable matters.
 - b) Apply tile setting adhesive plaster as recommended by tile manufacturer.
 - c) Fit tile around corners, fixtures, drains and other built-in objects to maintain uniform joint appearance. Cut edges smooth, even and free from chipping. Edges resulting from splitting will be rejected.
 - d) Make joints between tile uniform and approximately 1/16 in. (1.5 mm) wide, plumb, straight, true, even and with adjacent tile flush. Where tiles are applied in sheets, ensure sheet layout is not visible after installation. Align joints vertically and horizontally.
 - e) Lay out units so perimeter tiles are minimum 1/2 size.
 - f) Sound tiles after setting and replace hollow-sounding units to obtain full bond.
 - g) Make internal angles square, external angles bullnosed or mitred. Use bullnose edged tiles for bullnosed effect.
 - h) Use bullnose edged tiles or mitred at termination of tile panels except where panel butts projecting surface or differing plane.
 - j) Grouting:
 - i) Allow minimum 24 hours after installation of tile, before grouting.
 - ii) Grout cement to be mixed with dry cement colour as directed by the Engineer.
 - iii) Mix grout to a creamy consistency in accordance with manufacturer's directions.
 - iv) Force maximum grout into joints with trowel before it sets. Strike or tool joints to base of cushion and fill gaps. Do not permit setting bed material to show through grout joints. Cure joints by sponging down with water for three days.
 - v) Use epoxy grout in rooms scheduled to receive similar grouting to floors.
 - k) Keep building expansion joints free of mortar or grout.
3. Floor Tiling:
 - a) Install tile in accordance with pertinent descriptions for wall tile.
 - b) Apply cement/sand bed to 1:6 proportion to a minimum of 1/2 in (12mm) thickness. Apply epoxy tile setting adhesive plaster as recommended by tile manufacturer. Grout joints with epoxy cement.
4. Decorative Tiling:
 - a) Install as per pertinent description for General Wall Tiling except as described here.
 - b) Tiles shall be set flush with adjoining plaster to layout shown on Drawings.
 - c) No tiles shall be cut.
5. Grout shall be tinted as approved by Engineer, to match color of tile surfaces.

198.4 TOLERANCES

1. Maximum variation shall not exceed 1/8 in. in 10 ft. (3 mm in 3 m)

198.5 CLEANING & PROTECTION

1. Upon completion of tile installation and grouting, and after ceramic tile has thoroughly set, sponge and wash tile thoroughly and diagonally across joints. Remove surface cement. Prevent damage to tiles and adjacent materials. Do not use acid cleaners. Finally, polish with clean, dry cloths.
2. Protect tile after cleaning with non-staining heavy Kraft paper or other approved coverage until acceptance of the building.

GENERAL FOR "ACOUSTICAL TREATMENT"

199.0 DESCRIPTION

1. Work included:

Work of this Section includes the supply and installation of metal tile ceiling materials and accessories to areas indicated on the Drawings and Bill of Quantities. For any specified ceiling system such as "DAMPA" etc. The complete system will be as per manufacturers specification.

199.1 QUALITY ASSURANCE

1. Qualifications of installers:

- a) For installation of ceilings, use only thoroughly trained and experienced installers who are completely familiar with the requirements of this Work and approved by the manufacturer.
- b) In acceptance or rejection of installed materials, no allowance will be made for lack of skill on the part of workmen.

199.2 SUBMITTALS

1. Samples:

Within 120 days after award of Contract, and before any material for this work is delivered to the Job Site, submit to the Engineer, in accordance with the provisions of these Specifications, mock-ups of the proposed ceiling finish and accessories, etc.

199.3 PRODUCT HANDLING

1. Delivery and storage:

- a) Deliver materials of this Section to the Job Site in their original unopened containers with labels intact and legible at time of use.
- b) Store materials under cover to prevent damage and contamination. Store only the specified materials at the Job Site.

2. Protection:

Protect materials of this Section before and during installation and protect installed work and materials of other trades.

3. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

200.0 PRODUCTS

200.1 TILES

1. Metal Clad Ceilings as per "DAMPA" AL - 15 system.

Tiles for other application shall have the following characteristics:

- a) Tile: Roll formed electro-galvanized mild steel perforated flat sheet with 1/16 in. diameter holes equally spaced, giving a total of 25% open area. Leave an unperforated border of 1 in. around perimeter of panel phase.
- b) Sound absorption pad: 1 in. fibreboard of 22 lbs per cu. ft. (350 Kg/m³)

approximate density, conforming to B.S. 1142 Part 3. Pad shall be adhered to metal tile at perimeter only. Do not permit adhesive to block tile perforations.

- c) Size: as shown on the drawings.
- d) Finish: Factory applied synthetic alkyd stoving primer and stoving enamel. Paint shall be washable and white. Use I.C.I. manufacture or equal.

200.2 SUSPENSION SYSTEM

1. Suspension system as per "DAMPA" specification. Grid for mounting tiles for other system shall be electro-galvanized cold rolled steel, factory finished enamel white 'T' sections, for lay-in type tiles, in a 12 in by 24 in. (300 mm X 600 mm) configuration.
 - a) Main tees shall be from point 0.030 in. thick material with pre punched openings to receive cross tees. They shall be double web design 1-1/2 ins deep with rectangular bead and integral reversible splice. Exposed flange shall be 13/16 in. with rolled-on prefinished cap. Holes for cross tees at 6 ins.centres and holes for hanger wire at 2 ins. centres.
 - b) Cross tees shall be from .025 ins thick material. They shall be of similar design to main tees except that web shall be extended to form a positive interlock at main tee holes. Lower flange extended and offset to provide a flush level intersection.
 - c) Wall moulding shall be from same material as main tees but formed into an angle 1 in. high by 3/4 in. with rolled seams at edges.
 - d) Use 8 gauge annealed steel wire hangers galvanised to B.S. 443 with approved fastenings at structure.
 - e) Total weight per square foot of tile and grid, and complete design of ceiling to be approved under procedure of submittal.
2. Materials and methods not specifically described, but required for proper fabrication and installation of ceilings shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

201.0 EXECUTION

201.1 SURFACE CONDITIONS

1. Coordination:

Coordinate with other trades to ensure provision in grid for installation of items mounted to, or passing through tiles, in the locations required.
2. Inspection:
 - a) Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence. Wetwork shall be completed and dry.
 - b) Verify that the material to be installed may be completed in strict accordance with the original design to the approval of Engineer.
3. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

201.2 MATERIAL AND INSTALLATION

1. Supply and installation of DAMPA AL-15 Lay-in tile acoustic ceiling size 600 x 600 mm perforated 0.7 mm thick aluminium chromated and stove enamelled in polyester white finish No. 3000. Tile shall be perforated with 1.8 mm holes at 45° pattern with 20.5% free area. The units shall be provided with a factory applied high sound absorption acoustic felt in black colour. The suspension system shall be exposed grid inverted aluminium tee with black anodised finish (or white stove enamelled finish) and edge trims in matching colour. Suspension shall be made by means of adjustable suspenders of 8 SEG galvanised steel wire and cadmium plated spring clips supported at 4'-0" centre to centre. The suspenders shall be fixed to the slab/beam soffit with nylon anchors 1-1/2" x 12 No. round head steel screws and washers.

201.3 TOLERANCES

1. Deflection of suspension system components inclusive of all attachments and panels shall not exceed 1/360th of the span.
2. Allowable tolerance of finished ceiling to be level within 1/8 in. in 12 feet.

201.4 CLEANING A PROTECTION

1. Prevent the accumulation of scraps and debris arising from the Work of this Section.
2. Installed ceiling panels shall be adequately protected from dust, dirt, paint and other extraneous materials.
3. Prevent disfigurement and immediately prior to hand-over of building, thoroughly polish and/or clean.

GENERAL FOR “MARBLE & TERRAZZO”

202.0 DESCRIPTION

1. Work included:
 - a) Marble and terrazo required for this Work is indicated on Drawings and Schedules, and includes flooring, steps, sills, pool edges, counter tops, wall finishing, but not necessarily limited to same.
2. Related work:
 - a) Adjacent plastering to Marble, refer to Section 9200 External and Internal Plasterwork.
 - b) Caulking work for joining materials of this Section and dissimilar adjacent materials is described in Section for Sealants, 7900

202.1 QUALITY ASSURANCE

1. Qualifications of workmen:
 - a) For installation, use only skilled tile setters who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.
 - b) In acceptance or rejection of installed material no allowance will be made for lack of skill on the part of workmen.
 - c) Provide one skilled supervisor who shall be present at all times during execution of the work of this Section and personally direct the execution of this portion of the Work.

202.2 SUBMITTALS

1. Samples:
 - a) Within 120 days after award of Contract and before any material is delivered to the Job Site, submit three samples of proposed material to the Engineer for his approval.
 - b) Samples should include each colour, type and pattern proposed for use on the project. Samples shall illustrate the limit of extremes in colouring.
 - c) Installed material must conform to accepted samples.
 - d) No material shall be worked upon until the Shop Drawings have been approved by Engineer.
2. Shop Drawings:
 - a) Contractor shall prepare Shop Drawings showing details of bases (skirtings), bedding, bonding, anchoring and jointing of the work, including typical and special anchoring. Dimensions and numbers of pieces shall be indicated on Drawings submitted to the Engineer. Work only from approved Shop Drawings. Shop drawings to confirm and reflect as built site conditions.
 - b) Obtain and verify cut-out dimensions in marble slab counter tops, from Engineer before submitting Shop Drawings.

202.3 PRODUCT HANDLING

1. Transportation and handling:
 - a) Finished material shall be carefully loaded for transportation using

reasonable and customary precautions against damage in transit. No material which would cause staining shall be used for blocking.

- b) Stack material at the Job Site on timber or platforms at least 4 ins above ground. Prevent staining during the storage period.
- c) Protection:
Protect material before, during and after installation and protect installed work and materials of other trades.

2. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

203.0 MATERIALS

203.1 MARBLE

1. Physical Requirements:

- a) Marble shall be sound, free from spalls, cracks, open seams, pits, or other defects that would impair its strength, durability, or appearance. Marble shall be uniform in tone and color as approved by Engineer.
- b) Incised marble shall be one piece slabs, with open veins and crevices filled with compatible cement. Finished surface shall be polished flush. Grade of marble and percentage of incisions shall be controlled by submittal selection.

2. Marble Types:

- i) These shall conform to Color Schedule provided by Consultant.
- ii) Marble to all areas shall be priced on the basis of using Mallagory type, Type A or Best Grade.
- iii) Contractor shall submit current prices of various types of marble available as required by Engineer, for the purposes of adjustment of Contract under this Article.

3. Marble Sizes:

- i) Large tiles, 12 ins by 12 ins (300mm x 300mm) to 24 ins by 24 ins. (600mm x 600mm). Floors, 3/4 in. (18~19mm) thick, shaped and dimensioned to conform to patterns shown on Drawings.
- ii) Small tiles, 8 ins by 8 ins.(200mm x 200mm), berelled edges.
Floors and walls: 3/8 in. (9mm) thick, shaped and dimensioned to conform with patterns shown on Drawings.
- iii) Marble saddles and thresholds shall be sized as indicated on Drawings.
- iv) Counter tops and aprons shall be in one piece. Cut shapes as shown on drawings. Expose edges radiused
- v) Special Shapes: Shown on Drawings, sufficient thickness to prevent marble cracking from superimposed loads and dimensioned so that joints will align with those of adjacent marble surfaces where applicable.

4. Marble Finishes:

Floors and walls in lobbies and counter tops to be highly polished. Floor and walls in other interior and exterior conditions to be moderately polished.

203.2 PRECAST TERRAZZO

1. a) Tiles:
Precast terrazzo tiles shall be of reputable manufacture. Size of tiles to be 12" x 12" x 3/4" (300 x 300x 19mm) with a terrazzo topping of min. 3/8 ins.(9mm). Grey/white cement and sand mix to be used in tile base construction. Tile topping shall be comprised of Malagori marble chips up to No. 4 size, white cement and color pigment.
- b) Skirting:
Precast terrazzo to be same as width of tile, or as elevation or cross section shown on Drawings. Construction similar to pertinent data for tiles.
- c) Curing:
Tiles and skirting shall be cured to proper hardness and exposed surfaces ground smooth and polished.
- d) Finishes:
Tiles and skirting to be grounded and highly polished.

203.3 SETTING MATERIALS

1. Mortar bed:
Apply cement/lime/sand bed mixed with water to 1:2:6 proportion to a min. of 1/2 in. (12 mm) thickness. Apply epoxy tile setting adhesive plaster as recommended by the tile manufacturer. Grout joints with epoxy cement.
2. Holes and anchors:
 - a) Anchors for marble shall be stainless steel sized to support loads to be carried. Tying of anchors shall be in dovetail inserts cast into concrete or engaged in joints of masonry.
 - b) Holes required for anchors, cramps and dowels shall be cut in accordance with approved Shop Drawings.

203.4 OTHER MATERIALS AND ACCESSORIES

1. Grout to be compatible, non-staining, white, unless otherwise indicated or approved. Colouring agent to be added to permanently tint grout where applicable. Procure grout type for terrazzo from supplier of tiles. Waterproofing admixtures or epoxy based grouting shall be used for jointing and grouting exterior marblework.
2. Aluminium and brass edge strips 1/4 in.(16 mm) thick including anchors to same.
3. Fillers, where required, to match approved samples.
4. Sealers to be used only with approval of Engineer.
5. Waterproof membrane under screed mortar bed in areas where a floor drain occurs as shown on Mechanical or Architectural Drawings. Refer to Section on Damproofing.
6. Caulking shall be as described in Section on Sealants.
7. Glazed ceramic soap dish build-in unit: refer to Section on Toilet and Bath Accessories and Schedule.
8. Glazed ceramic toilet tissue holder build-in unit: refer to Section on Toilet and Bath Accessories and Schedule.
9. Materials and methods not specifically described but required for proper fabrication and installation of materials in this Section, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

204.0 EXECUTION

204.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to Work of this Section, carefully inspect the area is complete to the point where this installation may properly commence.
 - b) Verify that material may be installed in accordance with the original design.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify Engineer.

204.2 INSTALLATION

1. General:

Install unit materials as indicated on Drawings and in accordance with tile manufacturer's instructions.
2. After approval of Shop Drawings, material shall be cut to provide sizes required in a panel from the same set of raw slabs. Severe differentiation between stones within a panel will not be acceptable.
3. Panels shall be laid out prior to installation for Engineer to inspect and verify the acceptability of grain and/or colour. Unacceptable units shall be replaced or relocated, at no additional cost to Employer.
4. Waterproof Membrane:

To be installed under Section on water proofing.
5. Precast Terrazzo:

Lay solid wet sand and lime bed in proportions by volume of 1:6 to depressed depth required by thickness of tile. Apply a cement slurry adhesion coat to bed. Set and tamp tiles immediately following, with butted joints. Joints shall be grouted with white cement and pigment in same proportions as topping of tiles.
6. Marble:
 - a) Floors:

Cement/lime/sand setting bed to be 1:2:6 proportion laid to a min. of 1/2 in. thickness. Apply tile setting adhesive plaster as recommended by tile manufacturer. Joints to be grouted with cement and pigment 1/16" width, pattern as shown on Drawings.
 - b) Walls:
 - i) Install tiles in accordance with pertinent parts of Section on Ceramic Tiling. Joints to be grouted with cement and pigment 1/16 in. (1.5mm) width, pattern as shown on Drawings.
 - ii) Install anchoring to vertical marble slabs in accordance with Shop Drawings. Joints shall be grouted similar to tile work conform to pertinent data of BS CP 298.
 - c) Exterior stone facing shall have waterproof bedding, jointing and grouting. Waterproofing agents shall be added in accordance with manufacturer's instructions. Admixtures shall not exceed 10 per cent of cement content.
 - d) Counter to bathrooms and washrooms shall have waterproof tile jointing.
 - e) Caulking shall be as described in Section on Sealants and as shown on Drawings.
7. Grout shall be tinted as approved by Engineer, to match color of pre-cast terrazzo and marble surfaces.

8. a) Where material of this Section adjoins dissimilar flooring material, and where no other transition material is specified, install edge strips. At door location set strips to align with face of door. Use brass with marble and aluminum with terrazzo.
- b) Set edge strips straight, true to line and properly anchored so that on completion of grinding tops of strips and floor surface are flush.

204.3 TOLERANCES

1. A tolerance of no more than 1/32 in. (0.75mm) shall be acceptable in lengths and widths of individual slabs. Thicknesses shall be within 1/16 in. (1.5 mm) from those shown on Drawings except where it is exposed. Maximum variation shall not exceed 1/8 in. in 10 feet (3mm in 3m).

204.4 CURING

1. Installed terrazzo and marble surfaces shall be cured for a minimum of 7 days.

204.5 GRINDING AND POLISHING

1. Following curing, marble and terrazzo tile surfaces shall be machine ground twice to attain smooth and level finish.
2. Wash down with clean water, dry and apply 'chemical' polish to surfaces with approved sealer, to the entire satisfaction of the Engineer.

204.6 INSPECTION AND CLEANING UP

1. Inspection:
Upon completion of the Work of this Section, make a thorough inspection and verify that units and joints have been installed in accordance with the provisions of this Section, Contractor shall make adjustments or replacements at his own expense as directed by Engineer.
2. Cleaning and Protection:
 - a) Installed material shall be adequately protected from discolouration and disfigurement. Prior to hand-over of building clean surfaces of dust and residue.
 - b) Upon completion of Work to this Section, promptly remove from the Job Site broken units, debris arising from the Work, tools and equipment and leave areas in a neat and orderly condition to the approval of Engineer.

205.0 MEASUREMENT AND PAYMENT

Except otherwise specified herein or else wherein the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items or 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.

Supply of all types of Marble, Terrazzo or Cement tiles, Grinding, washing, polishing acid washing and finishing of tiles.

Pigments used for making of tiles or grouting material.

Adhesive for fixing vinyl tiles and flooring.

Setting base and screeding for tiles.

Preparation of concrete surfaces for laying tiles.

Cement concrete base.
Sealants, caulking, and grouting materials
Brass, Aluminum or glass strips.

205.1 WASTAGE OF MATERIAL

Measurement of acceptable completed works of finished floor and skirting will be made on the basis of net actual area in square metre laid in position as shown on the drawings or as directed by the Engineer. Exposed edges of tiles or marble will not be included in the measurements.

Payment will be made for acceptable measured quantity of finished floor and skirting on the basis of unit rate per square metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the items.

GENERAL FOR “CONCRETE FLOOR TOPPING”

206.0 DESCRIPTION

1. Work included:

Work of this Section includes the supply and installation of granolithic or concrete topping material on interior floor slabs, providing a final finish or left ready to receive a second material, as indicated on Drawings and Schedules.

206.1 QUALITY ASSURANCE

1. Qualifications of installers:

- a) For application of toppings, use only thoroughly trained and experienced cement finishers who are completely familiar with the requirements of this Work and the recommendations contained in the referenced Standards.
- b) In acceptance or rejection of installed materials, no allowance will be made for lack of skill on the part of workmen.

206.2 PRODUCT HANDLING

1. Delivery and storage:

- a) Deliver materials of this Section to the Job Site in their original unopened containers with labels intact and legible at time of use. Where material is delivered loose, store as directed by Engineer.
- b) Store materials under cover to prevent damage and contamination. Store only the specified materials at the Job Site.

2. Protection:

Protect materials of this Section before, during, and after installation and protect installed work and materials of other trades.

3. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to the Employer.

207.0 PRODUCTS

207.1 MATERIALS AND EQUIPMENT

1. Portland Cement conforming to B.S. 12 or ASTM C-150.
2. Sand: Clean sharp, angular, free from alkali, silt or organic matter, to conforming to B.S. 1198-1200 Alternatively hard aggregate conforming to B.S. 882, 1201 passing 200 mesh sieve.
3. Water: Potable, clean, free from deleterious amount of oils, salts, alkalis, organic matter and other harmful materials conforming to B.S. 3148.
4. Coarse aggregate:
 - a) Granolithic topping: hard angular stone chips conforming to B.S. 882, 1201, approved by Engineer. Aggregate size to be 1/4 in. to 1/2 in. and free from dust.
 - b) Concrete topping: well graded natural gravel, crushed gravel or crushed stone conforming to B.S. 882 and 1201. Aggregate size to be 1/2 in. to 1/4 in. and free from dust.

5. Concrete floor hardener to be of approved quality and manufacturer.
6. Silicate of Soda dust retarder, proprietary brand approved by Engineer.
7. Materials and workmanship for floor toppings not explained in these specifications shall comply with the requirements of BS CP 204.
8. Circular trowelling machines

207.2 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper fabrication and installation of floor toppings, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

208.0 EXECUTION

208.1 SURFACE CONDITIONS

1. Inspection:
 - a) Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
2. Discrepancies:
 - a) In the event of discrepancy, immediately notify the Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.
3. Surface treatment:
 - a) Concrete slabs to receive concrete topping shall be cleaned to remove grease, form oil and other impurities which will otherwise adversely affect the adhesion of the topping to the surface. Surface of concrete if so required by Engineer, shall be hacked by approved means to give the required key for topping.
 - b) Surfaces shall be washed with clean water and kept damp for 2 hours before further treatment. Surfaces thus prepared shall be treated uniformly with a cement and sand slurry of one part cement, one part sand mix brushed on immediately before application of topping.
 - c) Extreme caution should be taken to avoid rapid setting of mixture and resultant shrinkage cracks.

208.2 WORKMANSHIP

1. General:
 - a) Do not apply toppings when temperature is below 4 C (39 F) for atleast 4 to 6 days after application to ensure that conditions will permit the curing treatment specified.
 - b) Do not undertake work if area of application is exposed to dry hot winds.
 - c) Thicknesses of toppings to be as per Drawings.
2. Proportioning and mixing:
 - a) Measurement of materials by volume shall be of known capacity to maintain consistent proportions. No lumpy or cracked material shall be used. Mixing equipment, boxes and tools shall be clean. Materials shall be proportioned as specified or as directed by the Engineer. Mixing shall be continous until ingredients are evenly distributed.

- b) Only limited water shall be used for proper workability. Water cement ratio shall not exceed 0.45. Mortar shall be consumed within thirty minutes of mixing. Retempering will not be permitted. Mortar which has begun to stiffen shall be discarded.
- c) Mix ingredients shall be thoroughly mixed by mechanical mixer.
- d) Mortar mix for concrete topping to be one (1) part cement, two (2) parts sand, and four (4) parts coarse aggregate. Mixing shall be in accordance with B.S. CP 204
- e) Mix for granolithic topping to be one (1) part Portland cement, one (1) part fine aggregate and two (2) parts coarse aggregate. Mix concrete floor hardener with cement in a dry state at ratio of 1:4 by weight. Mixing procedure to be approved by hardener Manufacturer.

3. Concrete toppings:

- a) Where indicated on Drawings or schedules provide trowelled fine finish topping, true to lines and levels shown and left ready to receive finish where applicable.
- b) Apply mix over required areas in alternate strips or bays not exceeding 250 sq. ft. (24 sq. M).
- c) Screeding shall be carried out immediately after placing, spreading and vibrating is complete.
- d) Darbying or bull floating shall be done immediately after screeding and shall remove high spots and fill voids left in the concrete surfaces by screeding.
- e) Mechanical or hand floating shall commence after bleed water has evaporated and concrete has stiffened sufficiently to prevent the working of excess mix to the surface. Floating shall be terminated when the coarse aggregate is firmly embedded below a thin layer of mortar and has produced a surface of uniform texture.
No cement or mixture shall be applied to the surface for hardening.
- f) When concrete is sufficiently hard the surface shall be given a steel trowelled finish. The surface shall be dense hard and smooth, and free from blemishes.
- g) Topping shall be cured for a minimum of 7 days after finishing. Use plastic sheeting, building paper or hessian.
- h) Screenshot battens shall be removed after 24 hours and nonabsorbent paper placed against exposed edge and folded over finish.

4. Granolithic Toppings:

- a) The concrete floor slab shall be poured, screeded and consolidated to within 3/4 in.(18 mm) of the final finished floor level.
- b) After bleed water has disappeared and surface will support workmen without appreciable indentation, the topping mixture shall be spread, compacted, floated, finished and cured as described for Concrete Toppings.
- c) Install coved bases integral with the floor and with 3/4 in. radius, as shown on Drawings and Schedules.
- d) Granolithic floor areas are required to have a dust free finish. After the floor is dry apply with a single application of 10 per cent solution of silicate of soda, in accordance with manufacturer's instructions or as directed by Engineer. Finish floor with machine applied chemical polish as directed by the Engineer.

- e) Stair treads shall have a non-slip finish.

208.3 TOLERANCES

1. Deviations exceeding 1/8 in. under a 10 ft. straight edge applied in all directions will not be accepted.

208.4 CLEANING UP

1. General:

Prevent accumulation of scraps and debris arising from the work of this Section. Maintain premises in a neat and orderly condition at all times. In the event of spilling or splashing material onto other surfaces immediately remove the same, and traces of residue, to the approval of Engineer.

GENERAL FOR "PAINTING WORK"

209.0 DESCRIPTION

1. Work included:
 - a) The types of material and surfaces to be treated are listed in "Schedule of Finishes" attached as part of these Specifications. Read this section in conjunction with Drawings and Schedules.
 - b) Included also in this Section are painted murals in Public Spaces as shown on Drawings.
2. Definitions:

The term "paint", used here, includes enamels, sealers, stains, fillers, emulsions, and other coatings whether used as prime, intermediate, or finish coats.

209.1 QUALITY ASSURANCE

1. Qualifications of painters:

Use only qualified painters for the mixing and application of paint. In the acceptance or rejection of installed painting, no allowance will be made for lack of skill on the part of painters.

209.2 SUBMITTALS

1. Materials list:
 - a) Within 120 days after award of Contract, and before any paint materials are delivered to the Job Site, submit to the Engineer a list of materials to be furnished and installed under this portion of the Work.
2. Samples:
 - a) Accompanying the materials list, submit to Engineer two copies of full range of colours available for proposed products.
 - b) Prepare and deliver to Engineer two identical sets of Samples of selected colours painted on 8 ins by 12 ins by 1/4 in. (200mm x 300 x 6mm) thick material. Whenever possible, the material for Samples shall be the same material to which the coating will be applied at the Job Site.
3. Manufacturer's recommendations:

Where material proposed is not the same as specified or specifically described as an acceptable alternate in this Section, submit for Engineer's review the current recommended method of application published by the manufacturer.

209.3 PRODUCT HANDLING

1. Delivery:

Deliver materials to the Job Site in original unopened containers with labels intact and legible at time of use.
2. Protection:
 - a) Store only approved materials at the Job Site, in a designated area restricted to paint materials and related equipment.
 - b) Ensure the safe storage and use of paint materials and prompt, safe disposal of waste.
 - c) Protect paint materials before, during, and after application and protect

installed work and materials of other trades.

3. Replacements:

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

210.0 PRODUCTS

210.1 PAINT MATERIALS

1. Manufacturer:

- a) Materials shall be first grade and meet or exceed minimum standards of reputable manufacturers, subject to approval of Engineer.
- b) Paint material selected for each type of surface shall be the product of a single manufacturer.
- c) Subject to compliance with requirements provide products of one of the following manufacturer
 - i) ICI Pkistan
 - ii) Berger, Pakistan

2. Compatibility:

- a) Paint materials and equipment shall be compatible in use: finish coats shall be compatible with prime coats; prime coats shall be compatible with the surface to be coated; tools and equipment shall be compatible with the coating to be applied.
- b) Thinners, when used, shall be only those thinners recommended for that purpose by the manufacturer of the material to be thinned.

210.2 COLOURS

1. Colors of approved manufacturer shall match those included in the color and sample set.
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. Where a 'two color' or tint combination may be selected or approved for the treatment of any particular surface in any space or room, no additional payment shall be made to the contractor in any instance
3. Primers shall be tinted where deep tone accent colors are used.

210.3 OTHER MATERIALS

1. Materials and methods not specifically described but required for proper installation of paint material, shall be provided by Contractor subject to prior approval of Engineer, at no additional cost to Employer.

211.0 EXECUTION

211.1 SURFACE CONDITIONS

1. Inspection:

- a) Prior to Work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

- b) Verify that paint finishes may be applied in strict accordance with manufacturer's recommendations and requirements of these Specifications.
2. Discrepancies:
- a) In the event of discrepancy, immediately notify Engineer.
 - b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

211.2 PREPARATION OF SURFACES, GENERAL

1. Protection:
- a) Prior to surface preparation and painting operations, completely mask, remove, or otherwise adequately protect hardware, accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces but not scheduled to receive paint.
 - b) Surfaces shall be prepared in accordance with paint manufacturer's recommendations.
 - c) Clean and remove foreign materials. Smooth out rough spots. Remove rust from metal surfaces with wire brush. Dust-off and remove all oil and grease stains with penetrating type solvent.
 - d) Fill and sand smooth nail holes and similar imperfections, after prime coat.
 - e) Fill and smooth, before painting, hair cracks and minor defects in plaster, interior only.
 - f) Wood work that is to have a finish treatment, whether executed as field work or shop finished, shall be smooth and free from raised grain or other surface imperfections that affect its appearance and shall be lightly sanded or steel woolled during finishing operations.
After filler has been applied, if required all nail holes or other similar blemishes shall be carefully stopped with linseed oil putty.
2. Precautions:
- a) Do not apply any putty on exterior surfaces, bathrooms, kitchens and places where the moisture content in the air may be high.
 - b) Do not paint plaster for at least two months after its installation.
3. Priming:
- a) Spot prime exposed nails and other metals to receive enamel paints, using a primer recommended by the manufacturer.
 - b) Apply rust inhibitive primer paint to ferrous metal surfaces.
 - c) Refer to Sections 5.1 Miscellaneous Metal and 5.2 Ornamental Metal for shop priming of items in these sections of Division 5.
4. Cleaning:
- a) Before applying paint or other surface treatment, thoroughly clean surfaces involved.
 - b) Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - c) Prior to start of any work the Contractor shall, as a part of his contract, carefully inspect all surfaces to be painted or finished and notify the Engineer in writing of any defective workmanship, materials, or any other conditions, which, in his opinion, will affect the satisfactory execution and/or performance of his work.
No work in this section shall be initiated until all such surfaces or

conditions have been corrected; the absence of any such notification will be construed as an acceptance by the Contractor of all such surfaces and later claims of defects in these surfaces that may result in finished surfaces being unsatisfactory to the Engineer will not in any way relieve the contractor from the responsibility and/or accountability under his guarantee.

- d) No work to be done under the conditions that are unsuitable for the production of good results, nor at any time when the plastering is in progress or is drying, or not dry.
- e) Neither paint nor any other finish treatment is to be applied over wet or damp surfaces unless specifically required, nor shall succeeding coats be applied until the preceding coat is thoroughly dry.

211.3 APPLICATION

- 1. General:
 - a) Paint surfaces as indicated on Drawings and Schedules.
 - b) Paint grills and other pre-finished items where factory pre-finish is not in accordance with Schedules and colour selection.
 - c) Apply transparent finishes and paints in accordance with manufacturer's instructions and as specified herein.
- 2. Drying:
 - a) Allow drying time between coats, as recommended by manufacturer.
- 3. Environmental conditions:
 - a) Comply with the manufacturer's recommendations as to environmental conditions under which paint may be applied.
 - b) Do not apply paint in areas where dust is being generated.
- 4. Defects:

Sand and dust between coats to remove defects visible to the unaided eye from a distance of 5 feet.

211.4 INSPECTION

- 1. General:

Do not apply additional coats until previous coat has been inspected and approved by Engineer.
- 2. Number of coats:

Only inspected and approved coats of paint will be considered in determining the number of coats applied.

211.5 PROTECTION

- 1.
 - a) Place drop cloths to adequately protect finished work.
 - b) Do not paint any finish hardware or other finish item that is already fitted into place.

211.6 PAINT TYPES

- 1. Apply the following finishes to areas or items where designated on Schedules. Type no's are prefixed by the letter 'P' on Schedules.
 - a) Finish type 1 (matt finish for plaster or masonry) 1 coat alkali resisting primer, 3 coats alkyd flat enamel.

- b) Finish type 2 (gloss finish for plaster or masonry) 1 coat alkali resisting primer, 3 coats Alkyd gloss enamel.
- c) Finish type 3 (on interior and exterior wood) 2 coats shellac knotting over knots, cellulose filler to cracks and defects, 1 coat oil based primer, 2 coats alkyd gloss enamel.
- d) Finish type 4 (on shop primed metals) 1 coat of spot primer, 1 coat of alkyd enamel undercoat, 2 coats alkyd gloss enamel.
- e) Finish type 5 (on ferrous metal) 1 coat red lead or zinc chromate primer, 3 coats alkyd gloss enamel.
- f) Finish type 6 (on galvanised and zinc coated metals) 1 coat vinyl wash primer, 1 coat of alkyd enamel undercoat, 2 coats alkyd gloss enamel.
- g) Finish type 7 (special finish on masonry or plaster) 2 coats of Epoxy Concrete Paint by I.C.I.
- h) Finish type 8 (exterior plaster or masonry) 1 coat of alkali resisting primer/sealer, 3 coats of exterior emulsion. Alternatively 3 coats of cement paint.
- j) Finish type 9 (matt finish for plaster or masonry) 1 coat of alkali resisting primer, 2 coats of vinyl or plastic emulsion.

211.7 TRANSPARENT FINISH TYPES

1. Apply the following finishes to wood items designated on Schedules. Type no.'s are prefixed by the letter 'T' on Schedules.
 - a) Finish type 1 (interior and exterior application to Teak, Sheesham, Oak and Pine).
 - i) Exterior: 1 coat of 10 to 15% linseed oil mixed with 80 to 90% mineral spirits. Allow to dry for 2 days. Second coat of 30% linseed oil and 70% mineral spirits.
 - ii) Interior: 1 coat of 6 to 10% of linseed oil mixed with 90 to 94% mineral spirits.
 - b) Finish type 2 (interior application to Deodar wood)
 - i) Tint solution with oil soluble dyes manufactured by I.C.I. or any approved manufacturer. Where lighter wood surfaces are required to match darker speices. Use light fast dyes, where required for interior and exterior works.

211.8 REINSTALLATION OF REMOVED ITEMS

1. Following completion of painting in each space, promptly reinstall items removed for painting, using only workmen skilled in the particular trade.

211.9 CLEANING UP

1. General:
 - a) During progress of the Work, prevent accumulation of empty containers or other items except in areas specifically set aside for that purpose.
 - b) Prevent accidental spilling of paint materials. Remove spilled material immediately and the waste of other equipment used to clean up spill. Wash surfaces to their original undamaged condition, at no additional cost to Employer.

2. Prior to final inspection:

Upon completion of this portion of the Work inspect surfaces and remove paint and traces of paint from surfaces not scheduled to be painted.

GENERAL FOR “SUSPENDED CEILING”

212.0 DESCRIPTION

Work of this section includes the supply and installation of metal Tile, Mineral Fiber & Gypsum board ceiling (plain or moisture proof) and accessories to areas indicated on the Drawings and Bill of quantities. For any specified ceiling system, the complete system will be as per manufacturer’s specification.

212.1 QUALIFICATIONS OF INSTALLERS

- a) For installation of ceilings, use only thoroughly trained and experienced installers who are completely familiar with the requirements of this work.
- b) In case of acceptance or rejection of installed materials, no allowance will be made for lack of skill on the part of workmen.

212.2 SAMPLES

Within 10 days after award of contract, and before any material for this works is delivered to the Job site, submit to the Engineer, in accordance with the provision of these specifications, Samples mock-ups of the proposed ceiling finish and accessories etc.

212.3 DELIVERY AND STORAGE

- a) Deliver materials of this section to the Job side in their original unopened containers with labels intact and legible at time of use.
- b) Store materials under cover to prevent damage and contamination. Store only the specified materials at the Job Site.

212.4 PROTECTION

Protect materials of this Section before and during installation and protect installed work and materials of other trades.

212.5 REPLACEMENTS

In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

213.0 ALUMINUM STRIP CEILING

The ceiling system will consist of visible, primary grid of parallel channel sections with lay-in rectangular panels between grid members similar to DAMPA VANGEEL type LG-100 as per manufacturer’s recommendations subject to the approval of the Architect/ Project manager.

The ceiling panel will be 0.7mm aluminum 300mm wide and 1800mm long perforated with 1mm dia holes at 2mm centers in diagonal patterns and 30mm plain border on both longitudinal sides. The longitudinal sides will be beveled making v-formed joints between units. All perforated panels will have factory applied black non-woven acoustic inlay bonded to the surface of the panels.

The ceiling panels and visible grids will be finished using polyester-based materials in RAL color 9010 or any other approved shade.

The panels shall be laid flush into 100mm wide visible linear grids comprising of parallel sections made of elector galvanized steel, fabricated in made to measure lengths providing a precision, close fitting butt joint between lengths. The suspension system shall include necessary couplings, brackets, connectors and edge trims etc. the grids will be installed with adjustable type rigid hangers.

213.1 INSTALLER QUALIFICATIONS

Workman shall be skilled, well trained and experienced in their respective crafts and familiar with specified requirement and method. In acceptance or rejection of installed materials, no allowance will be made for lack of skill on the part of workmen.

213.2 TOLERANCES

Suspension system components, hangers, fastening devices, supporting light fixtures, metal pan tiles and others shall be so installed that maximum deflection is not more than 1/360th of the span. Allowable tolerance of finished ceiling system shall be level to with in 37.50mm in 3600mm.

214.0 GYPSUM BOARD

Ceiling with concealed Metal Furring Channels; Suspended Ceiling comprising of imported rigid gypsum plaster board size 2400x 1200x 12mm thick or as specified in the drawings, firmly bonded on both sides with special linear/ square/ tapered edge suspended on galvanized steel furring channels, adjustable hangers and white pained edge trim excluding painting (paint shall be applied as per architects recommendation) applied in strict compliance to the manufacturer’s specifications, complete in all respect and confirming to the drawing and specifications or as directed by the Engineer.

Gypsum board plain or moisture proof of “Elephant Brand” shall be used, or approved equivalent. Contractor to submit sample of the same of 450x 450mm with the hanging system, before execution of work.

215.0. MINERAL FIBRE

“Excel-Tone of Daiken Acoustical Ceiling System” or Thi-Tone of Celotex Acoustical Ceiling system with imported, exposed tee, or approved equal. Special quality of high sag resistively, reveal and beveled edge, warranty of 10 years from the manufacturer, with factory applied vinyl latex paint.

ITEM	THICKNESS (mm)		SPECIFICAT ION COMPLIAN CE
	12	15	
Noice reduction coefficient	Min. 0.5		ISO 354
Flexural Strength (Kgh)	Min. 12	Min. 15	KSF 2263
Density (Kg/m ³)	Max. 400		JIS A 6307
Thermal Conductivity (Kcal/mh ⁰ c)	Max. 0.055		KSF 2264
Surface Burning Characteristics	Flame spread: Max. 25 smoke Development : Max. 50		ASTM E-84

GENERAL FOR “KITCHEN CABINET”

216.0 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.

216.1 DESCRIPTION WORK

1. Extent of kitchen cabinets is indicated on drawings.
2. Sink units in countertops are specified in a Division for plumbing; sanitary fixtures and fittings.
For cabinet hardware refer to ‘Finish Hardware’ section of Division-8.

216.2 QUALITY ASSURANCE

1. Subject to compliance with requirements provide kitchen cabinets of one the following makes:-
Sterling Plywood Industries, Karachi, Pakistan.
Celebrity, Modern Wood works, Karachi, Pakistan.
Charisma, Karachi, Pakistan.
Long life Kitchen, Karachi, Pakistan.
2. Obtain kitchen cabinets from a single manufacturer to ensure uniformity in quality of appearance and construction, unless otherwise indicated.
3. Verify sizes and shapes of kitchen cabinets prior to fabrication by field measurements taken after (flooring and plaster/tiles) are installed.

216.3 SUBMITTALS

1. Submit manufacturer’s technical product data and installation instructions indicating materials, hardware, and finishes used in fabrication of kitchen cabinets, as required to show compliance with specifications.
2. Submit fully finished samples of following items required for kitchen cabinets:-
 - i) Solid wood 1 finished samples, 3/4"x6"x18" (18x150x450mm)
 - ii) Plastic laminate samples, 12"square for each type of finish, pattern and color. (300x300mm)
 - iii) Plywood 1 finished samples, 12" square for each type of finish. (300x300mm)
 - iv) Block board 1 finished samples,12" square (300x300mm)
 - v) Hardware one unit of each type and finish.

216.4 PRODUCT DELIVERY, STORAGE AND HANDLING

1. Protect wood cabinets and countertops during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
2. Do not deliver wood cabinets and countertops until painting, wet work, grinding and similar operations, which could be performed before installation of kitchen cabinets, have been completed in installation areas. Store kitchen cabinets in installation areas or, if that is impracticable, in areas with ambient conditions meeting same requirements.

217.0 MATERIAL

217.1 BASIC MATERIALS

1. Lumber

Defect Allowed

Wood type Grade Area of req- Defects uired witho-ut defects.

Deodar (Cedurus 1st Qua- 5 sq.ft. Any piece Deodar) lity over 5 sft. 3 detects allowed

Notes: Defects consists of tight knots not larger than 3/4" checks 0.05"x7", pitch pocket 0.09"x8"

2. Provide Kiln-dried or air dried lumber having a moisture content from time of manufacture until time of installation not greater than 7-12% Inspect each piece of lumber and plywood or each unit of finish carpentry after drying. Do not use twisted, warped, bowed or otherwise damaged or defective wood.

217.2 WOOD TREATMENT

1. Following basic fabrication, liberaily apply preservative in flood coats to all surfaces requiring treatment to ensure maximum absorptions. Use a coarse, low pressure spray wherever possible. Allow each coat to soak in, but not to dry before applying further coats. The preservative shall be an organic solvent type, with a water repellent component. This treatment should be provided after seasoning. Materials should be cut and machined before treatment wherever possible. Where material is cut, drilled or machined after treatment, the areas so cut drilled or machined, should be treated by bursh or spray application of the same preservative. Treated timber shall be able to receive glue, paint, putty, neoprene or PVC gaskets and standard sealants with no adverse effects to either materials.
2. Manufacturer: Subject to compliance with requirements provide products of:-
Solignum Limited, U.K.
Discard treated lumber which does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discoloured, or otherwise damaged or defective lumber.

217.3

Use 3/4" thick blockboard or chipboard with plywood veneered to both surfaces and minimum density of 40 lbs/cu.ft.

217.4

Imported Plastic Laminate of standard thickness in colours or patterns and textured finishes selected by Engineer from manufacturer's standard selections.

217.5

Plywood shall be of good commercial grade, any species, factory treated with specified wood treatment with a plain face pattern and density not less than 35 lbs/cu. ft.. minimum 3ply.

217.6 CABINET CONSTRUCTION

1. Front-Frame Drawer Rails shall not be less than 1"x1-1/4" lumber mortised and fastened into face frame.
2. Bottoms shall be of block board with plastic laminated to both sides secured in and fully supported by rabbets in end panels front frame and back bottom rail.
3. Back Panels shall be of block board fastened to machined rear edge of end panels and to top and bottom rails. Both surface pre-finished with plastic laminate.
4. Horizontal bracing members to be of Deodar wood 1"x2" back top and bottom rails with glued mortise and tenon joints, rabbeted to receive top and bottom panels.
5. Drawers will have Sides, sub-fronts and backs of not less than 3/4" thick wood: bottom to be of blockboard. Provide box type construction with front, bottom and back rabbeted in sides and secured with glue and mechanical fasteners. All surfaces of drawer to be plastic laminated.
6. Drawer Suspension: Minimum 50 lbs. capacity twin track, side-mounted drawer glide suspension with nylon rollers and positive stop.
7. Shelves blockboard with plastic laminate on top, bottom and exposed front edge.
8. Top, Bottom, side and divider panels: blockboard with plastic laminate on both surfaces side panels fabricated with notches to provide adjustability and retainment of interior storage devices.
9. Corner Posts: Deodar wood not less than 1-1/2"x1-1/2" attached to all 4 vertical corners. Corner posts shall not be spaced more than 4"0" apart.
10. Joinery: Rabbet backs flush into end panels and secure with glue and mechanical fasteners. Connect wall cabinet tops and bottoms and floor cabinet bottoms and stretchers to end and dividers by means of glue and mechanical fasteners. Rabbet top, bottoms and backs into end panels.
11. Toe Space of 1" height clear toe space without toeboard to be provided.
12. Countertops should be formed (moulded front edge) one piece countertop of blockboard with plastic laminate veneered to both sides.
13. Countertop Thickness 1-1/4"
14. Doors shall be of blockboarded with 3/4"x1" deodar wood edge framing with plastic laminate on both sides, all beading of doors to be of deodar wood.
15. Flush Overlay Style: Provide wall and full height units(if any), with draw fronts, doors and fixed panels (if any), overlaying and concealing face frames of cabinet body unless otherwise indicated.

217.7 CABINET HARDWARE

1. Provide manufacturer's standard hardware units of type, size and finish indicated or if not indicated as selected by Engineer from manufacturer's standard choices.

217.8 ACCESSORIES

1. Provide manufacturer's standard accessories.
2. Sliding Utility Baskets shall be Thermosetting powder coated wire baskets with integral slides for use in floor cabinets.
3. Cutlery Dividers shall be placed Lengthwise with divider drawer.
4. Hood for Cooker Fabrication and appearance similar to cabinets with interior lined with 22SWG aluminum plain natural anodized sheeting. Hood to accommodate

exhaust fan. Coordinate with HVAC works prior to fabrication to ensure alignment of hood with exhaust fan in wall.

217.9 FABRICATION

1. Fabricate wood kitchen cabinets to dimensions and profiles and details indicated in drawings and confirmed by field measurement.
2. Assemble units in shop in as large components as practicable to minimize field cutting and jointing.
3. Install and Seal Kitchen sink into cabinet. Coordinate with plumber prior to fabrication of cabinet.

217.10 PAINTING

1. Provide paint to all surfaces not to receive plastic laminate or other finish refer section 'Painting' in Division-9 of these specifications.

218.0 EXECUTION

218.1 INSTALLATION

1. Install cabinets plumb, level, true and straight with no distortions. Shim as required using concealed shims. Where wood kitchen cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips and mouldings as required in finish to match cabinet face.
2. Anchor cabinets securely in place with concealed (when doors and drawers are closed) fasteners, anchored into structural support members of wall construction.
3. Attach countertops securely to floor units. Install sealant in joints in countertops. Provide concealed mechanical clamping of joint. Provide cut-outs for fixtures and appliances as indicated, drill pilot holes at corners before making cutouts. Smooth cut edges and coat with waterproof coating or adhesive.
4. Complete hardware installation and adjust doors and drawers for proper operation.

218.2 CLEANING AND PROTECTION

1. Repair or remove and replace defective work as directed upon completion of installation.
2. Clean exposed and semi-exposed surfaces, touch-up finish as required. Remove and replace damaged components.
3. Cover completed work with 4-mil polyethylene protective enclosure, applied in manner to allow easy removal without damaging cabinets or adjoining work. Remove cover immediately before time of final acceptance.

SPECIFICATIONS PLUMBING

1.0 SCOPE

The work under this section consists of providing all material and equipment and performing all the work necessary for the complete 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. The systems included in plumbing works are as follow:

- a) Cold and Hot Water Supply
- b) Sanitary Drainage
- c) Roof Drainage

All the above named systems shall be completed in all respects including extension of these internal systems upto the specified limits outside the building as indicated on the drawings.

2.0 GENERAL

All the materials and equipments shall be of the specifications mentioned herein and the Contractor shall submit the sample, necessary catalogues, sketches, the name of manufacturer and guarantee if necessary, before installation. The system shall be installed after the Engineer approves it. All material and equipment shall be new and unused.

Approval of material and equipment by the Engineer shall not absolve the Contractor of the responsibility of furnishing the same of proper size, quantity, quality and all performance characteristics to efficiently fulfill the requirements and intent of the Contract Documents.

The Contractor shall be responsible for his work until its completion and final acceptance, and shall replace any of those that may be damaged, lost or stolen without any additional cost. All openings left in floor for passage of lines of water supply, soil, waste, vent, etc. shall be covered and protected.

All open ends of pipes shall be properly plugged to prevent any foreign material from entering the pipe.

Misuse of plumbing fixtures to be installed under this Contract is prohibited during the currency of the contract.

All metal fixture trimmings shall be thoroughly covered with non-corrosive grease, which shall be maintained until all work is completed.

Upon the completion of work, all fixtures and trimmings shall be thoroughly cleaned, polished and left in perfect 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.

All pipes shall be properly installed as shown on the drawings and/or as directed by the Engineer, and shall be as straight as possible forming right angles and parallel lines with the walls and other pipelines. The position, gradients, alignment and inverts shall be as shown on the drawings and/or as directed in writing and set out by the Engineer.

The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings. However, the Engineer reserves the right to change the location. 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 damage caused to other works in the correction of piping. The Contractor shall closely coordinate with other works and utilities during the entire stage of execution.

A minimum distance between different services shall be maintained as per applicable codes and standards that is shown on the Drawings and/or as approved by the Engineer.

Pipes should be installed in such a manner that minimum distance should always be maintained between pipe and wall, beams, columns, etc. Pipes shall be supported on hangers and brackets as shown on the drawings or as directed by the Engineer.

Waste-water outlet from each fixture shall be individually trapped.

Each vent terminal shall extend to the outer air and be so installed as to minimize the possibilities of clogging and the return of foul air to the building.

When the roughing-in is completed where required after approval by the engineer, the plumbing system shall be subjected to test prior to concealing the roughing-in, in order to ascertain that all threads and connections are watertight.

Cast iron soil and drainage fittings for change in direction shall be used as follows:

*Vertical to horizontal: short sweep or long-turn for diameter 75 mm and larger; long sweep or extra-long-turn for less than 75 mm dia.

*Horizontal to vertical: quarter bend or short turn.

All fittings with hubs shall be aligned so that the hub faces

upstream. No drainage or vent piping shall be drilled.

All exterior openings provided for the passage of piping shall be properly sealed with snugly fitting collars of metal or other approved rodent-proof material securely fastened into place.

Joints at the roof, around vent pipes, shall be made watertight by the use of lead, copper, galvanized iron, or other approved flashings or flashing material. Exterior wall openings shall also be made watertight.

Each length of pipe and each pipe fitting, trap, fixture, and device used in a plumbing system shall have cast, stamped or indelibly marked on it the maker's mark or name, the weight, type, and classes of the product, when such marking is required by the approved standard that applies.

Where different sizes of pipes, or pipes and fittings are to be connected, the proper size increasers or reducers or reduced fittings shall be used between the two sizes.

Any fitting or connection which has an enlargement, chamber, or recess with a ledge, shoulder, or reduction of pipe area that offers an obstruction to flow through the drain pipe is prohibited.

Each fixture trap shall have a water seal of not less than 50 mm and not more than 100 mm . Full S, bell; crown vented traps and traps/depending for their seal upon the action of movable parts are prohibited. No fixture shall be double trapped. Where fixture comes in contact with wall and floors, the joint shall be watertight. Piping in ground shall be laid on a firm bed as per detail shown in the relevant drawings for its entire length.

Piping in the plumbing system shall be installed without undue strains and stresses. Vertical piping shall be securely held to keep the pipe in alignment and carry the weight of the pipe and contents. Horizontal piping shall be supported to keep it in alignment and prevent sagging. Hangers and anchors shall be of metal of sufficient strength to maintain their proportional share of pipe alignments and prevent rattling. Hangers and anchors shall be securely attached to the building under construction. It must be clearly understood that the Contractor shall be fully responsible for hangers and supports and shall obtain prior approval of design as to the shape, material, dimensions, spacing etc.

Piping in concrete or masonry walls or footings shall be placed or installed in sleeves, which will permit access to the piping for repair or replacement. Roof drain leaders installed inside columns shall be permanently embedded in concrete.

The indirect waste piping from food handling equipment etc. shall so discharge that the air gap between the indirect waste and the building drainage system is at least twice the effective diameter of the drain served.

3 COLD & HOT WATER PIPES AND PIPE FITTINGS

3.1 Scope

The work under this section of the specifications consists of providing all plant, labour, equipment, appliances, material and labour for proper supply and installation of PPR Pipes and pipe fittings for cold and hot water supply including jointing, clamping, cleaning, painting etc. both above ground and underground and embedded in walls as shown on the Drawings or as specified herein.

3.2 PP-R Pipes & Fittings for Water Supply

3.2.1 Material

All cold & hot water pipe work shall be PP-R (PN 20) (Polypropylene Random- Copolymersate). The pipes shall be of high molecular weight, stabilized to high temperature and conforming to ISO 15874, DIN 8077, DIN 8078 & DIN 16962 with heat fusion welded joints.

3.2.2 Installation

The run and arrangement of all pipes shall be as shown on the drawings and as directed by the Engineer during installation. All vertical pipes shall be erected plumb and shall be kept parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls or hanged with roofs. If required to change the location etc. during the execution of the work, the Contractor will do so at no additional cost. Contractor

should follow the Manufacturer's recommendation for installation of the pipe and as directed by the Engineer.

All pipes passing through floors and walls shall be furnished with G.I sleeves, the inside dia. of which shall be at least 15 mm greater than the outside of the pipe passing through it. Sleeves in exterior walls and pits shall have anchor flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

3.2.3 Pipe work Supports

All supports, clips, steel rods and hangers shall be of mild steel painted with twocoats of approved metallic zinc primer.

All clips and brackets shall be equipped with 1/3mm sectional rubber liners (shore-hardness A 40+50).

Pipe work supports shall be installed in order to allow free movement due to expansions and contraction. Supports shall be arranged adjacent to joints, changes of direction and branches.

Each support shall carry the overall weight of pipe work and water to be borne by it. The intervals between pipe supports shall not exceed as per Manufacturer's recommendation and as directed by the Engineer.

Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle iron shall be fitted to the underside of slab by two hangers and the pipes shall be supported from the channel iron by rod hangers and flat iron bands.

All hanger rods shall have double nuts and beveled washers to allow the hanger rod to swing.

Multiple pipe run along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

Exposed pipe work shall be supported on channel, angle iron or with U-bolts to form a rigid guide.

All U-bolts, except used as anchors, shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide and allowing the pipe to slide axially. U-bolts shall be provided on alternate pipe bracket.

Small pipe work running along skirtings shall be supported by standard built-in or screw-on type clips.

Pipes shall be individually supported. Pipes shall not hang from other pipes.

Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means-of support for the riser.

Supports for insulated water pipe work shall be arranged such that the supporting steel work does not come into contact with the pipe surface.

Vibration isolators shall be provided with the hangers as approved by the Engineer.
Hangers and supports shall be from Hilti /Fishers or approved equivalent

3.3 G.I. Cold and Hot Water Pipes

3.3.1 Material

The galvanized pipes shall be of Class 'B' and conform to British Standard Specifications 1387 for "Steel Tubes and Tubular suitable for screwing to BS 21 pipe threads".

All screwed tubes and sockets shall have BS pipes thread in accordance with BS

21. In order to prevent damage to the leading thread, the ends of the sockets shall be chamfered internally.

A complete and uniform adherent coating of zinc will be provided for galvanized pipes.

Every tube shall be tested at the manufacturer's works to a hydraulic test pressure of 4.90 MPa and shall be maintained at the test pressure sufficiently long for proof and inspection.

Tubes, which are bundled, shall be secured together by rope or soft iron or other suitable material.

The threads of all tubes shall be effectively covered with good quality

grease or other suitable compound, and each tube above 50 mm nominal bore shall have a protecting ring affixed to the unsocketed screwed end.

All pipe fittings up to 75 mm dia. shall be of malleable cast iron. Pipe fittings above 75 mm dia. shall be of approved material and specifications as decided by the Engineer.

All exposed GI piping shall have anticorrosive protective coating/polyethylene tape coating for pipe protection.

3.3.2 Installation

The run and arrangement of all pipes shall be as shown on the Drawings and as directed by the Engineer during installation. All vertical pipes shall be erected plumb and shall be kept parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls. If required to change the location etc. during the currency of the work, the Contractor will do so at no additional cost. Contractor should follow the Manufacturer's recommendation for installation of the pipe and as directed by the Engineer.

Screwed joints in G.I. pipes shall be made perfectly tight, without the use of any filler except approved jointing compound or tape. Wherever required to make flanged joints, they shall conform to BS 10 Table D.

All pipe passing through floors and walls shall be furnished with sleeves of G.I. sheet, 18 gauge, the inside dia. of which shall be at least 15 mm greater than the outside of the pipe passing through it. Sleeves in exterior walls and pits shall have anchor flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

3.3.3 Pipe work Supports

All supports, clips, steel rods and hangers shall be of mild steel painted with two coats of approved metallic zinc primer.

All clips and brackets shall be equipped with 1/3 mm sectional rubber liners (shore-hardness A 40+50).

Pipe work supports shall be installed in order to allow free movement due to expansions and contraction. Supports shall be arranged adjacent to joints, changes of direction and branches.

Each support shall carry the overall weight of pipe work and water to be borne by it. The intervals between pipe supports shall not exceed as per Manufacturer's recommendation and as directed by the Engineer.

Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle from shall

be fitted to the underside of slab by two hangers and the pipes shall be supported from the channel iron by rod hangers and flat iron bands.

All hanger rods shall have double nuts and beveled washers to allow the hanger rod to swing.

Multiple pipe run along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

Exposed pipe work shall be supported on channel, angle iron or with U-bolts to form a rigid guide.

All U-bolts, except used as anchors, shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide and allowing the pipe to slide axially. U-bolts shall be provided on alternate pipe bracket.

Small pipe work running along skirting shall be supported by standard built-in or screw-on type clips.

Pipes shall be individually supported. Pipes shall not hang from other pipes.

Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means- of support for the riser.

Supports for insulated water pipe work shall be arranged such that the supporting steel work does not come into contact with the pipe surface.

Vibration isolators shall be provided with the hangers as approved by the Engineer.

Hangers and supports shall be from Hilti /Fishers or approved equivalent

4 SOIL, WASTE AND VENT PIPES & FITTINGS

4.1 Scope

The work under this section of the specifications consists of providing all plant, equipment, appliances, material and labour for supply and proper installation of soil, waste, and vent pipes and pipe fittings including, clamping, cleaning, painting etc., as shown on the drawings or as specified herein.

4.2 uPVC Waste and Vent Pipes & Fittings

4.2.1 Material

The material shall substantially consist of poly (vinyl chloride) (PVC) as per the requirements of aforesaid standard. Pipes and fittings shall be sufficiently stabilized against thermal ageing and ultraviolet (UV) light.

Un-plastised PVC pipes conforming to ASTM D-1785 Schedule 40 & fittings conforming to D-2466 for soil waste and vent shall be served as non-pressure pipes. Fittings and specials compatible to use with UPVC pipes and jointing shall be elastomeric (Rubber ring) or solvent cement joint. Clamps hangers and supports shall be as recommended by manufacturer.

4.2.2 Installation

All uPVC soil pipes and fittings shall be installed to the lines and grades shown on the drawings or as directed by the Engineer. When required to be installed above ground floor level, suitable and substantial number of hangers and supports of approved type and make shall be provided. No piping shall be hung from the piping of other systems. Clamps shall be provided on not more than 1.5 m centers or a minimum of one hanger per each length of pipe whichever is smaller. Where excessive numbers of fittings are installed, additional clamps will be provided.

All steel clamps, hangers and support etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint.

uPVC pipe and fittings installation and jointing should be push-fit/solvent joint as per Manufacturer and as directed by the Engineer.

Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. All vent pipes to be installed in the system shall be provided with approved cowl and will rise at least 760 mm above the roof.

4.2.3 Rubber Rings

The rubber rings may either be synthetic or natural conforming to ASTM Standards or as recommended by the manufacturer. UPVC pipes shall be used for domestic installation inside the buildings for soil and waste discharge, ventilation and drainage of rain water.

5 TESTING AND COMMISSIONING

For testing and commissioning refer section 5180.

The Contractor shall furnish and 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.

The Contractor shall also be responsible for the repair of this work & other trades work that may be damaged or disturbed by the tests.

Defects disclosed by the tests shall be repaired. Defective work shall be replaced with new work without extra cost to the Employer. Tests shall be repeated as directed, until all work is proven satisfactory.

6 MEASUREMENT AND PAYMENT

6.1 General

Except otherwise specified here in or elsewhere in the Contract document, no separate measurement and payment shall be made for the under mentioned works related to the relevant items of the Bills of Quantities, but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rates of the respective items of the Bills of Quantities.

- Submission of Samples.
- Factory Tests.
- Site demonstration test
- Transportation
- Cutting, jointing of pipes.
- Rubber rings.
- Providing & fixing of pipe.
- Pipe fittings and accessories
- Cleaning, testing and commissioning of lines.
- Testing and compaction of trench bottoms.
- Water used for testing of pipes.
- Hangers, clips and brackets, steel clamps, tie rods, nuts and bolts, Channels and angle iron, etc.),
- cutting and breaking concrete and then making it good,
- Protective painting, coating, lining and wrapping
- Cleaning, testing, disinfection (for potable water lines), commissioning.
- Marking etc.

6.1.1.1 Measurement

Measurement of acceptable completed work for PP-R, G.I, uPVC pipes & fittings shall be in running meter length and the work to be done shall include earth work, providing and fixing of pipe, pipe fittings, jointing, supports and the measurement will be made for complete work specified herein.

6.1.1.2 Payment

Payment will be made at the unit rate per running meter length of pipe quoted in Bill of Quantities and shall constitute full compensation for all the work related to the item.

7 PLUMBING FIXTURES

7.1 Scope

The work under this section of the specifications consists of providing all material and labour for supply and proper installation of plumbing fixtures such as wash basins, water closets, janitor sink, kitchen sink, shower head with mixer, shower tray, urinals, baby bath tub and ablution faucet etc. alongwith 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.

7.2 Materials and Installation

7.2.1 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 imported and of best quality and finish and shall be of approved manufacture, shape and size.

Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer for his approval, a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams, drawings and such other technical data as may be required by the Engineer to satisfy himself as to the suitability, durability, quality and usefulness of the material to be purchased.

Approval of the schedule shall not be construed as authorizing any deviations from the specifications unless the attention of the Engineer has been invited to the specific changes. If the material or equipment offered under this provision is, in the opinion of the Engineer, equal to or better than specified, it will be given consideration.

Plumbing fixtures shall have smooth impervious surfaces, be free from defects and concealed fouling surface. They shall be true to line, angles, curves and colour, etc. 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 overflow 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 380 mm from its centre to any sidewall. No urinal shall be set closer than 300 mm from its centre to any side wall or partition or closer than 600 mm centre to centre.

The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow. All cuttings, making holes etc and making it good shall be included in the work. All fixtures shall be tested for soundness, stability or support and satisfactory operation.

7.2.2 Wash Basins

Wash basin shall be Vitreous China (counter top, with or without pedestal) of approved manufacture, shape and size and type as approved by the Engineer. It shall be installed as a complete unit including 20 mm C.P brass automatic sensor basin mixer or lever type or double knob type as specified in BOQ item, 20 mm CP stop-cocks, CP brass bottle trap for individual wash basin and CP brass P trap for battery of wash basins as applicable, CP brass strainer, heavy cast iron brackets with bolts, screws etc. Stainless steel water inlet connection pipe as approved, CP brass or steel waste outlet and/or waste pipe, joints jointing and sealing material, etc, with all other minor accessories required to complete the job in all respect.

7.2.3 Water Closets (European Type)

European type water closet shall be best quality, of color, size and type as approved by the Engineer. It shall be installed as a complete unit including all accessories. Flush tank shall be of low level type, it shall be fitted with either double push button type. Double push button type

flushing system is fitted with one 3 liter small button and one 6 liter large button. Trap shall be cast integral with pan. The seat shall be of smooth non-combustible non-absorbent materials like Bakelite and of the open front type fixed to the pan with hinges. The fittings shall also include approved water inlet connection pipe, nuts bolts, 20 mm dia. stop cock etc. required for complete installation.

Dual-flush in-wall carrier system and concealed tank with actuator flush panel or pneumatic push button for wash-down, wall-hung toilets shall be vitreous China, best quality, of color, size and type approved by the Engineer.

7.2.4 Bidet

Wall hung bidet shall be of shall be vitreous China, best quality, of color, size and type approved by the Engineer, complete with 1 hole punched and overflow including fixation set, fully skirted with invisible fixation, in addition to anti- scale coating and anti-bacterial glazing.

7.2.5 Water Closets (Asian Type)

Squatting (Asian/Orissa) type water closet shall be vitreous China including cistern of vitreous china having capacity of 12 to 15 liter, best quality, of color, size and type approved by the Engineer. It shall be installed as a complete unit including, 20 mm CP stop cock, approved water inlet connection pipe, low level or high level Flush tank, as required. All fittings shall be installed at low level, or high level as required including interconnecting flush piping. Foot rests, cast iron P trap, joints, jointing and sealing materials, etc. with all other minor accessories for complete installation.

7.2.6 Kitchen Sink

Kitchen sink shall be of stainless steel of best quality, color, and type as approved by the Engineer, double/single deep-bowl with integral drain board. It shall be installed as a complete unit with arrangement for both cold and hot water supply, 20 mm C.P. mixer for cold and hot water, approved water inlet connection C.P. brass strainer, waste outlet pipe, heavy brackets with bolts screws etc., joints jointing & sealing material etc., with all other minor accessories required for complete installation.

7.2.7 Bath Tub

Bath Tub shall be Vitreous China of approved manufacture, shape and size. It shall be super smooth & burr-free cutting edges. It shall be installed as a complete unit including 20 mm CP mixer or 20 mm CP pillar cock, as applicable, 20 mm Stop cock, CP brass chain with 40 mm rubber plug CP brass strainer heavy cast iron brackets with bolts, screw etc. CP brass steel waste outlet and /or waste pipe, joints, jointing and sealing material, etc. with all other accessories required to install the bath tub in all respect.

7.2.8 Urinal

Urinal shall be of vitreous China of approved manufacture, shape and size. Urinal shall be wall-hung type either with integral water seal trap or with separate CP brass P trap. The complete unit shall be installed including 15mm CP stop-cock, water inlet connection pipe, cast iron brackets, bolts, screws and all internal accessories CP steel flush pipe, CP steel waste pipe, joints, jointing and sealing material etc. with all other accessories.

7.2.9 Shower Head / Shower rose

Shower head shall be local best quality chromium plated adjustable type installed at suitable height, complete with all accessories such as chromium plated extension pipe, C.P. brass escutcheons etc. including C.P. stop cock.

7.2.10 Mixer for Shower Head / Shower rose

Mixer for shower head lever type mixer shall be of best quality, shape and size as approved by the Engineer. Mixer for shower head shall be chromium plated of brass concealed inside wall with hot and cold water taps (either knob or lever) projecting outside wall, diverter and piping. It shall be mounted on the wall at a suitable height or below shower rose complete with all accessories.

7.2.11 Janitor Sink

Janitor sink of white fire clay with a hard wood pad at the front edge, stainless steel lift up bucket grid; chromium plate brass fittings comprised of wall mounted cold water CP brass bib tap 20mm, with exposed inlet; projection approx. x 20mm screen type waste fitting 40mm, CP brass P-trap diameter 50/40 with 75mm seal and adjustable inlet pipe, set of built-in cantilever brackets of white enameled cast-iron, with seal and fixing material.

7.3 Testing and Commissioning

For testing and commissioning refer Section 5180.

7.4 Measurement and Payment

7.4.1 Measurement

Measurement for wash basins, water closets, bidets, kitchen sinks, bath tubs, urinals, and shower heads/shower rose, shower tray, mixer for shower head/shower rose and janitor sinks will be made as per actual number acceptably provided and installed. The Contractor's bid against these items shall include supply and installation of complete unit as specified herein, inclusive of all work from inlet connection of water

supply to outlet connection with the sanitary system, complete as per Contract Documents and/or as directed by the Engineer.

7.4.2 Payment

Payment of acceptable completed Measurement for wash basins, water closets, bidets, kitchen sinks, bath tubs, urinals, shower heads/shower rose, shower tray, mixer for shower head/shower rose and janitor sinks shall be made at the applicable unit price per number quoted in the Bills of Quantities and shall constitute full compensation for all the work related to that item.

8 MISCELLANEOUS ITEMS

8.1 Scope

The work under this section of the specifications consists of providing all material and labour, equipment, appliances etc., for supply and proper installation of miscellaneous plumbing items of valves, cocks, bottle trap, floor traps, floor drain, cleanouts, mirror, float valve as specified, herein or as shown on the Drawing or as directed by the Engineer. The Contractor shall furnish appropriate catalogues and literature and obtain approval of the Engineer before purchase.

8.2 Material and Installation

8.2.1 Bronze Valves

All valves of 75 mm diameter and smaller shall be of bronze unless otherwise specified conforming to BS 5154 and shall be of PN-16 pressure rating. All valves shall be so located that they become accessible with ladder. Open and shut indicators shall be marked on the handle. The ends may be screwed or flanged. All valves shall be of renowned manufacturer.

8.2.2 Taps and Cocks

All the taps and cocks shall be of brass, gun metal or other equally suitable corrosion resisting alloy conforming to BS 1010 and shall 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 composition or other equally suitable material. Every tap/cock shall be tested; complete with its component parts, to a hydraulic pressure of at least 1.96 MPa. During test it shall not leak.

8.2.3 Floor drains

Floor drains shall be of cast iron, uPVC or of other anti-corrosive metal. They shall have minimum water seal of min 50 mm and shall be provided with stainless steel grating and P-trap, removable bucket strainer and cleanout. 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.

8.2.4 Floor Traps

Floor traps shall be of cast iron, uPVC or of other anti-corrosive metal. They shall have minimum water seal of 50 mm and shall be provided with stainless steel grating and P-trap, 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.

8.2.5 Cleanouts

Cleanouts of cast iron or uPVC shall be of the same nominal size as that of the pipe on which it is installed with chromium plated (CP) brass cover. Cleanouts shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of cleanout shall be flush with the floor by means of finished metal plate secured in position and screwed firmly to the plug.

Cleanout shall be so installed that there is a clearance of at least 300 mm for pipes less than 75 mm diameter and at least 500 mm for pipes of 75 mm and larger diameter, for the purpose of rodding.

Cast iron pipe used with cleanout shall be measured and paid under cast iron pipe item. All other work of ferrule, plug, concrete work, frame and cover etc. shall be measured and paid under cleanout item.

8.2.6 Float Valve

Float valve shall be of piston type and conform to BS 1212-1 of Brass Seat with rod and the float shall be of polyethylene material including all accessories required for its installation as approved by the Engineer.

8.2.7 Vent Cowell

All vent pipe terminating above the building shall be provided with best quality cast iron and a stainless clamp for clamping of water proofing membrane as approved by the Engineer.

8.2.8 Glass Mirror

The glass mirror shall be of best quality and size, as approved by the Engineer, securely fixed on hard board packing and of first class quality. The mirror shall be fixed on wall as shown on the drawing or as directed by the Engineer.

8.2.9 Towel Rail

The chrome-plated stainless steel towel rail shall be of size as approved by the Engineer and shall be fixed to wall with chrome-plated brackets.

8.2.10 Toilet Paper Holder

The chrome plated stainless steel toilet paper holder (complete in all respects) shall be approved by the Engineer and shall be fixed to the wall with low level chrome plated screws.

8.2.11 Soap Dispenser/ Soap Dish

The chrome plated stainless steel soap dispenser/ soap dish (complete in all respects) shall be approved by the Engineer and shall be fixed to the wall at desired location.

8.2.12 Grab Bars

The Grab Bars for handicaps shall be of size as approved by the Engineer of chrome-plated steel and shall be fixed to wall with chrome-plated brackets.

8.2.13 Hand Drier

The hand drier shall be of best quality as approved by the Engineer with strong metal housing, infrared proximity switch and with easy operation. If required, it shall also be plugged in integrated installation kit for wall mounting.

8.2.14 Gully Traps

Gully traps in RCC / Block masonry chamber as shown on the drawing shall be provided with a P-trap having a 65 mm minimum water seal and a cast iron frame & cover and shall be internally plastered with pudlo shall be provided as per plumbing drawings and details.

8.2.15 Grease Traps

Grease trap in RCC chamber shall be provided as per plumbing drawings and details. It shall be constructed according to the standards for drainage applications. Contractor should select the size of grease trap as per requirement of the sink connected or as shown in the drawing.

8.2.16 Fiber Glass Water Tank

Fiber glass tank shall be of specified capacity and shall be installed at location shown on drawings or directed by the Engineer.

Fiber glass tank shall be of thermo setting polyester resin reinforced with glass fiber. Resin shall be rapid curing and suitable for tropical climate. It shall conform to BS-3496, type E. The material shall have adequate strength, rigidity and resistance to impact. The tank shall be painted with heat reflecting metallic paint. The tank shall be non-toxic to water. It shall be impervious to water.

The tank shall have the following provisions:

- One manhole opening with cover of not less than 500 mm diameter or square size.
- Outlets for connection of filling overflow drain and supply pipe.
- Outlets for connection of vent pipe with cowel or wise mesh.
- Built-in feet for supporting the tank.

8.2.17 Electric Water Heaters

Water heater shall be of automatic storage type eclectically operated, including all necessary fittings for complete installation & operation. The heater shall be of best quality, as approved by the Engineer.

The working and test pressure of the heater to be of 6 bar and 10 bar respectively and shall deliver water at 150 degree F. It shall be capable to reach the peak demand, storage capacity.

Heater shall be provided with following accessories.

- i) Thermostatic control
- ii) Temperature & pressure relief valve High limit Control.

Other specifications of Water Heater are as given below:

Inner tank shall be extra heavy gauge anti-rust G.I. sheet metal to hold maximum system water pressure. As insulation, imported glass wool shall be used to maintain the desired temperature. The outer body shall be made of at least 16 gauge M.S. sheet shaped into reinforced circumference. Flow and delivery pipes shall be of high quality G.I. pipes fabricated with heavy gauge anti-rust baffle plate. The thermostat shall be of western European make. Special anti-rust-baked primer-heavy coated stove enamel paint with high gloss automotive shine shall be used on sheet metal.

6.2.18 Gas Water Heaters

Hot water heater shall be automatic, storage type and gas operated including all necessary fittings and accessories for complete installation & operation.

The minimum requirement of material and finish for the inner and outer shells shall be as given in the table below. Thicknesses of the outer and inner shells shall be adequate to withstand the rated pressure, but shall not be less than the thicknesses given in the table below.

Heater		Inside	Outside	
Capacities	Shell	Material	Finish	Finish
Less than 50 Gallons	Inner	* 14 SWG Steel	Galvanized	Galvanized
	Outer	22 SWG Steel	Galvanized	Galvanized and finished with synthetic enamel
50 to 100 Gallons	Inner	12 SWG Steel	Galvanized	Galvanized
	Outer	22 SWG Steel	Galvanized	Galvanized and finished with synthetic enamel
Over 100 Gallons	Inner	10 SWG Steel	Galvanized	Galvanized and lined with at least 1.5mm. thick copper sheet
	Outer	22 SWG Steel	Galvanized	Galvanized and finished with baked enamel

SWG - Standard Wire Gauge

The annular space between outer vessel & inner vessel shall be filled with fibre glass, glass wool or similar insulation material with thermal conductivity of not more than 0.04 W/M-°C.

The working & test pressure of the heater shall be 5 bars and 10 bars respectively. The burner capacity shall be adequate for delivering

water at not less than 70°C at rated output capacity.

Heater shall be provided with following accessories:

- i. Thermostatic control
- ii. Safety pilot
- iii. Temperature & pressure relief valve
- iv. Burner
- v. Drain valve
- vi. Auto-shut off in case of failure of pilot lamp

8.3 Measurement and Payment

8.3.1 Measurement

Measurement of acceptable completed works for payment for valves, taps & cocks, floor drains, floor traps, bottle traps, cleanouts, float valve, vent cowel, towel rails, toilet paper holders, soap dispenser/ soap dish, grab bars, hand drier, gully traps, grease traps, fiber glass water tanks, Electric water heaters and geysers shall be made on the basis of actual number acceptably provided and installed in position. Measurement of glass mirror shall be made on the basis of square meter.

The Contractor's bid against these items shall include providing and installation complete as specified herein and/or as shown on the Drawings.

8.3.2 Payment

Payment for valves, taps & cocks, floor drains, floor traps, bottle traps, cleanouts, float valve, vent cowel, towel rails, toilet paper holders, soap dispenser/ soap dish, grab bars, hand drier, gully traps, grease traps, fiber glass water tanks, Electric water heaters and geysers shall be made at the applicable unit rate per number quoted in bill of quantities and shall constitute full compensation for all the work related to that item. Payment of glass mirror shall be made on the basis of square meter.

9 ROOF DRAINAGE

9.1 Scope

The work under this section of the specifications consists of providing all plant, equipment, appliances, material and labour for supply and proper installation of rain water pipes and pipe fittings including, clamping, cleaning, painting etc., as shown on the drawings or as specified herein.

9.2 Cast Iron Rain Water Pipes And Fittings

9.2.1 Material

The cast iron pipe shall conform to British Standard 416 for "Cast Iron spigot and socket soil, waste and ventilating pipes and fittings" with socket and spigot or hubless ends. Cast iron pipe below ground shall conform to BS. 437 "cast iron spigot and socket drain pipe and fittings" with socket and spigot ends. The joint shall be lead caulked or elastomeric (Rubber Ring) to BS. 2494.

Cast iron pipes shall be centrifugally (spun) cast.

The quality of material shall be according to B.S.S. No.1452 for Grade 10.

The contractor shall supply coated pipes and fittings. The coating composition shall be of tar basis or a mixture of natural bitumen with a suitable hardener and natural asphalt. The coatings shall be smooth, tenacious, sufficiently hard, not to flow when exposed to a temperature of 63°C and not so brittle at zero degree centigrade that it chips soft when scribed lightly with the point of a pen knife.

Every pipe shall be tested at the manufacturer's work to a hydraulic test pressure of 0.07 MPa. Every pipe and fitting shall ring clearly when tested for soundness by being struck all over with a light hammer.

9.2.2 Installation

All rain water pipes and fittings shall be installed to the lines and grades shown on the drawings or as directed by the Engineer. When required to be installed above ground floor level, suitable and substantial number of hangers and supports of approved type and make shall be provided. No piping shall be hung from the piping of other systems. Clamps shall be provided on not more than 1500 mm centers or a minimum of one hanger per each length of pipe whichever is smaller. Where excessive numbers of fittings are installed, additional clamps will be provided.

All steel clamps, hangers and support etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint. All exposed C.I. soil/vent pipes shall be given two coats of synthetic enamel paint. Materials for painting shall be high quality product of well-known manufacturer and will be approved by the Engineer before using. The instructions of the manufacturer regarding all painting work shall strictly be adhered to.

Caulked joints for cast iron bell-and-spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 25 mm deep and not to extend more than 1/8 inches below the rim of the hub. Rubber ring joints shall also be allowed. No paint, varnish, or other coatings shall be permitted on the jointing material until after the joint has been tested and approved.

Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. All vent pipes to be installed in the system shall be provided with approved cowl and will rise at least 750 mm above the roof.

The entire system of drains, waste, and vent piping inside the building shall be tested by the Contractor under a water test. Every portion of the system shall be tested to a hydrostatic pressure equivalent to at least 10 feet head of water. After filling this Contractor shall shut off water supply and shall allow it to stand two hours, under test during which time there shall be no loss or leakage.

The Contractor shall furnish and pay for all devices, materials, supplies, 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.

The Contractor shall also be responsible for the repair of this work & other trades work that may be damaged or disturbed by the tests.

Defects disclosed by the tests shall be repaired. Defective work shall be replaced with new work without extra cost to the Employer. Tests shall be repeated as directed, until all work is proven satisfactory.

All fixtures shall be tested for soundness, stability or support and satisfactory operation.

9.2.3 Measurement and Payment

9.2.4 General

Except otherwise specified here in or elsewhere in the Contract document, no separate measurement and payment will be made for the under mentioned works related to the relevant items of the Bills of Quantities, but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rates of the respective items of the Bills of Quantities.

- Submission of Samples.
- Factory Tests.
- Site demonstration test
- Cutting, jointing of pipes.
- Rubber rings.
- Providing & fixing of pipe.
- Cleaning, testing and commissioning of lines.
- Testing and compaction of trench bottoms.
- Water used for testing of pipes.
- Hangers, clips and brackets,
- steel clamps, tie rods, nuts and bolts, Channels and angle iron, etc.),
- Cutting and breaking of concrete and then making it good,
- Applying protective painting,

- Cleaning, testing, disinfection (for potable water lines), commissioning.
- Marking

9.2.5 Measurement

Measurement for C.I. pipes, pipes shall be in running meter length and the measurement will be made for complete work specified herein.

9.2.6 Payment

Payment will be made at the unit rate of bid per running meter length of pipe. The amount bid shall be full payment for the work specified herein.

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

SPECIFICATION S VALVES & APPURTENANCES

1. GENERAL

1.1. SCOPE

The work to be done under this section of the specifications includes furnishing all plant, labor, equipment, appliances, materials and performing all operations required in connection with supply, installation, testing and commissioning of valves and appurtenances as specified herein, as shown on the drawings and as directed by the Engineer.

1.2. GENERAL REQUIREMENTS

- 1.2.1 Valves and appurtenances shall be of renowned manufacturers.
- 1.2.2 Valves and appurtenances shall be new and unused.
- 1.2.3 Valves and appurtenances intended for firefighting network/ system shall be UL listed and FM approved. All necessary documents shall be provided by the Contractor to confirm the required certification before installation of the valves and appurtenances.
- 1.2.4 Material of valves and appurtenances shall be suitable for installation on pipelines and must be similar to that of pipeline.
- 1.2.5 Service ratings of the valves and appurtenances shall be as specified herein, on the drawings or in the contract document but shall not be less than 10 bars.
- 1.2.6 Valve ends shall be of appropriate class, material and type of the pipe/fittings to which they are to be joined.
- 1.2.7 Valves and appurtenances shall be installed in positions as shown on the drawings or as directed by the Engineer.
- 1.2.8 Before installation the interior of valves and appurtenances shall be cleaned of all foreign materials and greased. Damaged paints shall be retouched.
- 1.2.9 Before installation and after commissioning valves and appurtenances shall be subjected to test pressure which shall be not less than 1-1/2 times the working pressure or the service pressure of the valves and appurtenances, whichever is higher and that no leakage shall be permitted during the test.
- 1.2.10 Valves and appurtenances shall be adequately supported and labeled.

1.2.11 Manufacturer's literature and operation manual for valves and appurtenances shall be provided.

1.2.12 Specifications are only general guidelines and by no means cover details of each equipment. These only spell out the intent of the requirement. The details have to be provided by the Bidders along with details of performance, construction and technical literature with the tender. The specifications are to be read in conjunction with the drawings.

2. MATERIALS AND PRODUCTS

2.1. CAST IRON GATE VALVES

Cast iron gate valves shall have flanged ends and wheel handle and shall conform to B.S.5150 "Specifications for Cast Iron Gate Valves". Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of 10 bars to 25 bars as specified in the Bill of Quantities. Valves shall close in clockwise direction.

The valve parts shall be of the following materials.

- i. Valve body shall be of cast iron.
- ii. Flanges shall be of cast iron.
- iii. Shaft shall be of stainless steel.
- iv. Disc shall be of stainless steel with bronze trim.
- v. Seat shall be of cast iron with bronze trim.

Valve parts in contact with water shall be of corrosion resistant material, free from toxic substances and shall not foster microbiological growth or impart taste, odour, turbidity or color to the water.

Inside surfaces of valves shall be enameled and outside surfaces shall be epoxy coated.

2.2. CAST IRON CHECK VALVES

Cast iron check valves shall be of non-slam, swing type with flanged ends and shall conform to B.S. 5153, "Specifications for Cast Iron Check Valves for General Purposes". Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of 10 bars to 25 bars as specified in the Bill of Quantities. The direction of flow shall be permanently marked on the body of the valve.

The valve parts shall be of the following materials.

- I. Valve body shall be of cast iron.
- II. Flanges shall be of cast iron.

- III. Shaft and spring shall be of stainless steel.
- IV. Disc and seat shall be of stainless steel with bronze trim.
- V. Disc and shaft seal shall be of rubber (O-ring type).
- VI. Wheel handle shall be of cast iron.

Valve parts in contact with water shall be of corrosion resistant material, free from toxic substances and shall not foster microbiological growth or impart taste, odor, turbidity or color to the water.

Inside surfaces of valves shall be enameled and outside surfaces shall be epoxy coated.

2.3. DUCTILE IRON GATE VALVES

Ductile Iron Gate valves shall have flanged ends and wheel handle and shall conform to B.S.5150 "Specifications for Ductile Iron Gate Valves" or EN1171. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of 16- bars to 25 bars as specified in the Bill of Quantities. Valves shall close in clockwise direction.

The valve parts shall be of the following materials.

- i. Valve body, bonnet and wedge shall be of ductile iron.
- ii. Wedge seat shall be of bronze.
- iii. Stem shall be of stainless steel.
- iv. Hand wheel shall be of ductile iron.
- v. Body seat shall be of bronze.

Valve parts in contact with water shall be of corrosion resistant material, free from toxic substances and shall not foster microbiological growth or impart taste, odour, turbidity or color to the water. Inside surfaces of valves shall be enameled and outside surfaces shall be epoxy coated.

2.4. BRONZE GATE VALVES

Bronze gate valves and shall conform to B.S. 5154, "Specifications for Copper Alloy Globe, Globe Stop, Check and Gate Valves for General Purposes". Valves shall be rated for a working pressure of 10 bars to 25 bars. Valve ends shall be flanged as shown on the drawings. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall close in clockwise direction. Open and shut indicators shall be marked on the wheel handle.

The hose bibs shall be provided with concrete pedestal as shown on the drawings or as approved by the Engineer.

2.5. BRONZE CHECK VALVES

Bronze check valves shall conform to B.S. 5154, "Specifications for Copper Alloy Globe, Globe Stop, Check and Gate Valves for General Purposes". Valves shall be

rated for a working pressure of 10 bars to 25 bars. Valve ends shall be flanged as shown on the drawings. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. The direction of flow shall be permanently marked on the valve body.

2.6. BUTTERFLY VALVES

Butterfly valves shall conform to B.S. 5155, "Specifications for Butterfly Valves" and shall be rated for a working pressure of 10 bars to 25 bars. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. The direction of flow shall be permanently marked on the valve body. Valves shall be double flanged or wafer type as mentioned in Bill of Quantities.

- Valve body shall be of cast iron/ductile iron as per BOQ.
- Seat Ring shall be Ethylene Propylene Diene Monomer (EPDM).
- Disc shall be stainless steel with bronze trim.
- Stem (Shaft) shall be S.S Cr.13
- Lever or gear shall be cast iron/ductile iron.
- Stem O ring shall be EPDM.

Wherever mentioned in Bill of Quantities, butterfly valves shall be provided with lever/wheel, worm gear and with extended stem as shown on the drawings or as specified herein.

2.7. SURGE RELIEF VALVES

Surge relief valves shall be spring operated globe type for continuous services conforming to ISO Standard or Equivalent. Valves body shall be of cast iron with stainless steel rim.

Spring shall be of stainless or high tensile steel. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of minimum 16 bars. Valves shall relieve pressure when the surge pressure in the system exceeds the pre-set value. The pressure will be adjustable.

2.8. DUCTILE IRON DOUBLE ACTING AIR VALVE

The automatic air release valves shall include a small orifice and a large orifice, consisting of: One resilient seated large orifice for release and admission of air when filling and emptying one small nipple orifice for release of air accumulated under normal working conditions. It shall be designed to operate under the pressures shown in the BOQ. The air valves shall have incorporated isolated valve. All air valves shall have integrated flanged inlet drilled according to ISO 7005-2 and EN 1092-2 complying with the pressures mentioned above and shall be fitted with lifting eyes for handling. The dimensions of the flanges shall be suit to tight with the flanges of the gate valves flanges mentioned above. Air valves should have orifice(s) sized for the operating conditions. Air Valves should comply with EN 1074-4. Valves should be suitable for water service and where required should combine the operating features of air release and air re-entry into

the system to prevent vacuum and allow system drainage. The air release portion should automatically exhaust entrained air that accumulates in system. Ductile iron body, cover and flange, Stainless steel ball floats for large and small orifice and trim should be provided to meet the operating conditions. Valve body should be coated with Epoxy powder Coating of minimum thickness 300 micron. The valve should automatically operate in order to:

- a) Positively open under internal pressure lower than the atmospheric pressure, to admit air in bulk during pipeline draining,
- b) Exhaust air in bulk during pipeline filling and positively close when water fills the body of the valve,
- c) Exhaust accumulated air under pressure when the pipeline is in operation

The valve body and bonnet should be made of ductile iron. The ball floats should be made of stainless steel or rubber coated steel. The nozzle (small orifice of the valve) should be made of brass. The valve should be flanged. The flange should comply with ISO 7005-2, EN 1092-2 or equivalent from other standards. For pipes 150 mm and larger, automatic air vacuum and air release valves shall be supplied with double orifice air valves with both, small and large orifices. Valves shall be of the flanged type and of pressure class PN 16 or PN 25 as mentioned in the BoQ. The following types and minimum sizes of air valves (nominal diameter) shall be used:

Pipeline = 150-300 mm - double air valve DN 50

Air release valve shall be provided at all high points to ensure adequate venting of the piping system.

In addition to above, the air release valves provided in firefighting system/network shall be UL listed and FM approved as mentioned in the BoQ.

2.9. FLOAT VALVES

Float valve shall be copper alloy piston type and conform to BS 1212. Float shall be of copper conforming to BS 1968.

2.10. PRESSURE REDUCING VALVE

Pressure reducing valve shall consist of screwed pressure reducing valve, body and screws of brass, spring, bonnet and regulation handle of high quality synthetic material, valve insert of corrosion resisting synthetic material (completely interchangeable), mesh strainer of corrosion resisting synthetic material with fine mesh of stainless steel, mesh width 0.16 mm diameter, strainer chamber of standard construction of shock-proof transparent synthetic material, 1/4" connection for pressure gauge on both sides of valve body, 2 pressure gauges, casing of synthetic material, diameter 63 mm, 1/4" connection. At bar calibrated

scale 0-16 bars. One double socket wrench for loosening of spring and strainer chambers, including all necessary sealing, and fixing material.

2.10 ABOVE GROUND FIRE HYDRANTS

Above ground fire hydrants shall conform to AWWA C502-80 and shall be of Ductile Iron body. The pressure rating shall be of at least PN 16 and test pressure of 1.5 times the working pressure. The lower part shall consist of ductile iron with drain opening. The upper part shall be of ductile iron with one 100mm (4") outlet and two 65mm (2½") outlets. The connection between upper and lower parts shall be constructed as a security break device with ductile iron ring and hexagonal screws.

The 100mm (4") outlet coupling shall be screwed according to BS 750, round threaded, the two 65mm (2½") couplings shall be of brass quick release/instantaneous type with brass covers and shall be suitable with the . The spindle and other equipment shall be stainless steel or other corrosion resistant material.

The inside coating shall be either pure enamel or epoxy resin based paint. The outside shall be painted bright red (fire red according to RAL 3000) with epoxy resin based paint.

2.11 BELOW GROUND FIRE HYDRANTS

Fire hydrants below ground shall be of type shown on drawing and shall be fixed vertical on ductile iron tee. It shall conform to EN 14339:2005 and BS 750. It shall be of Ductile Iron body and shall be securely anchored as shown on the drawings. The pressure rating shall be of at least PN 16 and test pressure of 1.5 times the working pressure.

All exterior surfaces of buried metal components of fire protection system shall be coated with a minimum of two coats of black bituminous enamel. The hydrant shall be installed in water tight chamber as shown on the drawings. Letter "F" or word "FIRE" shall be inscribed on the cover. The cover shall be water tight for the below ground fire hydrant chambers.

3. INSTALLATION OF VALVES

Valves shall be installed either in chambers with water tight covers or above grade on line as shown on the drawings and/or as directed by the Engineer. Before installation, the interior surfaces of valves shall be cleaned of all foreign matters, inspected to ensure that all components are sound and in working condition and tested to 1-1/2 times the working pressure and internally and externally coated. After installation, valves shall be securely anchored; tested, retouched where paints have been damaged and labeled.

4. MEASUREMENT AND PAYMENT

4.1. 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 therefore shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- i. Jointing arrangement of pipe on both ends of valves, including gaskets, nuts, bolts etc.
- ii. Valves and appurtenances supports and anchors
- iii. Keys for operation of valves
- iv. Steel embedded parts and label plates
- v. Valve boxes
- vi. Manufacturer's literature and operation manual for valves and appurtenances
- vii. Painting of valves appurtenances

4.2. MEASUREMENT

Measurement of acceptably completed works of valves and fire hydrants will be made on the basis of actual number of valves and fire hydrants provided and installed in position as shown on the drawings, and as directed by the Engineer.

4.3. PAYMENT

Payment for the acceptable measured quantity of valves and fire hydrants will be made on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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

SPECIFICATIONS

UNPLASTICISED POLYVINYL CHLORIDE (uPVC) PIPES AND PIPE FITTINGS (SEWER/GRAVITY)

1.0 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all uPVC pipes, plant, labor, equipment, appliances and materials and in performing all operations required for installing and testing of sewer pipes in strict accordance with the specifications of this section and applicable drawings and subject to the terms and conditions of the contract.

2.0 APPLICABLE CODES AND STANDARDS

All works and materials under this section shall conform to the latest edition of the following applicable codes and standards. When the requirements of this specification or the drawings exceed the code requirements, the Contractor shall be bound by the specifications and/or drawings for those requirements.

<u>Number</u>	<u>Title</u>
B.S. 3505	"Unplasticised PVC Pipe for Cold Water Services"
P.S. 3051	"Unplasticised PVC Pipe for Potable Water Services"
B.S. 4346	"Joints and Fittings with Unplasticised PVC Pressure Pipes"

Other authoritative codes and standards which ensure equal or higher quality than those references may also be acceptable subject to satisfaction and approval of the Engineer.

Any conflict between the requirements of this specification and those on the figures herein or in the codes, standards and specifications referred to herein shall be brought to the attention of the Engineer for resolution whose decision will be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 Pipes shall be new and unused.

3.2 Where manufacturers of pipes are specified, they shall be of the same manufacturer unless otherwise approved by the Engineer.

3.3 Where more than one similar item of pipes is specified, they shall be of the same manufacturer.

- 3.4 The Contractor shall submit to the Engineer for approval the following information regarding the specified/proposed items of pipes and fittings.
- (i) Name and address of the manufacturers
 - (ii) Country of origin, make and model
 - (iii) Dimensions and wall thicknesses of pipes
 - (iv) MTC - mill test certificate from the manufacturers
 - (v) Method of jointing, testing and commissioning
- 3.5 Approval by the Engineer shall not be construed as authorizing any deviation(s) from the specifications unless they are specifically brought to notice of the Engineer.
- 3.6 Approval by the Engineer shall not relieve the Contractor from any of his contractual responsibility regarding satisfactory performance and other requirements of the works.
- 4.0 SPECIAL REQUIREMENTS
- 4.1 Pipes shall be suitable for the intended use.
- 4.2 Every pipe shall be tested at the manufacturer's works to specified hydraulic test pressure. The test pressure shall be maintained for sufficiently long time for proof and inspection.
- 4.3 Each pipe shall be permanently marked or engraved giving the following information:-
- i Manufacturers Name or Trademark
 - ii Manufacturing date
 - iii Manufacturing number
 - iv Nominal diameter in mm
 - v Class or pressure rating
 - vi Manufacturers Inspection mark
 - vii Standards according to which the pipes and fittings have been manufactured.
 - viii Heat number should be embossed on all pipes, fittings and flanges
- 4.4 Unless otherwise specified, diameters of pipes and fittings shall be nominal. Actual inside and outside diameters and tolerances in diameters of pipes and fittings shall be according to the specified standards.
- 4.5 Unless otherwise specified, service ratings of pipes and fittings shall not be less than the maximum pressure to which they will be subjected to.
- 4.6 Unless otherwise specified, wall thicknesses of the pipes shall be according to the class, schedule or duty of the pipes. The wall thicknesses shall be measured at locations excluding the jointing ends. The tolerances in wall thicknesses shall be according to the specified standards.

Wall thicknesses of fittings shall not be less than those of corresponding pipes to which they are joined together.

4.7 Pipes and fittings ends shall match and compatible with each other and with the ends of valves and appurtenances to which they are joined.

4.8 Unless otherwise approved by the Engineer, pipes and fittings, jointing materials such as rubber rings, gaskets, nuts & bolts etc. shall be of the same manufacturers as those of the pipes and fittings.

5.0 MATERIALS

5.1 General

Materials shall conform to the latest referred standard specifications and other provisions stipulated herein and shall be new and unused. Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer for his approval a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams, drawings and such other technical data as may be required by the Engineer to satisfy him as to the suitability, durability, quality and usefulness of the material intended to be purchased.

5.2 Pipes

uPVC Sewerage Pipes shall conform to specified or appropriate class of B.S. 3505 or P.S 3051.

5.3 Material

The material from which the pipe is produced shall consist substantially of polyvinyl chloride, to which may be added only those additives that are needed to facilitate the manufacture of the polymer, and production of sound, durable pipe of good surface finish, mechanical strength and opacity. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic hazard or to impair the fabrication of welding properties of the pipe or to impair its chemical and physical properties.

The pipe material shall not have any detrimental effect on composition of the water flowing through them. The quantities of lead, dialeotal tin C4 and higher homologues and any other toxic substances extracted from the internal wall of the pipes shall not exceed the values specified in B.S 3505.

5.4 Joints

uPVC Sewerage pipes and fittings shall be joined with solvent cement of best quality as specified herein, in bill of quantities, as shown on the drawings and/or as directed by the Engineer and shall conform to B.S. 4346.

6.0 PIPE TESTS

6.1 Factory Tests

The Contractor shall inform the Engineer the schedule of pipe manufacturing in the factory for this particular project. The Engineer may visit pipe factory to inspect the pipe manufacturing process. The Engineer may assign his representative to supervise the manufacturing and testing of pipes.

The Contractor shall assign his representative at factory to supervise the pipe manufacturing and quality control.

The Contractor shall arrange the following tests at factory in the presence of Engineer or his representative on selected pipe samples.

- i. Dimension measurements (Wall thickness, Diameter, Length)
- ii. Visual Inspection

All the manufacturing pipes shall be individually checked for cracks and other defects before transportation to the site.

All pipes shall be properly marked at factory by embossing that number to identify the project consignment.

MTC – Mill Test Certificates for the above shall be submitted by the manufacturer.

6.2 Site Demonstration Test

- 6.2.1 The Contractor shall arrange the site visits of the pipe manufacturer or his representative to explain and demonstrate the pipe jointing, laying and hydraulic pressure testing procedure for all the pipe sizes, in the presence of Engineer before actual laying of uPVC pipes in the trenches.

Separate demonstration test will be required for each uPVC pipe size to be installed. Requirements of standard hydraulic pressure test specified in the later part of this section shall be applicable to this demonstration test.

Pipe joints and pipe surfaces shall be inspected during this demonstration. If the pipe joint are found leaking and the leakage is more than the allowable limits, the demonstration will be rejected and the Contractor will be required to remove the defective material either pipes or rubber rings whichever is applicable.

The pipes and rubber rings shall be selected at random by the Engineer from the stock lot brought at site by the Contractor. The Contractor must ensure delivery of quality material at site. The whole stock/lot shall be rejected if the pipes do not pass the demonstration test.

7.0 HANDLING AND STORAGE

7.1 General

The Contractor shall be responsible for proper handling, as per manufacturer's recommendations, of pipes and pipe fittings etc. All the material shall be stacked in accordance with the manufacturer's recommendations at approved places as directed by the Engineer.

7.2 Transportation

Transportation of pipes shall be done in such a way that they are secure and that no more than an absolute minimum of movement can take place on the vehicle during transit. The same care is needed if pipes are to be transferred from one vehicle to another, how short the final journey may be.

7.3 Off-loading

Cranes shall be used for off-loading. Whole sequence of operations shall be carried out smoothly and without snatch. Rope or nylon slings, lifting beams with flattened hooks or scissor-dog shall be used. Hooks and dogs shall be well padded to prevent the pipe being damaged and shall be fitted with locking device. Steadying ropes are essential.

7.4 Storage

Pipes should be carefully stored to prevent damage, pipes should not rest directly on ground. Solid timbers base should be set on ground for pipe stacking. Pipes should not be stacked so high as to over load the bottom. (The height of stack shall be further limited by the head room available for any fitting gear used on site). Pipe sockets should not normally rest on other pipes in the stack. The end pipes in the bottom row should be securely locked, wedges should be firmly anchored to prevent collapse of the stack. Pipes, and fittings damaged during handling, transporting or lowering shall be rejected and replaced at the contractor's expense. Storage shall be under shade so that all uPVC pipes & fittings are not exposed to sunlight and extreme heat.

8.0 LAYING AND INSTALLATION

8.1 Trenching

Pipe trenches shall be excavated up to required depth as indicated in the drawing. The excavated soil should be placed on one side of the trench leaving the other side clear for equipment and pipe handling. The bottom shall be carefully levelled. In-situ field density of trench bottom shall be determined. The bottom shall be compacted if in situ density is less than 60% of relative density as determined by ASTM D 2043. The test shall generally be carried out at spacing of 200 meters. If in some portion soft clayey material or loose material is encountered 300 mm of this material shall be replaced by specified bedding

material in that reach. If excavation is carried below required depth, the excess excavated part shall be refilled with bedding material at no extra cost to the owner. (No bedding material shall be placed nor any permanent work commenced until the trench has been inspected by the Engineer and his permission to proceed to the work is given).

8.2 Stringing and Inspection

Stringing, consists of placing pipes on the ground in line ready for laying. Care is again needed to prevent damage during this operation.

The turned ends of all pipes shall be inspected to ensure that they are free from any local irregularities which could affect the water tightness of the joint. All pipe shall also be visually inspected for evidence of impact damage. When such damage is detected, a thorough examination of internal surface in region of the pipe ends shall be made for sign of hair cracks. Damaged pipes, joints, and fittings shall be rejected and replaced at the expense of the Contractor.

8.3 Bedding Material

Bedding material for pipe shall be sand, well graded with portion passing through sieve #200 shall not be more than 10%, free from boulders, clay, cinder, ashes and rubbish etc.

8.4 Laying

Laying shall start at the lowest point in the area in which work is being done, pipe sections shall be laid with socket upstream.

Each length of uPVC Pipes between manholes shall be in a straight line and to the true alignment, position, gradient, and the inverts as shown on the Drawings, unless otherwise directed in writing and set out by the Engineer. The Contractor shall check and satisfy himself as to the correctness of the final gradient, position, and slope of the complete sewer trenches before commencing the laying operation.

At all times when the work of laying the sewer is not in progress, all openings into the pipe and the ends of the pipe in trenches shall be kept tightly closed to prevent entrance of ground water, animals and foreign materials. The Contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, and shall assume full responsibility for any damage due to this cause and shall, at his own expense, restore and replace the pipe to its specified position and grade if it is displaced due to floating.

The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean condition until the work is completed and approved by the Engineer.

Pipe and accessories shall be carefully lowered into the trench by means of derricks, ropes, belt slings, or other suitable methods. Under no circumstances shall any of the pipe and other materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe.

The full length of each section of pipe shall rest solidly up on the prepared bed of trench. Pipes that have the alignment, grades or joints disturbed after laying, shall be removed and re-laid by the Contractor at his own cost. Pipe shall not be laid in water or when trench conditions are unsuitable for the work.

8.5 Jointing

Except where otherwise detailed on the drawings, all pipes and joints shall be of solvent cement type.

All joints shall be capable of withstanding the various tests specified for the appropriate class of pipe. Joints shall withstand while maintaining the specified test pressure at a deflection of not less than the values specified in the relevant specification.

The jointing surfaces of pipes shall be dry, clean and free from oil, grease, tar, mud or sand particles.

In placing the pipe and making the joints, care shall be taken to avoid disturbance of bedding underneath the pipe barrel. If the joints cannot be made manually, mechanical pulling devices shall be used.

9.0 TESTING

9.1 General

After the joints are properly fixed and before backfilling the trenches, sewers shall be tested for infiltration or ex-filtration as specified. The Contractor shall test all sewers and their branches in such lengths and time selected at or approved by the Engineer. Sections of the completed sewer shall be isolated and measurement of the infiltration or ex-filtration shall be made by approved methods used for testing of sewer lines shall be absolutely free from insoluble impurities of any kind.

No chemical or adhesive shall be used for water tightening and repairing of pipes. Test reach in no case shall exceed 500 meter.

All joints shall be kept exposed or remain excavated during the testing to witness any leakage in the joints.

9.2 Infiltration

Sewer line shall be tested for infiltration test when the crown of the pipe is below the ground water table. The pipe length under test shall be completely emptied before starting infiltration test. The ends should be effectively closed.

One hour after completely emptying the pipes, depth of water shall be measured at both ends of the pipe. Estimated quantity of water infiltrated shall not exceed the specified allowable limits.

9.3 Ex-filtration

The sewers which are constructed with ground water level below the crown of the pipe shall be tested for ex-filtration.

A section of sewer shall be isolated between manholes by means of expanding stoppers or other approved methods. The length to be tested should be subjected to an internal pressure test of 1.20 meters head of water above the crown of pipe at the high end but not more than 6.0 meters at the low end.

Quantity of water required to achieve the starting level in the test reach after 1 hour shall be measured which shall not exceed the specified allowable limit.

9.4 Allowable Infiltration or Exfiltration Limits

The calculated amount of infiltration or ex-filtration over a 24-hour period shall not exceed 6 liters per millimeter dia. per kilometer of sewer which rate shall be applied to the actual sewer size and length tested to determine the allowable infiltration or ex-filtration over the 24-hour period.

If the measured infiltration or ex-filtration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs so as to reduce the leakage to less than the permissible maximum stated above.

9.5 Commissioning

After successful infiltration/ex-filtration testing of selected isolated pipe lengths, the contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Owner.

10.0 MEASUREMENT AND PAYMENT

10.1 General

Except otherwise specified here in or elsewhere in the Contract document, no separate measurement and payment will be made for the under mentioned works related to the relevant items of the Bills of Quantities, but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rates of the respective items of the Bills of Quantities.

- 10.1.1 Submission of Samples.
- 10.1.2 Factory Tests.
- 10.1.3 Site demonstration test
- 10.1.4 Cutting, jointing of sewer pipes.
- 10.1.5 Rubber rings.
- 10.1.6 Providing & fixing of uPVC pipe.
- 10.1.7 Cleaning, testing and commissioning of sewer lines.
- 10.1.8 Testing and compaction of trench bottoms.
- 10.1.9 Water used for testing of sewers.
- 10.1.10 Route markers

10.2 Measurement

Measurement of acceptably completed works of providing, laying, cutting and jointing of uPVC pipes with rubber rings/ cement solvent including cleaning and testing of sewer lines will be made on the basis of actual length in running meter of sewer pipes as per drawing or as directed by the Engineer.

10.3 Payment

Payment will be made for acceptable measured quantity of providing, jointing, laying, cutting and jointing of sewer pipes fittings with rubber rings including cleaning and testing of sewer lines on the basis of unit rate per running meter quoted in the bills of quantities and shall constitute full compensation for all the works related to the item.

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

SPECIFICATIONS

STEEL PIPES & PIPE FITTINGS FOR FIREFIGHTING INSIDE BUILDINGS

1.0 SCOPE

The works under this section of the specifications include furnishing all plant, labour, equipment, appliances and materials and in performing all operations required in connection with the supply, installation, testing, disinfection only in case of potable water system, flushing and commissioning of black steel pipes and pipe fittings as specified herein, in bill of quantities, as shown on the drawings, and/or as directed by the Engineer.

2.0 APPLICABLE CODES AND STANDARDS

All works and materials under this section shall conform to the latest edition of the following applicable codes and standards. When the requirements of these specifications or the drawings exceed the code requirements, the Contractor shall be bound by the specifications and/or drawings for those requirements.

- B.S. 4504 : Flanges and Bolting for Pipes, Valves and Fittings." (Part 1)
- B.S. 534 : "Steel Pipe, Fittings and Specials for Water, Gas and Sewage."
- B.S. 1965 : "Butt Welded Pipe Fittings for Pressure purposes, Part 1: Carbon Steel."
- B.S. 3601 : "Steel Pipes and Tubes for pressure purposes, Carbon steel: Ordinary Duties."
- B.S. 3063 : "Dimensions of Gaskets for Pipe flanges".
- B.S. 4147 : "Hot applied bitumen based coatings for ferrous products."
- B.S. 4161 : "Coal tar based hot applied coating materials for protecting Iron and Steel products".
- B.S. 4515 : "Field welding of carbon steel pipe lines".
- ISO 898 : "Mechanical Properties of Fasteners, Bolts, Screws and Studs." C.P.2010
: "Pipelines Part 2: Design and Construction of Steel Pipelines in Land."

Other authoritative codes and standards which ensure equal or higher quality than those references may also be acceptable subject to satisfaction and approval of the Engineer.

Any conflict between the requirements of this specification and those on the figures herein or in the codes, standards and specifications referred to herein shall be brought to the attention of the Engineer for resolution whose decision will be final and binding.

3.0 APPLICABLE SECTIONS OF TECHNICAL SPECIFICATIONS

The following specification sections except for sub-sections "Measurement and Payment" shall be followed for carrying out associated works mentioned herein below.

4.0 GENERAL REQUIREMENTS

- 4.1 Pipes and fittings shall be new and unused.
- 4.2 Where manufacturers of pipes and fittings are specified, they shall be of the same manufacturers unless otherwise approved by the Engineer.
- 4.3 Where more than one similar item of pipes and fittings are specified, they shall be of the same manufacturer.
- 4.4 The Contractor shall submit to the Engineer for approval of the following information regarding the specified/proposed items of pipes and fittings.
- (i) Name and address of the manufacturers
 - (ii) Country of origin, make and model
 - (iii) Dimensions and wall thicknesses of pipes and fittings
 - (iv) Material and thicknesses of coating and lining
 - (v) MTC - mill test certificate from the manufacturers
 - (vi) Heat number should be embossed on all pipes, fittings and flanges
 - (vii) Warranty if so provided by the manufacturers
 - (viii) Method of jointing, testing and commissioning
- 4.5 Approval by the Engineer shall not be construed as authorizing any deviation(s) from the specifications unless they are specifically brought to notice of the Engineer.
- 4.6 Approval by the Engineer shall not relieve the Contractor from any of his contractual responsibility regarding satisfactory performance and other requirements of the pipes and fittings.

5.0 SPECIAL REQUIREMENTS

- 5.1 Pipes and fittings shall be in compliance with the NFPA requirements.
- 5.2 Every pipe shall be tested at the manufacturer's works to specified hydraulic test pressure. The test pressure shall be maintained for sufficiently long time for proof and inspection.
- 5.3 Each pipe and fitting shall be permanently marked or engraved giving the following information:-
- (i) Make and Nominal diameter
 - (ii) Class, Duty or Service (Pressure) Rating

- (iii) Standards according to which the pipes and fittings have been manufactured.
- 5.4 Unless otherwise specified diameters of pipes and fittings shall be nominal. Actual inside and outside diameters and tolerances in diameters of pipes and fittings shall be according to the specified standards.
- 5.5 Pipes and fittings shall be seamless or welded as specified herein or in bill of quantities, as shown on the drawings and/or as directed by the Engineer. If the Contractor so desires, seamless pipes and fittings may be substituted for welded pipes and fittings at no risk or cost to the owner. Where neither seamless nor welded pipes and fittings are specified, pipes and fittings shall be seamless unless otherwise approved by the Engineer.
- 5.6 Unless otherwise specified, service ratings of pipes and fittings shall not be less than the maximum pressure to which they will be subjected to.
- 5.7 Unless otherwise specified, wall thicknesses of the pipes shall be according to the class, schedule or duty of the pipes. The wall thicknesses shall be measured at locations excluding the jointing ends. The tolerances in wall thicknesses shall be according to the specified standards. Wall thicknesses of fittings shall not be less than those of corresponding pipes to which they are joined together.
- 5.8 Pipes and fittings ends shall be matching and compatible with each other and with the ends of valves and appurtenances to which they are joined.
- 5.9 Unless otherwise approved by the Engineer, pipes and fittings, jointing materials such as rubber rings, gaskets, nuts & bolts and jointing compound etc. shall be of the same manufacturers as those of the pipes and fittings.

6.0 MATERIAL

6.1 Pipe

Black steel pipes shall conform to ASTM – A53, schedule 40 and shall be listed in accordance with NFPA requirement.

6.2 Fittings

Dimensions of black steel fittings shall conform ASTM A-234.

6.3 Joints

Black steel pipes and fittings shall be joined by welding except for joining of valves and appurtenances and at locations as shown on the drawings and /or as directed by the Engineer. Welded joint shall conform to B.S. 4515. Black steel pipe flanges shall conform to specified or appropriate Table of B.S. 10. Nuts and bolts for flanges shall be of hexagon shape and shall conform to ISO 898. Gaskets shall be of flat shape and shall conform to B.S. 3063.

7.0 INSTALLATION

7.1 **Transportation, Handling and Storage**

The Contractor shall be responsible for proper transportation, handling (loading and unloading) and storage of pipes and fittings as per the manufacturer's recommendations and direction of the Engineer.

Crane, rope or nylon slings, lifting beams with flattened hooks or scissor-dog shall be used for loading and unloading of pipes and fittings. Hooks and dogs shall be well padded to prevent the pipe being damaged and shall be fitted with locking device. Steadying ropes are essential.

Pipes and fittings damaged during transportation, handling or storage or lowering shall be rejected and replaced at the Contractor's expense. Storage of gaskets and jointing compound shall be under shade to prevent damage by sunlight and extreme heat.

7.2 Inspection

Pipes and fittings shall be visually inspected for any evidence of damage or hair cracks. The turned ends of pipes and fittings shall be inspected for any local irregularities which could affect the water tightness of the joint. Damaged pipes and fittings shall be rejected and replaced at the Contractor's expense.

7.3 Laying and Jointing

(a) Above Ground (Unburied)

Before installation, the interior of pipes and fittings shall be thoroughly cleaned of all rust, dirt and foreign materials.

Pipe and fittings shall be installed to lines and grades as shown on the drawings and/or as directed by the Engineer.

Pipe joints shall be welded unless otherwise specified and/or directed by the Engineer except for jointing valves and appurtenances and where welding is not possible. Welding shall be done by qualified and licensed welders using electric arc welding process. The welding shall develop full strength of the adjoining steel. Defective joints and joints not developing full strength shall be rejected at the risk and cost of the Contractor.

Pipes and fittings shall be properly supported by galvanized steel clamps, brackets and hangers, etc. Supports shall permit unrestrained expansion and contraction. Clamps, brackets and hangers etc. shall be designed to take the weight of pipe, weight of water, seismic and wind loads.

Thrust anchors shall be provided at all changes in the pipe diameters and directions and at all branches and dead ends.

Thrust anchors shall be designed to resist maximum thrust forces resulting from the worst possible combination of working/static/test pressures, transient/water hammer pressure, thermal expansion/contraction, seismic and wind loads.

The Contractor shall submit to the Engineer for approval shop drawings of the pipe supports and thrust anchors. The supports and anchors shall be used only after approval by the Engineer.

Approval by the Engineer shall however, not relieve the Contractor from any of his contractual responsibility regarding safety requirements of the supports and anchors.

Pipes passing through floors, ceilings, roof, walls and columns in non water retaining structures above ground or water table shall be encased in black steel pipe sleeve. The annular space between the pipes and the pipe sleeves shall not be less than one inch. The annular space shall be filled with approved packing material and sealed at both ends with approved sealant.

Pipes passing through water retaining structures above or below ground and non water retaining structures below water table shall be provided with leak proof puddle flange. The flange diameter shall be larger than the outside diameter of the pipe by atleast 100mm for pipe diameters 150mm and smaller and by atleast 150mm for pipe diameters larger than 150mm.

After installation, pipes, fittings, pipe supports and thrust anchors shall be painted with two coats of red oxide or zinc chromate primer and two coat of synthetic enamel paint of approved quality.

(b) Below Ground (Buried)

Before installation, the interior of pipes and fittings shall be thoroughly cleaned of all rust, dirt and foreign materials.

Laying of pipes and fittings shall be carried out according to the British Standard practice CP2010: Part 4.

Pipes and fittings shall be laid to alignments and grades as shown on the drawings and/or as directed by the Engineer.

Pipes and fittings shall be lowered into the trench in a manner approved by the Engineer. All care shall be taken to avoid abrasion of the pipes and fittings.

The pipes shall be laid on specified bedding material. Before laying bedding material shall be approved by the Engineer. Recesses shall be excavated in the bottom and sides of the trench to accommodate joints, fittings and specials. After laying of pipe and fittings, the recesses shall be filled with specified bedding material and thoroughly compacted manually.

Pipes and fittings alignments, that have the grades or joints disturbed or dislocated after laying shall be removed and relaid to the entire satisfaction of the Engineer.

Backfilling shall be carried out with the specified materials and in the specified sequence. Backfill shall be laid in layers and compacted to 95 percent of AASHTO modified density.

The thickness of each compacted layer shall not exceed 6 inches. Hand tools shall be used for compaction of backfill/bedding material around the pipe and fittings. Mechanised methods may be used for compaction of backfill 12 inches over/above crown of the pipeline.

When laying is not in progress, the open ends of the pipeline shall be closed with a temporary plug as approved by the Engineer.

Small changes in direction may be made by deflecting the last laid pipe after the joint has been made. If the alignment requires deflection in excess of the manufacturer's recommended limits, bends shall be used.

Concrete thrust blocks shall be provided at all changes in the pipe diameters and directions and at all branches and dead ends.

After installation, pipe and fittings shall be applied with two coats of bituminous paint and wrapped with soaked bitumen hessian cloth. Alternatively pipe and fittings shall be double wrapped with bituminised tape ('Denso' or equivalent).

8.0 TESTING

After laying each section of pipeline as convenient to the contractor or as necessary in the Engineer's opinion, shall be tested for hydrostatic pressure. Field hydrostatic test pressure shall not be less than one and one a half times the maximum pressure to which the system will be subjected to.

Before testing, pipe section shall be cleaned and their ends shall be closed with blank flanges, plugs or caps. The closed ends shall be anchored against thrust forces. Valved air vent outlet shall be installed at the upper end of the pipe section and valved water inlet fitting shall be installed at the lower end of the section. Pressure gauge certified from any approved laboratory shall be installed at both lower and upper ends of the pipe section. An isolating ball valve shall be fitted between the pipe section and the gauges.

Sufficient backfill material shall be placed over the centre section of each pipe (leaving the joints exposed) to allow inspection of the pipe joints under the test pressure. All permanent anchors shall be in positions and shall have developed adequate strength before the testing begins. The pipe section under test shall be filled with water from the inlet fitting, taking care that all air is displaced through the vent outlet.

After filling, the pipeline shall be left under small pressure for 24 hours as directed by the Engineer in order to wet the pipe and the pipe joints. After the wetting period, additional water shall be introduced into the pipe section until the test pressure is achieved when the pipe section shall be closed.

The test pressure shall be maintained for at least two hours or for a period as directed by the Engineer. Pressure gauges shall be read at maximum intervals of 15 minutes during the test period.

If the pressure measurements are not made at the lowest point of the section, an allowance shall be made for the static head between the lowest point and the point of measurement to ensure that the specified works test pressure is not exceeded at the lowest point.

If a drop in pressure occurs, additional quantity of water shall be introduced into the pipe section in order to re-establish the test pressure. The additional quantity of water introduced into the pipe section shall be accurately measured.

During the test period all joints shall be inspected. If any abnormal movement, distortion, squirm or leakage is detected, the test pressure shall be relieved immediately and the defects shall be rectified in consultation and with the approval of the Engineer.

After rectification of the defects, the pipe section shall be re-tested.

The test will be considered to have passed, if no leakage or drop in pressure is observed after.

9.0 **FLUSHING**

After installation and testing pipelines shall be flushed with water until all dust, dirt, scales and extraneous matters are removed from the inside of the pipeline. During flushing all valves and appurtenances shall be closed and opened several times.

10.0 **COMMISSIONING**

After successful completion of testing and flushing duly approved by the Engineer, pipelines shall be commissioned. All valves and appurtenances shall be set at proper openings and all parameters shall be set at specified or manufacturers' recommended values.

11.0 **PIPEWORK SUPPORTS**

All pipe work supports shall be of mild steel rolled sections and shall be painted with two coats of approved rich metallic zinc primer. Straps, rods and hangers shall be of mild steel when used for galvanized steel pipes.

Straps shall be provided on all pipe supports. Straps shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide allowing the pipe to slide axially.

Horizontal pipe work along walls shall be supported on channel frames securely fixed to the column. All pipes shall be arranged to slide on the pipe supports and straps shall be provided to form a rigid guide.

Vertical pipe work shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means of support for the riser.

Pipe work supports shall be so designed and installed as to allow free movement due to expansion and contraction. Supports shall be anchored to steel or reinforced concrete column, wall, beam or slab.

Each support shall be able to carry independently its all the operational loads of pipe work and water.

All pipes shall be individually supported. Pipes shall not hang from other pipes. Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

12.0 MEASUREMENT AND PAYMENT (STEEL PIPE)

12.1 General

Except otherwise specified herein or elsewhere in the Tender/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 related to the section.

12.1.1 Submission of pipe/fittings sample/site demonstration test

12.1.2 Transportation

12.1.3 Stacking and stringing

12.1.4 Cutting, welding, jointing and laying including jointing materials such as rubberrings, gaskets, nuts and bolts, jointing compounds, welding electrodes etc.

12.1.5 Protective painting, coating, lining and wrapping

12.1.6 Testing, flushing and commissioning.

12.1.7 Pipe work supports such as clamps, brackets, hangers etc.

12.1.8 Pipe bedding

12.1.9 Thrust block

12.1.10 Cutting and breaking of concrete and then making it good.

12.1.11 Pipe fittings and accessories.

12.1.12 Water used for testing of pipeline

12.1.13 Steel Pipe reducer/ enlarger / sleeve

12.2 Steel Pipe

12.2.1 Measurement

Measurement of acceptably completed works of steel pipes including fittings and flanges etc. will be made on the basis of actual length in running meters of pipes provided, installed in positions, tested, flushed, and commissioned as specified herein, in bill of quantities, as shown on the drawings and/or as directed by the Engineer.

12.2.2 Payment

Payment for acceptable measured quantity of steel pipes including fittings and flanges will be made on the basis of unit rate per running meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the items.

***** END OF SECTION**

SPECIFICATIONS FIRE PROTECTION

1. SCOPE OF WORK

The work to be done under this section of the specification includes furnishing all plant, labour, equipment, appliances and materials and in performing all operations required in connection with the supply and installation of black steel pipes and fittings for fire fighting system, portable fire extinguishers, fire hose cabinets, as shown on the drawings, in compliance to NFPA requirement as specified herein and/or as directed by the Engineer.

2. PIPE AND FITTINGS

2.1 Material

Seamless black steel plain end pipe shall conform to ASTM A53 & fittings shall conform to ASTM A 234. in compliance to NFPA requirement. For detail specifications refer Section 5214A, for testing & commissioning of fire fighting system refer section 5180.

All underground piping to be wrapped using anticorrosive tape with overlapping as approved by Engineer. Exposed pipes are to be painted with two coat of red oxide and one coat of red paint. Red oxide and red paint shall be of reputed manufacture as approved by the Engineer.

Pipe & Pipe Fittings

2.2 Measurement

Measurement for acceptably completed works of supply and installation of black steel pipe will be in running meter length and the work to be done shall include earth work, providing and fixing of pipe, pipe fittings, jointing, supports (hangers, clips and brackets, steel clamps, tie rods, nuts and bolts, channels and angle iron, etc.), cutting and breaking concrete and then making it good, applying protective painting, cleaning, testing, disinfection, commissioning and the measurement will be made for complete work specified herein.

2.3 Payment

Payment for acceptable measured quantity will be made at the unit rate per running meter length of black steel pipe quoted in the Bill of Quantities. The amount bid shall be the full payment for completion of the work in all respects as specified herein.

3. PORTABLE FIRE EXTINGUISHERS

3.1 Materials and Equipment

Portable and trolley type fire extinguishers shall contain specified quantities and types of relevant extinguishing agents. All Fire Extinguishers are tested by the Underwriters Laboratory (UL) for safety and performance and shall be classified according to type of extinguishing agents, the class of fire types for which it is intended to be used. The extinguisher container/vessel shall be of anticorrosive material.

Extinguisher shall be coated externally with high quality 100% polyester resin / High quality polyester paint or as approved by the Engineer and shall be lined internally with corrosion-resistant material.

Portable and trolley fire extinguishers shall ensure stability against damage and corrosion resistance under sea environment

The extinguisher container shall be designed as pressure vessel and shall conform to all the applicable standards of ASME pressure vessel codes.

The container shall be fitted with spring-loaded pressure safety valve. The valve shall be set to blow off at 90% of container test pressure.

3.2 Codes and Standards

Portable and trolley fire extinguishers shall conform to NFPA (National Fire Protection Association) of U.S.A. or F.O.C. (Fire Offices Committee) of U.K, EN, DIN, MED, and BSI. Kite mark / LPCB Approved.

3.3 Types of Extinguishers

3.3.1 Carbon Dioxide Extinguisher

Carbon dioxide extinguisher shall contain specified quantities of carbon dioxide gas under pressure. The extinguisher shall have knob or lever operated valve, a short length of hose and a discharge hose at the end of the hose. A siphon/dip tube shall extend from the valve to the bottom of the container. The valve shall have safety pin to prevent accidental release of the extinguishing agent.

Extinguisher shall be coated externally with high quality 100% polyester resin / High quality polyester paint or as approved by the Engineer and shall be lined internally with corrosion-resistant material.

3.3.2 Foam Extinguisher

Foam extinguisher shall contain specified quantities of premixed foam of 1 liters of water the extinguisher shall be pressurized with nitrogen. The extinguisher shall have a short length of hose and a valved nozzle. The valve shall have safety pin to prevent accidental release of the extinguishing agent. The extinguishers shall be self-expellant. In no case antifreeze additive shall be used.

Extinguisher shall be coated externally with high quality 100% polyester resin

/ High quality polyester paint or as approved by the Engineer and shall be lined internally with corrosion-resistant material.

3.3.3 Dry Chemical Extinguisher

Dry chemical extinguisher shall contain specified quantities of dry powder chemical. The type of dry powder shall be suitable for the intended use. The extinguisher shall have knob or lever operated valve, a short length of hose and a nozzle at the end of the hose. A siphon/dip tube shall extend from the valve to the bottom of the container. The valve shall have safety pin to prevent accidental release of the extinguishing agent. The discharge pressure shall be obtained from pressurized carbon dioxide cartage attached to the body of the extinguisher. The operation of the knob or lever shall pierce the cartage to obtain the expellant pressures.

Extinguisher shall be coated externally with high quality 100% polyester resin

/ High quality polyester paint or as approved by the Engineer and shall be lined internally with corrosion-resistant material

3.3.4 Wet Chemical Extinguisher

Wet chemical portable fire extinguishers shall be the severe which are rated for kitchen fires such as ignition in cooking oil, deep pans frying pans, etc. for both domestic / small scale and industrial kitchens.

Extinguisher shall be coated externally with high quality 100% polyester resin

/ High quality polyester paint or as approved by the Engineer and shall be lined internally with corrosion-resistant material

3.3.5 Mobile CO2 Fire Extinguishers

Mobile CO2 Fire Extinguishers type fire extinguisher shall comply with all the specification requirements of BS EN 1866 standard, Kite mark / LPCB Approved Kite mark / LPCB Approved. Ideal for use in marine industry. CO2 cylinder with screw down valve and bursting device, high pressure hose with extinguishing shower/snow pipe. All mounted on trolley with solid rubber tyre disc wheels. Mobile CO2 Fire Extinguishers shall be made of rugged steel and welded to meet extreme use conditions shall be of anticorrosive material ready for instantaneous use and simple to operate.

Mobile CO2 Fire Extinguishers shall be weather-proof and have resistant coating or high gloss polyester/electrostatic powder painted, UV stabilized after shot blasting ensuring corrosion resistance under extreme condition or as approved by the engineer. Cap shall be of brass nickel chrome plated for ease during refilling the agent. Cylinder assemblies should be designed for easy maintenance by mounting it separately on steel frame and thus can be separated by just removing the steel clamp.

3.3.6 Foam Trolley

Foam trolley type fire extinguisher shall comply with all the specification requirements of BS EN 1866-1 standard. shall be Kite mark / LPCB Approved Agent used shall be AFFF with 6% concentration synthetic aqueous film forming foam for effective fire extinguishment. Trolley shall be made of rugged steel and welded to meet extreme use conditions. Foam Fire Extinguisher shall be weather-proof and high resistant coating of high gloss polyester/electrostatic powder painted UV stabilized after shot blasting to ensure corrosion resistance under extreme condition or as approved by the engineer. Cap shall be of brass nickel chrome plated for ease during refilling the agent. Cylinder assemblies should be designed for easy maintenance by mounting it separately on steel frame and thus can be separated by just removing the steel clamp. The trolley shall be of anticorrosive material ready for instantaneous use and simple to operate

3.4 Installation

Portable fire extinguishers shall be installed at 1 meter height above finished floor.

Where only extinguishers are installed, they shall be fixed to wall or column

with painted steel clamps or stored in steel or concrete fire extinguisher cabinets as shown on the applicable drawings or as directed by the Engineer. Where clamped to the wall/column the clamp shall be such that extinguisher can be conveniently fixed and removed without loss of time.

Where stored in cabinets, the cabinets shall be of steel or concrete with glazed steel door painted with at least two coats of anti-corrosive signal red enamel paint over a prime coat of red oxide paint. The locking arrangement will be such that the door can be opened from inside by breaking the glass and from outside with key.

Validity of portable fire extinguisher shall be at least one year after completion of defect liability period

3.5 Markings

Portable Fire extinguishers shall be painted with colour code according to NFPA Standard specifications. On the body of the extinguishers shall be marked/imprinted the following information.

- i. Instructions on how to use the extinguisher.
- ii. Name of the extinguishing agent.
- iii. Weight/volume of the extinguishing agent.
- iv. Gross weight of the extinguisher.
- v. Filling pressure of the extinguishing agent.
- vi. Classes of fires for which the extinguishing agents may be effectively used.
- vii. Name of the manufacturer and the year of manufacture.

3.6 Testing and Commissioning

Testing of portable fire extinguishers shall be as per NFPA -10

4. MEASUREMENT AND PAYMENT

Portable Extinguishers, Mobile CO2 & Foam trolley

4.1 Measurement

Measurement of acceptable completed works of portable fire extinguishers mobileCO2 & foam trolley will be made on the basis of actual number of extinguishers provided and installed in accordance with the above specifications and applicable drawings.

4.2 Payment

Payment for acceptable measured quantities of portable fire extinguishers, CO2 & foam trolley will be made on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

6. FIRE HOSE CABINET

6.1 Scope of Work

The works covered by this Section of the Specifications include all plants, equipment, appliances, materials and labour etc. for installation of Fire Hose Cabinets in compliance to NFPA requirement and strict accordance with these specifications and applicable drawings.

6.2 Fire Hose Cabinet

The recess type cabinet or wall type cabinet shall be of 8 gauge steel of size as shown in drawing. The cabinet shall be coated with approved red epoxy inside and outside. The door shall be hinged steel glass door with locking arrangement. It shall have steel hose rack with hose which can swing 180° on hinges. The cabinet shall have 40 mm diameter hydrant angle valve 40 mm, 30 meter. long synthetic, single jacket lined hose for test pressure of 20 bars minimum, with dia 15 mm one multi-purpose brass nozzle as approved by fire department

6.3 Installation

Fire Hose Cabinet shall be installed flushed with outside finishes or on wall as approved. The fire hose shall be connected to fire water system, through a Hydrant 65 mm x 40 mm diameter valve. The minimum pressure at the valve in cabinet shall not be less than 4.5 bars. The maximum pressure at the valve shall be more than 6 bars. In case the pressure at the valve exceeds 6 bars, the pressure shall be reduced to 6 bars using pressure reducing device such as orifice plate.

6.4 Siamese Connection

With two B-couplings according to NFPA or another equivalent, approved standard, (2-1/2" diameter) with ball valves, caps, and union, installed in one galvanized sheet steel plate.

6.5. PRESSURE REDUCING VALVE

Screwed pressure reducing valve, body and screws of brass, spring, bonnet and regulation handle of high quality synthetic material, valve insert of corrosion resisting synthetic material (completely interchangeable), mesh strainer of corrosion resisting synthetic material with fine mesh of stainless steel, mesh width 0.16 mm dia, strainer chamber of standard construction of shock-proof transparent synthetic material, ¼” connection for pressure gauge on both sides of valve body, 2 pressure gauges, casing of synthetic material, dia 63 mm, ¼” conn. At bar, calibrated scale 0-16 bars. One double socket wrench for loosening of spring and strainer chambers, including all necessary sealing, and fixing material.

Diameter : Diameter 20 mm

7. MEASUREMENT AND PAYMENT

7.1 Measurement

Measurement of acceptably completed works of fire hose cabinet, pressure reducing valve & Siamese connection will be made on the basis of actual number provided and installed in position as shown on the drawing or as directed by the Engineer.

7.2 Payment

Payment will be made for acceptable measured quantity of fire hose cabinet, pressure reducing valve & Siamese connection, on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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

SPECIFICATIONS

CAST IRON/ DUCTILE IRON COVERS WITH FRAMES

1.0 SCOPE OF WORK

The work to be done under this section of the specifications consists of furnishing all plant, labor, equipment, appliances, materials and performing all operations required in connection with the installation of Cast Iron/ Ductile Iron Cover with Frame, Gratings and ladder rungs, complete as specified herein, as shown on the drawings and or as directed by the Engineer.

2.0 APPLICABLE CODES AND STANDARDS

All works and materials under this section shall conform to the latest edition of the following applicable codes and standards. When the requirements of this specification or the drawings exceed the code requirements, the Contractor shall be bound by the specifications and/or drawings for those requirements.

<u>Number</u>	<u>Title</u>
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BS EN 124	"Gully Tops and Manhole Tops for Vehicular and Pedestrian Areas"
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Other authoritative codes and standards which ensure equal or higher quality than those references may also be acceptable subject to satisfaction and approval of the Engineer.

Any conflict between the requirements of this specification and those on the figures herein or in the codes, standards and specifications referred to herein shall be brought to the attention of the Engineer for resolution whose decision will be final and binding.

3.0 CAST IRON/ DUCTILE IRON COVERS WITH FRAME

Cast iron/ ductile iron cover and frame shall be of the sizes and duty as specified on the drawings. The specified size means the clear opening. The cover shall be complete with frame. Top of cover shall be roughened, name/ logo of the Employer marked with the letters representing system for which manholes are constructed duly approved by the Engineer. Locking and lifting arrangement shall also be provided. The frame shall be well set in place at the time of pouring of concrete. The cover shall tightly fit in the frame. The class and test load for cover and frame shall be as follows:

Class/Duty of Cover and Frame	Peak or Test Load
A 15	15 KN
B 125	125 KN
C 250	250 KN
D 400	400 KN
E 600	600 KN
F 900	900 KN

The Contractor shall ensure that the manhole is rated for above mentioned test load irrespective of the weight.

4.0 CAST IRON/ DUCTILE IRON GRATING AND FRAME

All cast Iron/ ductile iron grating and frame shall be of the sizes and duty as specified on the drawings. The class and test load for grating and frame shall be same as provided in the above table. The specified size means the clear opening. Cast iron grating shall be complete with frame. The casting shall be sound and free from all defects. The frame shall be set in place at the time of pouring of concrete. Opening in gratings shall be in an approved pattern.

5.0 LADDER RUNGS

Galvanized steel ladder rungs with epoxy coating shall be fabricated to the size specified on the drawings or as directed by the Engineer. The galvanized mild steel ladder rungs with epoxy coating shall be embedded in the concrete of manholes or chambers at locations shown on the drawings or as directed by the Engineer.

6.0 MEASUREMENT AND PAYMENT

Measurement

Measurement of acceptably work of cast iron cover & frame, ladder rung will be made on the basis of actual number provided and installed in position as shown on the drawing and as directed by the Engineer.

Payment

The payment for the acceptable measured quantity will be made on the basis of unit rate per number quoted in the bill of quantities and shall constitute full compensation for all the works related to the item.

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

SPECIFICATION FOR PUMPING MACHINERY

1. GENERAL

1.1 SCOPE

The Work under this Section shall include all labor, materials, and equipment required to furnish and install the pumps along with motors and all other accessories in the location and quantities as shown on the drawings and or as specified in this section.

1.2 REFERENCES

1.2.1 ASTM - American Society of Testing and

Materials ASTM A 36 Structural Steel.

ASTM A 48 Gray Iron Castings.

ASTM A 53 Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated (Galvanized), Welded and Seamless.

ASTM A 108 Steel Bars, Carbon, Cold Finished, Standard Quality. ASTM A 276 Stainless Steel Bars and Shapes.

ASTM A 297 Steel Castings, Iron-Chromium, Iron-Chromium-Nickel, Heat-Resistant, for General Applications.

ASTM A 536 Ductile Iron Castings.

1.3 MATERIALS AND PRODUCTS

Materials and machinery shall conform to the latest referenced specifications and other provisions specified herein and shall be new and unused. In case where manufacturers are specified, materials and equipment will be of the same manufacturers. In all other cases the Contractor shall ensure that all components and accessories shall be product of single manufacturer and submit the names and addresses of the Manufacturers and trade names of the materials and equipment that he intends to provide. Contractor shall also provide the information such as diagram, drawing and descriptive data. Approval of materials and all the machinery under this provision shall not be construed as authorizing any deviations from the specifications. The Engineer will review all submittals and all technical data to ensure compliance with the requirement of design drawings and specifications.

1.4 SPECIAL REQUIREMENTS

- 1.4.1 The Contractor shall furnish with each pump properly identified characteristic curves prepared and certified by the manufacturer showing capacity, head, efficiency and brake horsepower throughout the entire range of the pump.
- 1.4.2 The Pumps shall have stable throttling curves and be suitable for unrestricted parallel operation.
- 1.4.3 All Pumps shall be electric driven or as mentioned in bill of Quantities.
- 1.4.4 The Pumps and their drives shall not overload or trip when operating against zero pressure.
- 1.4.5 The design, construction and materials shall be such that the damage as a result of cavitation is completely eliminated.
- 1.4.6 Pumps shall have bearings and be suitable for continuous as well as intermittent operation without external sealing or cooling water. The pumps shall be such that they shall come into operation at once after a prolonged shutdown period without having to take special measures. Pumps shall be capable of delivering specified quantity of water at the specified pressure.
- 1.4.7 Pumps shall be tested at factory for FAT (Factory Acceptance Test) in the presence of Employer and Engineer or his representative before dispatching to the site.
- 1.4.8 Pumps shall be installed at positions shown on the Drawings and/or as directed by the Engineer.
- 1.4.9 Pumps and their drives shall be in perfect alignment when installed in position.
- 1.4.10 Pump set shall be provided with reducer/enlarger if necessary on pump discharge pipe, and suction piece on the suction end.

1.5 SUBMITTALS

- 1.5.1 Product Data: Submit manufacturer's Pumps specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.
- 1.5.2 Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

- 1.5.3 Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to plumbing of Pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory- installed and portions to be field-installed.
- 1.5.4 Certificate of Compliance.
- 1.5.5 Maintenance Data: Submit maintenance data for each type of Pumps, control, and accessory; including "trouble-shooting" maintenance guide.

1.6 TRANSPORTATION, HANDLING AND STORAGE

- 1.6.1 Deliver Pumps, hardware and accessories in manufacturer's original new, protective packing.
- 1.6.2 Handle Pumps and components carefully to prevent damage, breaking, denting and scoring. Contractor shall not install damaged pumps or components delivered at site and shall replace if any with new/ unused.
- 1.6.3 Store Pumps and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- 1.6.4 Comply with manufacturer's written rigging and installation instructions for unloading, plumbing Pumps, and moving them to final location.

1.7 WARRANTY

All pumping assemblies and components including Pumps, motors, controls, etc. shall be guaranteed by the system manufacturer in writing for a period of minimum 1 year after satisfactory installation, testing, commission and acceptance by the Client and from date of substantial completion against defective materials and workmanship, including motor burn-out.

Water pressure booster system as a whole shall be also guaranteed in writing by the manufacturer for a period of 1 year after satisfactory installation, testing, commission and acceptance by the Client and from the date of substantial completion against any defects in design, materials, construction or workmanship.

1.8 QUALITY ASSURANCE

- 1.8.1 Manufacturer's Qualifications: Firms regularly engaged in manufacture of Pumps with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years, and shall be subject to approval of the Engineer.

1.8.2 Provide pumps whose performance, under indicated operating conditions, are certified by the pump manufacturer.

1.8.3 Single Source Responsibility: All the components and accessories shall be product of single manufacturer.

1.9 PRODUCT HANDLING

Deliver all hardware in manufacturer original protective packing.

2. PRODUCTS

2.1 GENERAL

Materials and machinery shall conform to the latest referenced specifications and other provisions specified herein and shall be new and unused. In case where manufacturers are specified, materials and equipment will be of the same manufacturers. In all other cases the Contractor shall ensure that all components and accessories shall be product of single manufacturer and submit the names and addresses of the Manufacturers and trade names of the materials and equipment that he intends to provide. Contractor shall also provide the information such as diagram, drawing and descriptive data.

2.1.1 Statistically and dynamically balance rotating parts.

2.1.2 Construction shall permit complete servicing without breaking piping or motor connections.

2.1.3 Pumps connections shall be flanged.

2.1.4 Pumps shall be selected to operate with non-overloading characteristics.

2.1.5 The characteristic curve of a centrifugal pump shall be stable; the head shall increase with decrease in delivery until maximum head reached at zero flow which shall not exceed the discharge pressure at rated duty by more than 25%.

2.2 HORIZONTAL CENTRIFUGAL PUMPS & MOTOR (FOR POTABLE WATER)

2.2.1 The pump sets will consist of horizontal centrifugal pump and motor of specified capacity and head and shall be horizontal, totally enclosed, fan cooled, squirrel cage induction motors of specified power.

2.2.2 Pump materials shall be as under:

Body	:	Cast iron
Impeller	:	Bronze or Stainless

Steel Pump Shaft : Stainless Steel
Shaft Sleeve : Stainless steel

- 2.2.3 Pumps shall have mechanical seal. The suction and discharge flanges shall be rated for at least 1.5 times the working pressures.
- 2.2.4 The efficiency of the pumps should not be less than 60%.
- 2.2.5 Pumps shall have mechanical seal. The suction and discharge flanges shall be rated for minimum pressure of 16 bars.
- 2.2.6 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.3 POTABLE WATER BOOSTER PUMP SET

Potable water booster pump set shall be provided with the following accessories:

One number PVC / polypropylene / rubber / epoxy lined steel hydro-pneumatic pressure tank of specified capacity with neoprene rubber diaphragm between the water and air sections. The tank shall be complete skid mounted boosting system with automatic motor control unit for dry run protection and auto operation system shall be provided with stainless steel piping. The unit shall be furnished ready for installation L/C flexible pipe gate valve, non-return valve, pressure switch & pressure gauge and shall be ready for operation when connected to the piping & electricity supply. The tank shall be rated for a working pressure of 6 kg/cm² and test pressure of 9 kg/cm² and shall comply with all the relevant clauses of "ASME Code for Pressure Vessel".

Pump sleeve, intermediate chamber/guide vanes, impeller, suction inter-connector spline shaft cover plates etc. shall be of stainless steel with mechanical seal of approved material. Base plate shall be painted steel.

Pressure gauge, pressure switch, gate and check valve on pump discharge pipe. Pressure switch will be adjustable between 4.0 to 3.0 kg/cm² and shall be wired to motor

control panel.

- ✓ Gate valve and check valve on pump discharge pipe.
- ✓ Gate valve and foot valve on pump suction pipe.
- ✓ Minimum run timer adjustable from 0-6 minutes.
- ✓ Low water level cut-off switch.
- ✓ Reducer/enlarger, if necessary on pump discharge and suction pipe.

2.4 SUBMERSIBLE BOREHOLE PUMP & MOTOR (FOR TUBEWELL)

The pump shall be suitable for the intended use and shall have specified capacity and head. Pump shall be made of Stainless Steel 304 or above.

2.4.1 The materials of pump shall be as follows:

- Pump Casing - Stainless Steel
- Impeller - Stainless Steel
- Shaft - Stainless Steel
- Wear Ring - Rubber
- Diffuser - Stainless Steel

2.4.2 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.4.3 Pumps shall be provided with all necessary accessories for operation.

2.4.4 Contractor shall work out the actual flow and head of the pump based on the exploratory bore and site conditions and shall propose the pump accordingly.

2.4.5 The size of the pump shall be with respect to the size of the bore casing.

2.5 HORIZONTAL CENTRIFUGAL SEWAGE PUMPS & MOTOR (FOR WASTEWATER)

2.5.1 The pump sets will consist of horizontal centrifugal non clogging sewage pump and motor of specified capacity and head and shall be horizontal, totally enclosed, fan cooled, squirrel cage induction motors of specified power.

2.5.2 Pump materials shall be as under:

- Body : Cast iron
- Impeller : Stainless Steel or as suggested by the Manufacturer
- r Pump Shaft : Stainless Steel
- Steel Shaft Sleeve : Stainless steel

2.5.3 All wetted materials of pumps shall be suitable to withstand any chemical attack from municipal sewage water & blue wastewater (from Aircraft).

- 2.5.4 Pumps shall have mechanical seal. The suction and discharge flanges shall be rated for at least 1.5 times the working pressures.
- 2.5.5 The efficiency of the pumps should not be less than 55%.
- 2.5.6 Non-Clog impeller shall be designed to allow sizable spherical solids to pass the flow passage easily without clogging.
- 2.5.7 All pumps shall operate through level switches installed in wet pit as per the schedule provided in the drawings.
- 2.5.8 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.6 SUBMERSIBLE PUMP & MOTOR (FOR WASTEWATER)

The pump shall consist of submersible sewage non-clogging pump and motor of the specified capacity and head and shall be integral sealed unit with strainer. The pump should be capable to handle the drainage water / waste water.

Pump material shall be as under:

Body	:	Cast Iron
Impeller	:	Stainless Steel or as suggested by the
Manufacturer Shaft	:	Stainless Steel
Bearing	:	Pre-lubricated bearing
Motor	:	Air filled water tight

- 2.6.1 The pumps shall be installed inside the pit as shown on drawing. The discharge flanges shall be threaded to BS 21 and shall be rated for working pressure of 10 kg/cm².
- 2.6.2 The motor shall have a built-in over load protection, low voltage, over-heating and phase failure.
- 2.6.3 The operation shall be automatic according to the levels in the wet pit.
- 2.6.4 Pump suction and discharge flanges shall be of steel drilled to B.S 4504 or B.S 10 and shall be rated for the working pressure of 10 bars.
- 2.6.5 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.7 FIRE WATER PUMP SET

- 2.7.1 The pump set shall consist of horizontal centrifugal pumps and motors of specified capacity and head.

- 2.7.2 All fire pumps shall be UL listed & FM approved in compliance with NFPA 20. All equipment and other appurtenances shall be in accordance with the requirement of NFPA.

Scope of Supply:

A. ELECTRIC MOTOR DRIVEN FIRE FIGHTING PUMP &

CONTROLLER Type: Horizontal Centrifugal
Accessories Included for Each Electric Pump Set:

- Automatic Air Release Valve
- Discharge Pressure gauge
- Electric Pump Controller

B. DIESEL ENGINE DRIVEN FIRE FIGHTING PUMP &

CONTROLLER Type: Horizontal Centrifugal
Accessories Included:

- Automatic Air Release Valve
- Discharge Pressure gauge
- Double Wall Fuel Tank 119 gallons
- Fuel piping system
- Flexible residential exhaust size
- Battery 12V, rack & cables (lead acid, shipped dry)
- Residential type Muffler
- Diesel pump Controller
- Flowmeter | Flanged | 150mm
- Main Relief Valve 100mm
- Closed Waste Cone

C. JOCKEY PUMP & CONTROLLER

Type: Vertical Inline
Multistage Accessories
Included:

- Jockey Controller

D. PUMP ROOM VALVES &

SPECIALTIES Accessories Included:

- UL/FM Check Valve on Discharge of each Fire Pump x 2
- UL/FM Isolation Valve on Discharge of each Fire Pump x 2
- UL/FM Isolation Valve upstream of Flowmeter x 2
- UL/FM Isolation Valve downstream of Flowmeter x 1
- Electrical wiring between each driver & controller
- Common Discharge Manifold
- Pressure sensing lines on discharge side of each pump in SS construction x 3
- Fuel tank supply & return piping
- Engine exhaust piping

The Contractor shall carry out fabrication works within pump room, installation of pumps, piping and auxiliary equipment, transportation up to

site, commissioning of complete system, training & handover to the Client.

2.8 PUMP ACCESSORIES

Pumps shall be provided inclusive of the following accessories:

- 2.8.1 Pressure switches, pressure transducers, level switches, etc.
- 2.8.2 Reducer/enlarger is necessary if the Pumps discharge size is different from discharge piping.

2.9 MOTOR PROTECTION

Motors of 3kw or less power shall be started direct on line. Larger motors shall be started by star-delta starter.

Motor shall be protected against under voltage over voltage, overload, over-heating and phase failure.

Motor shall be rated for normal operation against a voltage fluctuation of + 10% and frequency fluctuation of + 2Hz.

2.10 CONTROL

(a) Potable Water Supply Pumps

- Operation of pumps shall be manual and automatically controlled by level switches installed in Overhead Water Tank.

(b) Wastewater Pumps and motors

- Operation of pumps shall be manual and controlled by level switches installed inside the wet sump pit of Sewage Lift Station.

2.11 PRESSURE GAUGES

- 2.11.1 Pressure gauges shall be of copper alloy, bourdon tube type with 100mm diameter dial face. The dial shall be engraved in black on white background from zero to 16 bars or 1.5 times the working pressure whichever is larger.
- 2.11.2 Gauge shall be installed to socket welded to the pipeline with an isolating plug/ball valve. If the pipeline installation is such that the above requirement cannot be met pressure gauge of remote reading type shall be installed.

2.12 WATER LEVEL INDICATOR

- 2.12.1 The water level indicator for high and low water level cut off shall operate on 230 Volt AC, 50 Hz and supplied complete with float, float chains, counter-weights, chain clamps steel mounting brackets, chain guide roller and any other equipment and material necessary for installation and satisfactory operation.
- 2.12.2 The level indicator shall have at least 5 switch-contacts or as required for sensing the required water levels within the specified range.
- 2.12.3 The level indicator shall be suitable to match with the specific gravity of the fluid in which it is intended to be installed.

2.13 LEVEL SWITCHES

The level indicator shall have at least 3 switch-contacts or as required for sensing the required water levels within the specified range. The level indicator shall be suitable to match with the specific gravity of the fluid in which it is intended to be installed. All operational, constructional and installation details shall be furnished by Contractor for approval.

2.14 FOOT VALVE FOR PUMPS

Foot valves shall be installed on the suction Line of the pumps where required or indicated on the drawing. Foot valve shall be of brass or as specified in bill of quantities, 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.

2.15 BELL MOUTH SUCTION FITTING

Shall be installed on the suction Line of the pumps where required or indicated on the drawing. Bell mouth shall be of same material as of suction pipe or as specified in bill of quantities. The size of bell mouth intake and connection end shall be as per drawings or as specified in the bill of quantities.

2.16 CHAIN AND PULLEY BLOCK ARRANGEMENT

- 2.16.1 Manually driven chain and pulley block arrangement shall be installed in Pump Room. The chain and pulley block arrangement shall be capable to lift the specified load and shall be provided and installed as shown in drawings, to serve as lifting arrangement for pumps and accessories.
- 2.16.2 The I-Beam shall be a standard AISI girder of required size and specific weight. The travel wheels of the pulley block shall be made of dia-forged steel and supported on ball or roller bearings. The bolts wherever used shall be of high

tensile steel. Rubber buffers shall be provided at the end of travel of pulley block in either direction.

2.16.3 The chain block shall be capable to provide a standard clearance/lift.

2.16.4 After installation, the lifting arrangement shall be subject to no load and full load tests for satisfactory operation. Before putting into operation, the arrangement shall be properly cleaned, greased and painted.

2.17 BAR RACK/ SCREEN

2.17.1 The manually cleaned screens shall be furnished and installed as shown in the drawings and as specified herein.

2.17.2 All materials used shall be Mild Steel suitable for service in a moist, corrosive environment as encountered in Wastewater treatment plants. Bar Screen shall be made of rectangular bars of size 12mm x 50mm and length as per drawings. Screen shall be installed at 50mm c/c.

2.17.3 Bolts, anchor bolts, and washers which are submerged or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel, with bronze nuts or cap screws of copper-silicon alloy. Wherever stainless steel bolts and nuts are specified, it shall refer to the above material combination, unless specifically excluded.

2.17.4 Unless otherwise shown, all anchors shall be stainless steel.

2.17.5 All protective coating for the ferrous metals and all materials exposed to the corrosive environment in the head works or submerged in wastewater shall be epoxy coated of at least 200 microns or selected by the manufacturer to ensure optimum, corrosion-free, and erosion-free.

2.18 MAINTENANCE MANUALS AND TOOLS

2.18.1 A comprehensive manual containing the complete information in connection with the assembly, operation, lubrication, adjustment and repair of the pumping equipment, electric motor, together with detailed parts list with drawings or photographs shall be furnished in duplicate.

2.18.2 For the pump room, special tools necessary for maintenance and repair of the pumps and electric motors including tools kits, grease guns etc. with accessories shall be furnished.

2.18.3 The manufacturer's recommended list of spare parts shall be submitted by the Contractor to the Engineer for approval. Such spare parts will also be furnished by the Contractor.

All the maintenance manuals, tools, spare parts etc., shall be supplied by the Contractor at no cost and all cost shall be deemed to be included by the Contractor in his bid against item of pumping set.

3. EXECUTION

3.1 INSTALLATION

3.1.1 Examine area and conditions under which pumps are to be installed. Do not proceed with the work until unsatisfactory conditions have corrected in manner acceptable to the Engineer.

3.1.2 Provide access around the pumps for service as shown in the drawings, but in no case less than that recommended by the manufacturer.

3.1.3 Unless indicated otherwise, install pumps on minimum of 100 mm high concrete base or as mentioned in the drawings with anchor bolts poured in place.

3.1.4 The submersible drainage non clogging pumps shall be installed in the sum pits at the locations shown on the drawings.

3.2 SHOP TESTING

3.2.1 Pump performance tests shall be conducted in accordance with Hydraulic Institute test codes as described in HI E35.01, E37.01 and E39.01. In addition, each pump shall be tested at five points of operation from shut-off head to run-out condition, including the guaranteed pump's performance point.

3.2.2 All pumps shall be hydrostatically tested for leaks at 1.5 times the design pressure. There shall be no leakage during the one hour test period.

3.2.3 The Contractor shall submit manufacturer's test certificates, including test data to show that pump meets specifications.

3.3 FIELD TESTING

3.3.1 Field performance test of all pumps shall be witnessed by the Engineer.

3.3.2 All tests shall be subject to approval of the Engineer.

3.4 ADJUSTING AND CLEANING

3.4.1 Check alignment, and where necessary, realign shafts or motors and pumps within recommended tolerances by manufacturer.

3.4.2 Start-Up: Lubricate pumps before start-up. Start-up in accordance with manufacturer's written instructions.

3.4.3 Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

4. MEASUREMENT AND PAYMENT

4.1 PUMPING MACHINERY

4.1.1 Measurement

Measurement for payment of pumping machinery shall be the actual number acceptably provided, installed, tested and commissioned in position; the Contractor's bid against these item shall include cost of providing, installing, testing and commissioning the pumping machinery including the pumps, electric motors, all accessories, level switches, pressure switches, pressure gauges, manuals, tools, spare parts, etc., as shown on the Drawings, as specified herein or as directed by the Engineer.

Measurement for payment of bar screen shall be the weight in kilograms acceptably provided and installed in position.

4.1.2 Payment

Payment will be made for acceptable measured quantity of pumping machinery, pressure switches, pressure gauges, etc on the basis of unit rate per number quoted in the Bill of Quantities. The amount bid shall be full payment for the work specified.

Payment of bar screen will be made for acceptable measured quantity on the basis of weight in kilograms quoted in the Bill of Quantities. The amount bid shall be full payment for the work specified.

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

SPECIFICATIONS

FLUSHING, TESTING, DISINFECTION AND COMMISSIONING OF PIPELINE

1. SCOPE OF WORK

The work under this section of specifications includes furnishing all plant, labor, equipment, appliances, materials and water and performing all operations required in connection with flushing, testing, disinfection and commissioning of all water lines and system in parts and as a whole as specified herein or as shown in the Contract Documents or as directed by the Engineer.

2. WATER FOR FLUSHING AND TESTING

The contractor shall arrange the required quantity of water for flushing & testing. No separate payment shall be made for the supply of water for flushing and testing.

3. FLUSHING

The Contractor shall provide facilities for flushing of water lines. Flushing shall be done section by section. A length of 500 meters will be considered to be a normal length of the section. Flushing shall be continued until clean water starts flowing through the other end. The flushing velocity shall be at least 2.5 feet per second. Flushed water will be disposed of as directed by the Engineer.

4. PRESSURE AND LEAKAGE TEST

Flushing of pipe line shall be followed by a pressure and leakage test as specified in the relevant specifications for various types of pipes and fittings.

During the test, all exposed pipes, fittings, valves, hydrants, and couplings shall be carefully examined.

The Contractor shall locate and repair the defective joints and/or pipes at his own expense until the specified leakage test is satisfactorily performed. The pipe connection and all necessary apparatus including gauges shall be furnished by the Contractor.

5. DISINFECTION

Only potable water lines and system shall be disinfected. Final disinfection shall be accomplished by chlorination. A chlorine and water mixture shall be applied by means of a solution feed chlorination device. The dosage applied to the water entering the pipe shall be at least 50 mg/liter of chlorine. The mixture of chlorine and water shall be retained for at least 24 hours. The chlorine residual at pipe extremities shall be at least 25 mg/liter at the end of the period. Following the

complete disinfection of the pipe line, all treated water shall be thoroughly flushed out, until the chlorine residual is less than 1 mg/liter.

6. COMMISSIONING

After successful completion of testing, the pipeline shall be commissioned by filling water and bringing the pipeline to full operating pressure. All temporary arrangements made for testing shall be removed.

7. TESTING OF FIREFIGHTING SYSTEM/ NETWORK

In addition to above, the Contractor shall test the firefighting system/ network as per NFPA standards and shall provide the Testing Protocol and Procedure for approval of the Engineer before carrying out the testing of the firefighting network/ system. The testing assembly required for testing the firefighting network/ system shall be arranged by the Contractor before the testing of the system. No payment shall be made for the testing assembly required to conduct the testing of the network/ system as per approved Testing Protocol.

8. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specification unless otherwise specifically stated in the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

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

SPECIFICATIONS TESTING AND COMMISSIONING

1.0 SCOPE OF WORK

The work under this section of specifications includes furnishing all plant, labour, 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.

2.0 GENERAL

The testing shall include a complete visual inspection of the whole plumbing and fire fighting 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 Programme

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, water closets, etc. and also the draining capacity shall be measured at the same time.

4.0 POTABLE WATER SUPPLY SYSTEMS (HOT & COLD)

4.1 Test Programme

The method of laying and sealing the water connections 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 pipes and flanged connections to devices, water-heaters, airconditioning devices, drainages and vents for symmetry and lack of strain.
- Checking of the setting of pressure reducing valve with reference to the pressure conditions specified with or pressure gauge.
- 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 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. 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. No additional charges shall be allowed for retesting of any section of the works found at fault.

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 5.5 bar i.e 1.5 times the maximum working pressure or as approved by the Engineer.

There must be no measurable loss of pressure for at least 30 minutes holding period.

5.0 DRAINAGE SYSTEMS

5.1 Test Programme

- 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, 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.
- Provide clean water and apparatus for testing.

5.2 Test Methods

5.2.1 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 0.5 bar 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.

5.2.2 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.

6.0 FIRE FIGHTING SYSTEMS

6.1 Stand Pipe System

6.1.1 Test Programme

Visual inspections shall be made of the entire network for the standpipe system with regard to laying, fixing, and suspension of pipes, 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 gauges, shall be checked.

The test programme shall also cover:

- Checking number, form and inscription of the labeling.
- Performance of pressure test for the entire network.

6.2 Hydraulic Pressure Test

As described for potable water supply system.

6.3 Test Pressure and Procedure

As described for potable water supply system.

7.0 COMMISSIONING

After successful testing of selected isolated pipe lengths for potable water (hot & cold), Sanitary drainage and firefighting system, the Contractor shall clean all the lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Owner.

8.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specification unless otherwise specifically stated in the Bills of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other item of the Bills of Quantities.

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

ELECTRICAL SPECIFICATION
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 therequired works, in accordance with the terms of the Contract.

1.0 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:

Section – E2:	Low Voltage Switch Boards / Distribution Boards	
Section –E3:	Low Voltage Cable and Wires	
Section – E4:	Conduits and Pipes	
Section – E5:	Wiring	Accessories
Section – E6:	Interior Lighting Fixtures	
Section – E7:	Addressable Fire Alarm System	
Section – E8:	Telephone & Data Cabling System & Accessories	Section – E9:
	Cable Tray, Ladder and Trunking	
Section – E10:	Close Circuit Television (CCTV) System	Section – E11: Earthing
	System	

List of Approved Manufacturer

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 partof 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.

2.0 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.

3.0 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.

4.0 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 : 90 %
- d. Minimum relative humidity : 26 %

4.2 Service Conditions

Equipment shall be designed and built for continuous service with a minimum of supervision and maintenance.

5.0 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 ± 10%
- Phase 3, 4 wire system
- Frequency 50 Hz. ±2 Hz.

5.2 Degree of Protection of Enclosures

For indoors, IP31 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.

6.0 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.

7.0 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.

8.0 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.

9.0 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.

10.0 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.

11.0 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.

12.0 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.

13.0 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:

Working drawings shall be submitted within two weeks of handing over the site.

b.

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.

14.0 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.

15.0 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 background of trifoliate and fixed with screws.

16.0 MARKINGS

The contractor shall provide "Danger Boards" and "Shock Charts" wherever required to comply with the requirements of local Electricity Rules and according to normal practice.

17.0 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.

18.0 STORAGE

The Contractor shall store the equipment in such conditions that it can not 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 conflict with any other specified requirement and submit copies of manufacturer's recommendations to the Engineer when requested to do so.

19.0 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, meggers, 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.

20.0 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.

21.0 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.

22.0 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 for 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.
- i. 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.

23.0 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.

23.1 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.

23.2 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.

23.3 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.

23.4 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.

23.5 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.

24.0 ELECTRICAL CONNECTION

Electrical connection for each building shall be supplied by other but necessary arrangement coordination to be done by this Contractor.

25.0 SHOP DRAWINGS/ AS BUILT DRAWINGS AND SERVICE MANUALS

A record shall be kept both in hard and soft copies 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 asbuilt/shop drawings of Lighting, Power, Telephone, Data, Fire Alarm, Public Address, CCTV, Access Control, and 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.

26.0 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.

27.0 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.

SECTION - E - 2
LOW VOLTAGE SWITCHBOARDS / DISTRIBUTION BOARDS

1.0 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 sitewith others for exact route, location and positions of electrical lines and equipment.

1.3 Standards

Switchboards shall comply with Section - E - 1, Clause 3. Particular reference shall be made to:

IEC 60027	Letter symbols to be used in Electrical technology.
IEC 60051	Direct setting electrical measuring instruments.
IEC 60073	Colour for indicator lights and push bottoms
IEC 60158	LV Switch gear and control gear.
IEC 60185	Current Transformers.
IEC 60186	Voltage Transformers.
IEC 60269	LV fuses.
IEC 60439	Factory built assemblies of LV switch gear and control gear.
IEC 60529	Degree of protection provided by enclosures.
IEC 60617	Graphic symbols for diagrams.
IEC 60947-2	LV Switch gear and Control gear.
BS 951	Earthing Clamps
BS 1433	Hard drawn bare copper conductor for earthing.
BS 2874	Nuts, Bolts, Washers and Rivets for use on copper.
BS 6346	PVC Insulated Cables.
CP 1013	Earthing

Any other standard referred to in above standards or these specifications.

1.4 Installation and Service Conditions

For general site conditions refer toSection - 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.

2.0 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 ϕ , 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 the 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 10 Amp. Minimum.

3.0 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 provided 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 background, 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.

4.0 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 inter change ability of common parts. Removable gland plated 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.

5.0 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 gasketed 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 colour RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

6.0 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. All components should comply with IEC 60947-2. Typical specifications are given hereunder.

6.1 Air Circuit Breaker (ACB)

Air circuit breaker should be draw out type with three poles / four poles as mentioned in drawing suitable for making and breaking a fault condition. Operating mechanism shall be manually or motor operated charged spring with front drive grip handle. These shall be locally operative. Mechanically operative ON-OFF-OFF indicators positively driven in both directions shall be provided to indicate the position of the unit.

Overload and over current features / relays shall be of an adjustable, manually resettable type, according to manufacturer's standard range.

Each ACB shall have built in tester with the selection of Trip or Non-Trip Functions. Also with the facility of testing the ACB in field from single phase (220VAC) supply only. Each of the above function shall have separate LED Indicators and Alarm switches for trip monitoring of Overload, Short circuit, Pre trip alarm and Ground Fault. ACB shall be having Trip Memory.

The Breaking Capacity of ACB shall be 65KA. ACB breaking capacity shall be; $I_{cu}=I_{cs}=I_{cw}$.

The circuit breaker shall have two normally open and two normally closed auxiliary contacts rated for 10 Amps. 230 VAC. The circuit breaker shall also provide for ON-TRIP- OFF indicating lamps. The circuit breaker shall have specified rupturing capacity without the use of back-up fuses. Auxiliary release and trip coils shall be provided for desired operation and / or interlocking as shown and / or stated on the Drawings.

6.2 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.

6.3 Miniature Circuit Breaker (MCB)

The MCBs with current rating from 3 to 80 amperes 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.

6.4 Earth Leakage Circuit Breakers (ELCB)

ELCBs shall be four pole, current operated type with tripping current of 0.3A and tripping time not more than 0.1 seconds.

6.5 Load Break Switches

Load Break Switches and contactors 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.

6.6 Air Break Contractor (ABC)

The contactors shall be air break, triple pole, 400 / 500 VAC and suitable for the type of duty to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with single phase 230 VAC operating coil and minimum one spare normally open and one normally closed auxiliary contact. The number of working auxiliary contacts shall be provided according to the system requirements.

7.0 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 and 50 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.

1 No. Auto-off-Manual selector switch

1 No. Current transformer with 5 amps secondary current, having suitable output burden and accuracy.

3 Nos. Instrument protection fuses.

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 10 seconds duration. Terminals to casing with an AC voltage of 3 KV for 10 seconds duration.

8.0 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 Q1 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 Line up 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.

9.0 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.

SECTION - E - 3
LOW VOLTAGE CABLES AND WIRES

1.0 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.

2.0 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 voltgrade and upto 50sqmm and above shall be of 600/1000V. Power cables for main feeders, main to sub main 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.

3.0 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.

4.0 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 colourcode 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 clock-wise and anti clock-wise sequence of core colors.

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.

5.0 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, labour, 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 effected 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.

SECTION - E - 4 CONDUITS AND PIPES

1.0 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.

2.0 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.

3.0 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.

4.0 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 2-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 of fitting, and continuity shall not depend on contact through the screws, nor on removal on site paint finish from ferrous metal.

5.0 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, off setting 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.

Under ground 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.

SECTION - E – 5 WIRING ACCESSORIES

1.0 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.

2.0 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.

3.0 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 un-switched 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.

4.0 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.

5.2.3 Ceiling Fans

The ceiling fans shall be suitable for hanging from the ceiling. These shall operate satisfactorily on 250 volts, single phase, 50 Hz, A.C. supply with + 10 % tolerance.

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed regulator, starting, radio interference, capacitor size, silent operation and temperature rise are concerned. For testing, BS 848 as amended shall be complied with.

SECTION - E –6
INTERIOR LIGHTING FIXTURES

1.0 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.

2.0 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.

3.0 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.

4.0 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 TL 28 / 14 watts respectively as specified. The fluorescent colour shall be warm white characteristics with an average output of 3350 lumens (+5%) for 28 watts and 1350 lumens (+5%) for 14 watts after 1000 burning hours. The ballast shall be electronic type for 28 / 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 LED Light Fixtures

The 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 LED light fixtures shall be of international standard and quality. The type of fixtures with manufacturer catalogue reference is 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 light fixtures shall be Light Emitting Diodes with driver and shall be supplied and installed according to the wattage as indicated on drawings.

Weather proof 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. The gasket shall be weather resistance type.

The LED light fixtures shall be supplied complete with driver and all accessories as per light fixture schedule and shall be installed in accordance with manufacturer's recommendations and sound engineering practice.

5.0 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 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 LED/CFL Light Fixtures

The LED and CFL 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 accordance with manufacturer's recommendations and in coordination with ceiling installation.

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.

The Contractor shall essentially use the standard products of a manufacturer, regularly engaged in the manufacture of the product and shall meet the requirement of the specifications.

TECHNICAL SPECIFICATIONS – AIR CONDITIONING & MECHANICAL VENTILATION WORKS

1.0 GENERAL:

The contract drawings indicate the extent and general arrangement of the Air Conditioning and Mechanical Ventilation System. Equipments, ducting and piping shall fit into the space allotted and shall allow adequate and acceptable clearance for entry, servicing and maintenance. Where component parts of equipment or system cannot be service without distributing adjacent work resulting from original installation of other work, corrective action satisfactory to the Client / Project Managers / Consultant shall be taken, without any additional cost to the Owner.

- (a) Capacities of equipment and materials shall not be less than those indicated.
- (b) Conformance with Agency requirements: Where materials or equipment are specified to conform to requirements of Air-conditioning and Refrigeration Institute of Heating, Refrigeration and Air-conditioning Engineers, etc., the Contractor shall submit proof of conformance. The label or listing of the specified agency will be acceptable evidence.
- (c) Nameplates: Each major item of equipment shall have the manufacturer's name, address serial and model numbers on a plate securely attached to the item.
- (d) Protective and Access requirements: Belts, pulleys, chains, gears, coupling, projecting set-screws, keys and other rotating parts are so located that any person in close proximity shall be fully enclosed or properly guarded. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified by the manufacturer. Items such as catwalk ladders and quadrails shall be provided where indicated for safe operation and maintenance of equipment.
- (e) Verification of dimensions: The Contractor shall visit the premises to thoroughly familiarize himself with all details of the work and working conditions and verify all dimensions in the field, and shall advise the Client / Project Managers / Consultant of any discrepancy before performing any work. The Contractor shall be specifically responsible for the co-ordination and proper relation of his work to the building structure and to the work of all trades.
- (f) Pipes crossing fire rated wall, the gap between wall and pipes shall be filled with soft packing like mineral wool, the ends shall be closed with approved sealant shall be deemed to have been included in the relevant items.

1.1 Equipment and Material:

(a) General:

These shall conform to the respective publications and other requirements specified herein, and as shown on the drawings and shall be the products of the manufacturers regularly engaged in the manufacture of such products. Items of equipment shall essentially be duplicate of equipment that has been in satisfactory use at least 10 years prior to bid opening and shall be supported by a service organization that is, in the opinion of the Client / Project Managers / Consultant, reasonably convenient to the site. It shall be solely the Contractor's responsibility to ensure that the equipment / material supplied by him shall fit into the space allotted for the purpose. If at any stage it is detected that the equipment supplied by him cannot fit into the space provided for the equipment, then the Contractor shall be responsible for supplying other equipment of suitable size, without incurring any additional cost to the Owner.

(b) Approval of Equipment and Material:

Before starting installation of any material or equipment, the Contractor shall submit for approval, working drawings of all areas and lists of materials and equipments to be incorporated in the work. The layout drawings shall include a plan and elevations of the proposed work, piping and equipment to establish that the equipment will fit in the allotted space with clearances for installation and maintenance. The drawings shall show proposed details for attachment anchoring, and hanging to structural framing of the building; vibration isolation units; foundation and support; location and size of sleeves and prepared openings for passage of pipes. If departures from the contract drawings are deemed necessary by the Contractor, details of such departures including changes in related portions of the project and the reasons thereof shall be submitted with the drawings. Approved departures shall be made at no additional cost to the Owner. A complete electrical connection diagram, for each electrically controlled component having automatic or manual control device, shall be submitted for approval. Wiring diagrams shall identify each component and one diagram shall show all interconnected or interlocked components. The lists of materials and equipment shall be supported by sufficient descriptive material, such as catalogs, diagrams, performance curves, charts, Layout drawings and other data published by the manufacturer, to demonstrate conformance to the specifications requirements; model numbers alone will not be acceptable. The data shall also include the name and address of the nearest service and maintenance organization that regularly stock repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time. One copy of the layout drawings, wiring diagrams and lists will be returned, marked to indicate approval.

All material / equipment shall be submitted for approval and only approved material / equipment shall be supplied to the site.

1.2 Equipment and Material:

The contract shall provide at his cost, samples of material, equipment for approval by the Engineer before order is placed for the same. Engineer may waive this requirement, if detailed published catalogues submitted by the contractor provide sufficient information for approval. These samples shall include but not limited to:

- (a) Pipe Insulation and Covering
- (b) Adhesive and Tapes
- (c) Electrical Items (Power and Control Cables, Conduit, Circuit Breakers)
- (d) Hangers and supports
- (e) Copper Piping and fittings
- (f) Condensate Drain Piping and fittings

2.0 DX SPLIT AIR CONDITIONING UNITS:

2.1 General:

Dx Split system air-conditioning Units, cool only type Units to be in two parts indoor & outdoor units, including filters, evaporator coils, compressors, condenser coils, and fan section, connection to electric power point, refrigerant piping, remote sensors, control wiring, complete in all respect.

Provide units pre-piped, pre-wired, pre-charged refrigerant gas (Ozone Friendly Green Gas), factory assembled and factory tested, with all controls pretested prior to shipping. Provide a terminal strip with each electrical component individually and separately wired to strip. Provide a separate fuse, internally mounted, for each electrical component. A single fuse for multiple compressors or fan motors will not be accepted.

2.2 Indoor Unit:

2.2.1 Cabinet, Casing and Frame:

Unit framework to be formed of structural steel members of 12 to 14 gauge mild steel. After assembly paint the framework for maximum protection against rust. Exterior panels to be fabricated of 18 gauge galvanized steel finished with a baked acrylic enamel over an epoxy primer. Provide neoprene gasketing between panels and frame members; panels to be attached to the frame with quick release latches (no sheet metal screws). Insulate sections including compressor compartment with 1" thick, 3-lb./cu. ft. density fiberglass having an R value of 4.16.

Arrange units for full front, side and rear service access to all mechanical, electrical and refrigeration controls, check out of electrical control panel, without disrupting or interfering with air flow.

2.2.2 Supply Fan and Motor:

Provide single width, forward curved Class I & II supply fans secured to a machined, ground and polished solid steel shaft. Coat shaft with a rust inhibitor and support by two outboard bearings selected for a minimum 200,000 hours average life.

Provide three-phase NEMA design 'B', 40qC continuously rated fan motor with energy-saving design, .85 power factor, NEMA 'T' frame, open drip-proof, operating at 1750 rpm and supplied with grease-lubricated ball bearings.

2.2.3 Direct Expansion Coil:

Provide direct expansion coil with ½" OD seamless copper tubes Expanded into copper fins, not less than 3 rows deep or more than 12 fins per inch. Provide evaporator coil with a distributor with side port for hot gas bypass and thermostatic expansion valve with adjustable superheat and external equalizer. Test coil at 300 PSIG air pressure under water, completely dehydrate and pressure test with refrigerant. Provide coils with heavy gauge, insulated, galvanized steel drain pans complete with mastic coating for corrosion protection.

2.2.4 Filters:

Provide filters having a 40% ASHRAE dust spot efficiency, U.L. Class I pleated media type 2-inch deep.

2.2.5 Evaporator Defrost Thermostat:

Provide defrost thermostat package with enclosure, wiring and hardware for field installation.

2.3 Condensing Unit:

2.3.1 General:

Provide units pre-piped and pre-wired, pre-charged refrigerant gas, factory assembled and factory tested, with all controls pre-tested prior to shipping. Design units for use with Ozone Friendly Green Gas Refrigerant.

Assemble all condenser components on a common base in a weatherproof housing. Provide condenser coil, condenser fans and motors, refrigerant reservoir, charging valve, all controls and holding charge of Refrigerant.

2.3.2 Condenser Coil:

Construct condenser coil of copper plate fins, mechanically bonded to seamless copper tubes. Circuit coil for sub-cooling. Test coils to 425 psi.

2.3.3 Condenser Fans and Motors:

Furnish direct driven, propeller type belt driven, centrifugal fans arranged for vertical horizontal discharge. Provide condenser fan motors of the permanently lubricated type, resiliently mounted. Provide a safety guard for each fan. Include controls for cycling fans for intermediate season operation and low ambient control. Balance each fan statically and dynamically.

2.3.4 Controls:

Locate factory wired controls in a separate enclosure. Provide high and Low pressure switches and compressor overload devices. Incorporate a positive acting timer to prevent short cycling of compressor if power is interrupted. Timer to prevent compressor from restarting for approximately 5 minutes after shutdown.

2.3.5 Refrigerant Circuits:

Each refrigerant circuit is to be an independent circuit completely piped, tested, dehydrated and fully charged with oil and Ozone Friendly Green Gas Refrigerant. The Refrigerant circuits are to include compressor, condenser coil with integral liquid sub-cooler, liquid line service and charging valve, filter drier, and sight glass. Compressor units to include suction and discharge line braided-wire isolators.

2.3.6 Casing:

Make unit casing fully weatherproof for outdoor installation. Construct casing of galvanized steel, zinc phosphatized and finished with baked enamel. Provide openings for power and refrigerant connections. Make panels removable for servicing. Provide heavy duty coil guards, unit mounting rails and drain holes.

2.4 Execution:

Provide refrigerant piping and accessories to connect condensing unit's condensers to indoor air conditioning units according to manufacturer's instructions.

Copper pipes shall be insulated with 1-1/4" (32 mm) thick closed cells synthetic

elastomeric foam insulation and wrapped with self-adhesive waterproofing tape. Condensate drain shall be insulated with 3/8" (10mm) thick closed cell synthetic elastomeric foam insulation. Contractor to provide minimum 25 mm dia Condensate Drain and terminate to nearest drain point.

No insulation shall be applied to any system of piping until all pipe work has been tested, cleaned out and made tight. All insulation shall be applied in a manner consistent with good practice and methods. All longitudinal joints of pipe shall be at the top and bottom. Insulation shall be continuous through walls, floors, ceiling and partitions etc.

All insulated refrigerant pipes exposed to atmosphere shall be provided with a cladding of 26 gauge (0.55 mm) thick G.I. or aluminium sheet metal with proper support system for cladding works. Cladding works shall be painted with one coat of primer and two coats of finish paint, as approved by the Engineer and as direct by Engineer in charge.

2.4.1 Startup and Testing:

- a. Manufacturer's service technician to check alignment of bearings, drives and motors after installation to ensure that no misalignment exists, or make any necessary alignment adjustments prior to startup.
- b. The manufacturer shall furnish a start up check list to the Owner at least two months prior to start up. The list must be explicit as to the various items to be checked prior to start up.
- c. Before units are started up, manufacturer to pump new grease into bearing housings to force out old grease and provide adequate lubrication.
- d. Before acceptance of the equipment by the Owner, conduct all tests as required to demonstrate that the equipment operates mechanically, electrically and acoustically as specified.
- e. Conduct a satisfactory performance test in the presence of the Owner / Engineer in charge. Any units found to vibrate beyond acceptable levels must be rebalanced in the field at the Contractor's expense.

2.5 Spare Compressors and Parts:

Minimum 10% spare shall be supplied as per Manufacturer's recommendations for two years continuous operation.

3.0 VENTILATION AND EXHAUST FANS:

3.1 GENERAL:

The contractor shall supply and install fans of the type and capacity specified in Schedule Sheet and conforming to the specifications given herein. The contractor shall be responsible for the proper selection of the fans so that the specified operating conditions are obtained. Connection to the electric power point is in contractor scope. Motor shall be sized to provide the required BHP for meeting the specified conditions without overloading. The Fans shall be provided as per List of Approved Manufacturer's.

External static pressure given in the schedule are indicative and for guidance only. The Contractor shall calculate the external and total static pressure for all fans and shall submit the same for Engineer's review and approval before ordering the fans. Required fan and motor shall be provided without any additional cost and no variation or claim shall be entertained in this regard.

3.2 PROPELLER FANS:

Shall be supplied of the quality indicated on the drawings. Propeller fans shall operate on 220V/1 phase/50 Hertz A.C. current. Fans shall be directly mounted on the motor, and shall operate without disturbing noise, during normal operation. The discharge side of the fan shall be provided with self- closing shutters. Propeller fans shall be as manufactured by National Japan or approved equal local brand.

3.3 INSTALLATION:

3.3.1 General: Fans as shown on drawings shall be installed by the Contractor, complete in all respects and as per satisfaction of the Consultants. Fans shall be rigidly secured so that they operate without vibration and transmission of vibration to the structure shall be through isolated. Connection to ducting shall be through flexible connectors. Ducting connection to fan shall ensure lowest turbulence and smooth transition of sizes. All supporting arrangements of the fans shall be drawn up by the Contractor and submitted to the Engineer for approval.

Floor mounted fans shall be installed on concrete housekeeping pad at minimum of 100 mm above the floor, fan shall be mounted on vibration isolator. Structural suspended fans shall be installed using threaded rods and vibration isolator.

3.3.2 Commission & Testing: The fans shall be commissioned and tested by the Contractor.

4.0 LIST OF APPROVED MANUFACTURERS:

S.NO.	EQUIPMENT / MATERIAL	RECOMMENDED MANUFACTURERS
1	WALL MOUNTED DX SPLIT AIR CONDITIONING UNITS	a) DAIKIN b) GREE c) HITACHI d) MITSUBISHI
2	COPPER PIPING	a) MUELLER b) YORKSHIRE c) CRANE ENFIELD d) NIBCO
3	HANGERS & SUPPORTS	a) HILTI, GERMANY b) FISHER, GERMANY c) SIKLA, UK d) MUNGO, SWITZERLAND
4	HVAC FANS	a) SASA. b) AEROTECH c) JALAL
5	ELECTRIC CABLES	a) PAKISTANCABLES b) NEW AGE CABLES
6	STEEL CONDUIT FOR ELECTRICAL WORKS	a) HILAL, PAKISTAN b) PREMIER, PAKISTAN

ADDRESSABLE FIRE ALARM SYSTEM

1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete Addressable Fire Alarm system 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 the system.

The Fire Alarm system with accessories shall also comply with the General Specifications for Electrical Works, Section E- I and with other relevant provisions of the Tender document.

2.0 STANDARDS

The latest editions of the following standards / codes shall be applicable for the materials covered within the scope of this specification:

BS-5839, EN approved NFPA 72

Any other standard referred to in above standards or these specifications.

3.0 OPERATION

The Fire Alarm System shall be analogue addressable type complete with battery standby power. MFACP have provision to monitor/interfaced with client area FACP for full proof monitoring.

At locations indicated in the drawings the break glass type fire alarm Control Panel, Repeater Panel and automatic detectors shall be installed. In case of any Fire, the manual station shall be operated by pulling down the handle or breaking glass. The actuation of this station shall cause an audio as well as visual alarm at the fire alarm control and indication unit, duly indicating the location of the respective station/zone.

An authorized person shall immediately visit the effected area and if after investigating, it is deemed necessary, alarm in the whole building shall be initiated from either the alarm switch located beside the fire alarm control panel by inserting a special key or the actuation of any indication at the Fire Alarm Control Panel. The general alarm shall be initiated by an authorized person after inspecting the affected location.

Circuit shall be so arranged that an open circuit in an initiating or indicating loop shall cause the individual zone and common trouble indication at the fire alarm control panel.

4.0 MATERIAL

4.1 Conduit and Conduit Accessories

The specifications for conduit and conduit accessories shall be same as given for electrical conduit in Section E - 5 of these specifications.

4.2 Fire Alarm Cable

Fire Alarm Cable shall be 2 core 1.5mm shielded twisted pair, fire resistant, PVC insulated 250/440 volts grade cable to be laid in concealed PVC conduit.

4.3 Power Supply

The supply and operating voltages shall be 220 volts, 50 c/s and 24 volts D.C. respectively. The control stations shall be provided with sufficient capacity nickel cadmium battery with charger to operate the complete system for the least 3 hours in case of mains failure.

4.4 Fire Alarm Control and Indication Unit

The fire alarm control and indication unit shall be a Solid State Modular Unit consisting of the following Modules; suitable number of modules shall be used to provide facility for 6 loops. It shall not be possible to remove the key without turning the key to its normal position, thus resetting the alarm contacts.

i. Loop Module

Loop Module shall have multiple of supervised initiating circuit with a trouble and an Alarm Lamp for each loop. Detection circuit wiring shall be two wire Class `A' and shall power all Detectors (Relay outputs and) voltage output for each zone alarm and voltage output for each zone trouble shall be provided.

ii. Audible Expander Modules

Audible Expander Modules shall provide for supervised control circuit for polarized alarm signaling devices. Loop activated lamp shall be provided for each loop to aid on system testing and trouble- shooting provide (1) (2) (3) indicating circuits.

iii. Power Module

Power Module shall supply the necessary power for the loop module and all Detectors (and shall contain a Battery Charger to charge the batteries) An AC power to Lamp shall be provided to indicate the normal condition of the panel. Individual supervisory lamps shall be provided for AC power failure indication, ground fault detection, and low battery. All controls shall be behind a key-locked door to prevent unauthorized operation. Two supervised control circuits for audible signaling shall be provided as part of this module. Common trouble and common alarm relay and logic outputs shall be provided. The panel cover shall be key-locked to prevent unauthorized access.

4.5 Addressable Manual Break Glass Station

The break-glass manual station shall be operated by pulling down on the handle. When operated, the handle shall remain down with the pre-signal alarm contacts closed until the station is reset. The general alarm contacts shall remain open until after investigation. The general alarm switch shall be operated by an authorized person with a special key.

4.6 Addressable Audible Signal Unit

Fire alarm sounder with strobe shall be red color surface mounted installed where indicated on the drawings. Sound intensity shall be such that an audible signal will be heard clearly throughout the structure when the entire bells ring. The bell shall be connected in multiple cross loop conductors.

4.7 Addressable Smoke Detector:

The Smoke Detector is optical type and shall be connected to the specific loop. Base shall be provided with detector.

4.8 Addressable Heat Detector:

The Heat Detector is connected to the specific loop. Base shall be provided with detector.

4.9 Annunciator if required

The remote visual annunciator shall have the capacity for indicating 6 distinct alarm loop and one common trouble condition. The annunciator shall be back lighted type to increase visibility and to deter tampering with the lamps. The descriptions of each zone shall be approved by the Engineer Incharge. In the normal condition the annunciator shall have a blank appearance. Alarm and trouble condition shall be annunciated both visually and audibly. Lamp shall be 24 V DC, and replacement shall be readily available. Lamp replacements shall be accomplished without tools.

A test switch shall be provided for periodic testing of all lamps in the annunciator. To reduce tampering the annunciator shall have a key operated silence switch and a keylocked cover. For aesthetic reasons the unit shall be compact, have a brushed metallic trim ring and be surface mounted.

4.10 Multi Sensors (Conventional / addressable)

The multi sensors shall incorporate photo electronic optical smoke sensor and high sensitivity thermal sensor and provide early warning from all types of smoldering and thermal fires. The smoke element shall be of the light scattering type using be of the light scattering type using a pulsed internal LED light source and a photocell sensor. The thermal element shall utilize high sensitivity, high speed thermistors optimized to measure small changes in temperature and rate of change. The detector shall be capable of protecting an area up to 100 m² at a height of up to 12 m.

4.11 Function of Addressable Fire Alarm Control Panel (FACP)

i. Design

The FACP shall be solid state, modular design with integral static protection. All indicating lamps shall be long-life, low maintenance solid state light emitting diodes (LED).

ii. Enclosure

The FACP enclosure shall be semi-flush mounted. The enclosure shall be hinged from the left and the cover shall have clear windows and locking mechanism to keep the system operating and status switches from being tampered keys shall be made available to fire department and other authorized operating personnel. Finish shall be "FIRE ALARM RED" and "BLACK".

iii. Loops & Identification

All controls shall be labeled, all loop locations shall be identified, and the FACP shall be provided with a set of permanently mounted operating instructions, to avoid confusion. Loop location identification shall be as approved by the Engineer Incharge and contain up to three lines of text with 1/8" minimum character heights.

iv. Components of Fire Alarm Control

Panel

The FACP shall include as minimum following:

- a. All hardware and software to allow the panel configuration and operation to be changed at the panel. Systems that require off-site programming are not acceptable.

The memory data for panel configuration and operation shall reside in non-volatile, memory provided by battery-backed RAM. Removal of the board shall not cause loss of memory contents.

Switches for panel setup, set reset, manual, evacuation alarm, silence and acknowledge. Individual supervisory LEDs shall be provided for power, run, alarm, trouble, disconnect, low battery and ground fault.

- b. Indicating zones: As indicated on the drawings, each zone containing smoke detectors shall provide power and monitoring for up to only 50% detectors. (All hardware and software shall be provided to facilitate selection of circuit performance to provide alarm verification for smoke detector circuits with field false alarms. When a detector signals an alarm, the panel shall automatically reset the detector, wait and their double checks to verify the alarm. Each zone shall have a red LED to indicate alarm and yellow or amber LED to indicate a trouble condition.

- c. Indicating Loops: 1 or 2 indicating circuits shall be provided. Each circuit shall provide power for polarized alarm signaling devices. A red LED to indicate the energized state of the circuit and a yellow LED to indicate a trouble condition shall be provided for each circuit. A disconnect switch for each circuit shall be provided to allow the FACP to be tested with sounding alarm signals. When disconnected, the FACP shall indicate both trouble condition and disconnect.

v. **Manual Functions**

At any time, even without an alarm condition on an indicating circuit, the operator shall provide the following manual capabilities in the FACP by means of switches located behind a key-locked cover:

- a. In case of fire if a general evacuation is needed all bells shall sound. These signals can be initiated from the main panel and secondary switch at manual fire alarm initiating device (break glass unit).
- b. Silence the local audible signal. This shall also cause the LED(s) to cease flashing and to be continuously 'ON'.
- c. Silence the alarm signals.
- d. Reset the FACP, after all initiating devices have been restored to normal.
- e. Disconnect any individual initiating or indicating circuit from the alarm sequence. This action shall light a disconnect LED and cause a trouble condition.
- f. Perform a complete operational test of the system microprocessor with a visual indication of satisfactory communication with each board.
- g. Test all panel LEDs for proper operation without causing a change in the condition on any zone.

vi. **System Supervision**

- a. Upon application of primary power, or reapplication following power failure, the FACP shall automatically be in a normal supervisory condition.
- b. In the normal supervisory condition, a green "POWER" LED shall be illuminated, indicating the presence of primary power.
- c. A green "RUN" LED shall be illuminated indicating that the microprocessor is communicating with the system and the memory contents are satisfactory.
- d. The following shall be electrically supervised: All initiating and indicating device circuits.

All plug-in circuit board shall have proper board type in the position. System that use electrical continuity to supervise the presence of plug boards, but that do not assure that board position have been exchanged, shall provide equivalent means for specified supervision, beyond that provided by the locked cover.

4.12 Shop Drawings / Technical Specifications

Prior to installation of any equipment, the Contractor shall submit for approval, shopdrawings including riser and terminal wiring diagrams and specifications data sheets. Submittals indicating typical one line riser and typical specification data sheets only will not be acceptable.

The Contractor shall review the total system point to point wiring layout to assure that the correct number and type of wire and conduit sizes are installed. Upon completion, the Contractor shall provide detailed written operation instructions and three sets of "as built" drawings including plan, layout, conduit runs and wiring diagrams as finally installed.

4.13 Test

Upon completion and at such time as the Engineer incharge may direct, the Contractor shall conduct a total system test where line supervision and each device shall be tested. All the tests shall demonstrate that the system meets the tests shall operating requirements of this specification, that individual conductors of all circuits are free of grounds, shorts and breaks, and that no grounds exist between any piece of equipment in the control unit and the cabinet. All final connections, testing, adjusting and calibrating shall be made under the direct supervision of a factory trained technician of the system supplier.

4.14 System

The fire alarm control panel (FACP) shall be installed at the Security room at lower ground floor by at a position and height as shown on drawing and as approved at site. The FACP shall match with the wall finish and shall be of neat finish, installed flush or semi-flush with the wall.

The fire alarm riser shall travel in one conduit for straight runs, separate conduit shall be used at branch office through junction boxes.

4.15 Fire Alarm Installation

The Fire alarm system shall be installed as mentioned in the drawings. The system shall be connected, tested and commissioned as per manufacturer's instructions and in the presence of Engineer Incharge. The wall recessed mounting Fire alarm manual stations shall be installed at a height of 4.5' feet above finished floor level. The connections of the appropriate Contactors of the Fire alarm system shall be made as per manufacturer's instructions.

The mounting height of the sounder shall be above the false ceiling or 7' from F.F. level when false ceiling is not comes. The conduit and wiring of the Fire alarm system shall be as per installation instructions for conduits and wirings given in the relevant section of these specifications. The Fire alarm system conduit shall be laid 15 cms (6") from the electrical conduits and cross the electrical conduit at 90 degree only. The Fire alarm system conduit shall be marked with red colour at terminations in order to distinguish it from other conduit system.

SPECIFICATIONS PRE-ENGINEERING BUILDING

PROPOSAL INDEX

SECTION NO: 1	BUILDING DESCRIPTION Building No. 1 Area No. 1
SECTION NO: 2	APPLICABLE CODES
SECTION NO: 3	MATERIAL SPECIFICATIONS
SECTION NO: 4	STEEL WORK FINISH
SECTION NO: 5	STANDARD SUPPLIED ITEMS
SECTION NO: 6	DELIVERING UNLOADING AND STORAGE AT JOB SITE
ENCLOSURES	PROPOSAL DRAWINGS

Section No: 1 Building Description

1.1	Building No: 01	Usage : Warehouse
		Quantity of identical buildings: 01
		Areas: This building contains 1 Area

Building 1:

Building Parameters		
1	Type	Multi Span (MS-1)
2	Width (m)	33.528
3	Length (m)	82.296
4	Clear Height (m)	10.0
5	Width Module (m)	16.764+16.764
6	Roof Slope	1.0 : 10
7	Bay Spacing (m)	12@6.858
8	Type of End Frames	Post and Beam End
9	Type of Bracing at Roof	Diagonal
10	Type of Eave	Eave gutter Downspout

Design Loads: (Refer to Section 2 'Applicable Codes' of this offer).		
1	Design Dead Load (KN/m ²)	0.1
2	Design Live Load (KN/m ²)	0.60
3	Collateral Load (KN/m ²)	0.15
4	Wind Speed (kmph)	130
5	Earthquake Zone	Zone B
6	Rain Fall Intensity (cm/hr)	15.00

Open Wall Conditions (Refer attached drawings)		
1	Near Side Wall	Open up to 3.0m for block wall (by others)
2	Far Side Wall	Open up to 3.0m for block wall (by others)
3	Left End Wall	Open up to 3.0m for block wall (by others)
4	Right End Wall	Open up to 3.0m for block wall (by others)

Eave Gutter and Downspouts
<p>The integrity of a roof drainage system is influenced by the design of its gutters and downspouts and by the proper spacing of the downspouts. A gutter is a cold formed "channel shaped" member designed to carry water from the roof of the building to the downspout. Similarly a downspout is a hollow cold-formed section used to carry the water from the roofgutter to the ground or to a storm drainage system.</p>

100mm thick Rockwool Borads 60 Minutes Fire Rated		
High quality rockwool Insulation. Outer and inner skin is Pre-painted sheet. Core material is 100mm thick rockwool rigid board with density of 80Kg/m ³ . Top Cladding 0.5mm thick corrugated and bottom cladding 0.5mm thick.		
No.	Quantity(m ²)	Description
1	Roof	100 mm thick Rockwool boards
2	Wall	100 mm thick Rockwool boards

Mezzanine Floor (Refer Attached Drawings)					
Standard supply includes support columns, primary beams, secondary joists and a steel deck that supports a 75 mm reinforced concrete slab (slab by others). The steeldeck is intended to carry the weight of the slab during construction only. It is not designed to carry the floor loads.					
S. No.	Floor Loads (kN/m ²)			Area (m ²)	Floor Clear Height (m)
	Live Load	Dead Load including floor	Collatera lLoad		
1	5.0	3.0	0.0	1709	3.047

Staircases upto Mezzanine Floor							
Treads may be made of pre-galvanized grating, red oxide primed checkered plate or red oxide primed "U" Shaped pans.							
No.	Qty.	Staircase type	Out to out width of staircase(mm)	Handrails	Top landing	Mid landing	Treads Type
1	02	Single Flight	1000	Yes	No	No	Pan

Monkey Ladder		
No.	Description	Quantity
1	Monkey Ladder	01

Canopy			
No.	Description	Quantity	Unit
1	Canopy -1 11.176mx3.660mx4.580m	440	Sq.ft
1	Canopy -2 5.588mx3.660mx4.580m	220	Sq.ft

Section No: 2 Applicable

Codes

All buildings included in this proposal are designed in accordance with the following codes:

(Pakistan Insulation has the right to provide intermediate splices in structural members as needed)

Loads applied on buildings and tolerances for fabrication and erection are in accordance with:

The 2002 edition of the **Low Rise Building Systems Manual** By
Metal Building Manufacturers Association, Inc. (**MBMA**) 1300
Summer Ave., Cleveland, Ohio 44115, USA

Hot rolled sections and built up sections are designed in accordance with:

The 1989 AISC Edition of the **Manual of Steel Construction – Allowable Stress Design**,
By American Institute of Steel Construction, Inc. (**AISC**)
1 East Wacker Drive, Suite 3100, Chicago, Illinois 60601-2001, USA

Cold formed members are designed in accordance with:

The 1986 AISI Edition of **Cold Formed Steel design Manual**
By American Iron and Steel Institute (**AISI**)
1000 16th Street, NW, Washington, DC 20036, USA

Welding is applied in accordance with:

The 20th Edition (2008) of **Structural Welding Code – Steel (AWS D1.1- 2008)**
By American Welding Society (**AWS**)
550 NW LeJeune Road, Miami, FL 33126, USA

Section No: 3 Material Specifications

Below are standard material specifications that will be used in the project.

No.	Materials	Specifications	Minimum Strength
1.	Built-Up Members / Hot Rolled Members	ASTM A 572M Grade 345 Type 1	$F_y = 34.5 \text{ kN/cm}^2$
		Or EN 10025-2:2004 S355JR	
		Or ASTM A 36	$F_y = 24.82 \text{ kN/cm}^2$
2	Cold Formed Secondary Members		
	•Galvanized Steel	ASTM A 653M SS Grade 340 Class 1, Z275	$F_y = 34.0 \text{ kN/cm}^2$
3	Sheeting & Liner Panels		
	•Pre-Painted Steel	ASTM A 792M Grade 340 Class 2, AZM120	$F_y = 34.0 \text{ kN/cm}^2$
		Or PPGI Z 120	
4	X- Bracing		
	•Rod	ASTM A 615 Grade 300	$F_u = 50.0 \text{ kN/cm}^2$
		•Or ASTM A 36M	$F_u = 40.0 \text{ kN/cm}^2$
5	Anchor bolt		
	Anchor Bolt	ASTM A 36M Hot Dip Galvanized to ASTM A 153 Mclass C	$F_y = 25.0 \text{ kN/cm}^2$ $F_u = 40.0 \text{ kN/cm}^2$

Section No: 4 Steel Work

4.1 Primary Steel

- All primary steel members will be sand blasted and painted at our factory with one coat of epoxy primer.

4.2 Secondary Steel

- All secondary steel members such as purlins, girts, eave struts, gable angles and base angles are made of pre-galvanized steel coils.

Section No: 5 Standard Supplied Items

The following are normally supplied unless mentioned otherwise:

1. Hot dip galvanized Anchor bolts for rigid frames, end wall posts.
2. Eave gutters & downspouts on sidewalls.
3. All necessary flashing & trims.
4. End lap mastic.
5. Connection bolts.
6. Sheeting fasteners.
7. Bead mastic.

Section No: 6 Delivering, Unloading, and Storage at Job Site

1. The contractor is responsible for unloading the delivered materials at the project site.
2. Materials should be thoroughly checked after unloading.
3. Care, storage, and protection of the materials at the site is the responsibility of the customer.
4. Red oxide and grey aluminum oxide primer paints are meant to protect the steel during transportation and for a short storage period at site (not to exceed two weeks).
5. The contractor is responsible for unloading the delivered materials at the project site.
6. Materials should be thoroughly checked after unloading.
7. Care, storage, and protection of the materials at the site is the responsibility of the customer.
8. Red oxide and grey aluminum oxide primer paints are meant to protect the steel during transportation and for a short storage period at site (not to exceed two weeks).

IP BASED CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

1.0 GENERAL

- A. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.
- B. All systems and components shall have been thoroughly tested and proven in actual use.
- C. All systems and components shall be provided with the availability of a toll-free, 24-hour technical assistance program (TAP) from the manufacturer. The TAP shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge for as long as the product is installed.
- D. All systems and components shall be provided with a one-day turnaround repair express and 24-hour parts replacement. The repair and parts express shall be guaranteed by the manufacturer on warranty and non-warranty items.

2.0 GENERAL SPECIFICATIONS

IP MEGAPIXEL CAMERA (INDOORWALL TYPE):

The camera shall be compact rugged, IR, 1.3Mega pixel 1/3 image sensor format digital color having the horizontal resolution of 1280x720 TVL or above with outstanding picture quality. The camera shall provide easy installation, digital signal processing, on screen displays, superior picture quality reliability. The camera shall accept AC or DC POE type. The camera shall provide auto-detection of lens type with lens wizard. The camera shall provide night sense feature to extend the excellent sensitivity in low light conditions.

The camera shall provide automatic sensing for tracking white balance. The camera shall support bidirectional communication technology using standard video cable. The camera shall be line locked to the power line zero crossing to ensure roll free vertical interval video switching and recording.

The rated voltage shall be 12VDC, 24 VAC 50 Hz and POE option. The operating temperature shall be -20 to 50 degree Celsius. Humidity shall be 5 to 93% non-condensing. Shock resistance shall be minimum 50 gm.

Signal to Noise Ratio	:	50 dB
Electronic shutter	:	AES or 1/77000 sec.
White Balance	:	Automatic sensing, (2500 – 9000K)
Video output	:	Composite video 1.0 Vp-p, 75 ohms.
Aperture correction	:	Horizontal and vertical, symmetrical.
BLC	:	Center window weighting
Synchronization	:	Line Lock
(When powered by AC only) Synchronizes the camera to the power line zero crossing for roll-free vertical interval switching.		
(When DC supply) Internal crystal.		
Video Compression	:	H. 264, multicast streaming.

Networking	:	10/100/1000 Mbps gigabit Ethernet,
RJ-45 Viewing Requirement	:	ONVIF
Field Of View	:	31 to 87, 25 to 880, 35 to 105 (Horizontal,
Vertical & Diagonal)		
Image Resolution	:	Main stream 1280 x 720 @ 25/30 fps. Feature: Extra
stream shall be provided.		
Audio Compression	:	Built-in
Support Protocol	:	TCP/IP, UDP, SMTP, UPNP, FTP,
HTTP or etc.Data Storage	:	Video or Snapshot. Built-in (Micro SD).
Low light Capabilities	:	0.0013 Lux. Additional feature should be removable
IR cut filter mechanism for increased sensitivity.		
Lens	:	DC Iris.
	:	Password protection, IP address filtering, user accesslog.
Users	:	10 Simultaneous users.
Video Analytic	:	Adaptive motion analytic to intelligently detect motion

time. Also count the objects

Imaging Device	:	16:9 Aspect Ratio 1/3 inch, effect 4:3 Aspect ratio
Cabling type	:	Cat-6
Alarm Pan Input	:	22 to 34 VAC 24 VAC nominal or
POE.Alarm I/P	:	10 VDC max, 75 mA max
Alarm O/P	:	0 to 15 VDC max, 75 mA.
Service Port	:	External 3 Connection 2.5 m pwds.
Certification	:	FCC, CE, UL/UL Listed.

3.0 INDOOR TYPE IP CAMERA (DOME TYPE):

The camera shall be compact rugged, 1.3 Mega pixel 1/3 (3 to 12mm) varifocal lens & image sensor format digital color having the horizontal resolution of 1280x720 TVL or above with outstanding picture quality. The camera shall provide easy installation, digital signal processing, on screen displays, superior picture quality reliability. The camera shall accept AC or DC POE type. The camera shall provide auto-detection of lens type with lens wizard. The camera shall provide night sense feature to extend the excellent sensitivity by a factor 3 in low light conditions.

The camera shall provide automatic sensing for tracking white balance. The camera shall support bidirectional communication technology using standard video cable. The camera shall be line locked to the power line zero crossing to ensure roll free vertical interval video switching and recording.

The rated voltage shall be 12VDC, 24 VAC 50 Hz and POE option. The operating temperature shall be -20 to 50 degree Celsius. Humidity shall be 5 to 93% non-condensing. Shock resistance shall be minimum 50 gm.

Signal to Noise Ratio	:	50 dB
Electronic shutter	:	Automatic, 1/5 to 1 /132,000 sec.
CCIR, 1/60 to 1/150000 sec. (EIA)		
White Balance	:	Automatic sensing, (2500 – 9000K)
Video output	:	Composite video 1.0 Vp-p, 75 ohms. Aperture
correction	:	Horizontal and vertical, symmetrical.BLC
	:	Center window weighting
Synchronization	:	Line Lock (When powered by AC only)
Synchronizes		
the camera to the power line zero crossing for roll-free vertical interval switching.		
(When DC supply) Internal crystal.		
Video Compression	:	H. 264, multicast streaming.
Networking	:	10/100/1000 Mbps gigabit Ethernet, RJ-45
Viewing Requirement	:	ONVIF
Field Of View	:	24 to 65, 15 to 37, 28 to 75 (Horizontal,
Vertical &		
Diagonal)		
Image Resolution	:	Main stream 1280 x 720 @ 25/30 fps. Feature:
Extra		
stream shall be provided.		
Audio Compression	:	Built-in
Support Protocol	:	TCP/IP, UDP, SMTP, UPNP, FTP, HTTP or etc.
Data Storage	:	Video or Snapshot. Built-in (Micro SD).
Low light Capabilities	:	0.0013 Lux. Additional feature should be
removable		
IR cut filter mechanism for increased sensitivity.		
Lens	:	DC Iris.
: Password protection, IP address filtering, user accesslog.		
Users	:	10 Simultaneous users.
Video Analytic	:	Adaptive motion analytic to intelligently detect
motion		
within the field of vision and trigger an alarm. Also detects vehicles near sensitive areas longer		
than the users define time. Also count the objects that enter in a define zone. Also any object		
placed in a define zone and then trigger alarm. Cameras shall have maximum feature which shall		
meet clients requirements.		
Imaging Device	:	16:9 Aspect Ratio 1/3 inch, effect 4:3 Aspect
ratio		
1280 x 720 @ 1.3 MP x1.		
Cabling type	:	Cat-6
Pan I/P	:	22 to 34 VAC 24 VAC nominal or POE.
Alarm I/P	:	10 VDC max, 75 mA max
Alarm O/P	:	0 to 15 VDC max, 75 mA.
Service Port	:	External 3 Connection 2.5 m pwds.
Certification	:	FCC, CE, UL/UL Listed.

4.0 OUTDOOR TYPE IP SPEED CAMERA:

The camera shall be compact weather proof, IP Speed Dome 36 x optical zoom format digital color having the horizontal resolution of 12 x DIGITAL ZOOM (530) TVL or above with outstanding picture quality. The camera shall provide easy installation, digital signal processing, on screen displays, superior picture quality reliability. The camera shall accept AC or DC POE type. The camera shall provide auto-detection of lens type with lens wizard. The camera shall provide night sense feature to extend the excellent sensitivity by a factor 3 in low light conditions.

The camera shall provide automatic sensing for tracking white balance. The camera shall support bidirectional communication technology using Cat-6. The Cameras shall high speed pan up to 260°/sec and tilt up to 120°/sec. built-in web browsing.

The rated voltage shall be 12VDC, 24 VAC 50 Hz and POE option. The operating temperature shall be -20 to 50 degree Celsius. Humidity shall be 5 to 93% non-condensing. Shock resistance shall be minimum 50 gm.

Image Sensor	:	¼” CCD
Signal to Noise Ratio	:	50 dB
Electronic shutter	:	Automatic, 1/5 to 1 /132,000 sec.
CCIR, 1/60 to 1/150000 sec. (EIA)		
White Balance	:	Automatic sensing, (2500 – 9000K)
Video output correction	:	Composite video 1.0 Vp-p, 75 ohms. Aperture
	:	Horizontal and vertical, symmetrical.BLC
	:	Center window weighting
Synchronization	:	Line Lock (When powered by AC only)
Synchronizes		
the camera to the power line zero crossing for roll-free vertical interval switching.		
(When DC supply) Internal crystal.		
Video Compression	:	H. 264, multicast streaming.
Networking	:	10/100/1000 Mbps gigabit Ethernet, RJ-45
Viewing Requirement	:	ONVIF
Field Of View	:	24 to 65, 15 to 37, 28 to 75 (Horizontal, Vertical & Diagonal)
Resolution	:	530 TVL
Sensor Element	:	PAL 752 (H) x 582 (V)
Lens Type	:	36 x optical zoom, 12 x digital zoom.
Focal Length	:	F1.6 ≈ r 3.8 f=3.4≈122.4mm.
Illumination	:	1.4 lux /0.01 lux.
Pan Range	:	On 360° Continuous, Speed 0.5 or 260°/sec.
Preset Point/ Tour	:	32 Preset, 16 Camera tour.
Focus	:	Auto/manual.
Video Capture	:	H.264,4CIF/CIF/QCIF
MJPEG	:	4CIF/CIF/QCIF
Image Frame rate	:	30 fps (N), 25 fps (P) for all resolution. 2 way
audio	:	Simplex/Duplex 2 way audio.
Lan port	:	RJ45 Connector, 10/100 M auto.
Alarm/out	:	Dry contact or relay output standard.
RS 485	:	For external keyboard.

Audio In/Out : Microphone in/out.
 Video Out : 1.0 Vp-p/75Ω Bnc optional.

116

Motion Detection : 1.5 Zone.OS
 : Windows based.
 Security : Password protection.
 Certification : FCC, CE, UL

5.0 MANUFACTURER’S WARRANTY

Repair or replacement of defective parts for a period of two years from the date of shipment, installation.

6.0 IP Video Management Systems (VMS):

- A. IP VMS shall support minimum 100 channel and the direct analog cameras.
- B. IP VMS shall provide 6 to 10 Mbps for recording of analog and IP video stream, play back and export.
- C. IP VMS shall support recording of H.264, JPEG, and MPEG-4 IP Stream.
- D. IP VMS shall support third party H.264 Megapixel video stream up to 10Mps resolution with total system throughout recording of all IP & analog streams, playback and export.
- E. The IP VMS shall have fully open architecture with support for both IP Specific Cameras and as well as ONVIF Compliance.
- F. The VMS shall support 0.264 compression, CIF 4CIF resolution at maximum 100 IPS, 16 audio input and RS422/485 PT2 Control with supplied system/ third party compatible protocol.
- G. VMS shall support unlimited no’s of system connected over network. Each system shall contain 5 16GB min network ports, one for IP Camera/Encoder data, 1 for client computer access.
- H. VMS shall view, managed, & playback through single user interface simultaneously with other compatible VMS through supplied PC Server & PC Client Software.

7.0 HARDWARE:

- A. The VMS server shall operate on 2nd generation Intel® Core i7 processor and 8 GB of Ram or approved equivalent.
- B. VMS server shall utilize windows 7” ultimate 64 bit operating system or windows based equivalent operating system. But it should not lesser than windows 7 ultimate.
- C. VMS server shall have internal DVD +RW
- D. VMS server shall have two DV1-D ports.
- E. VMS server shall have expansions of IP video channel capacity through a licensing without any modification in hardware.
- F. VMS server shall support multiple make/models of IP Camera and encoders including third party manufacturer.
- G. VMS server shall also support audio recording in addition to third party manufacturer’s audio recording.
- H. VMS server shall support recording the internal storage (Built-in) server with additional storage utilize SCSI attached HDD1 storage.

147

- I. VMS server shall capable of continuous scheduled alarm/event and motion recording, preand post alarm recording also be available and full programmable on per channel basis.
- J. The VMS system shall allow archival of video data to computers or SAN storage devices over a network connection with optional compatible archive utility. The archival schedule shall be either automatic at user defined intervals or manual and shall be configurable perconnected per connected camera.
- K. VMS shall indicate system performance.
- L. RAIDS or NAS storage media built in an external shall be used. Minimum 16 TB built in shall be required. Manufacture should submit the data storage calculation prior to bidding.
- M. System shall have 6, 3.5 inch drive and optical DVR ± RW.
- N. System shall have PC1-E slots x 16 and PC1-E x 4.
- O. Auxiliary interfaces shall be USB 2.0 and USB 3.0 ports.
- P. 100 to 240 VAC 50/60 Hz, Auto ranging.
- Q. The maximum frame per second for recording or storage shall be 15 fps. Supplier shall be responsible for better resolution and good result.
- R. The resolution or frame size is not less than 1280 x 720.
- S. System should have recording capacity for 90 days recording of all cameras at 24 hours aday.

8.0 CLIENT SOFTWARE

- A. The IP VMS shall be capable running client application.
- B. The minimum client hardware configuration shall be Intel core I7 with required graphiccards.
- C. The memory shall be 4 GB or high.
- D. The system shall have optical drive like DVR +.
- E. The optical system shall be windows based XP professional or as engineer approved.
- F. The system shall have required accessories like connecting cables, programming, hardwarefor rack mounting recovery disc etc.
- G. The client software shall include all licenses for any additional third party cameras. Noadditional license cost shall be barred by client.
- H. The client software shall have capable for interface the multiple DVR or NVR platforms.
- I. The client system & software shall support minimum 20 to 25 cameras matrix on required fps resolution. It is the suppliers' responsibility to provide the better resolution and performance.
- J. The client system & software shall provide live video review and record video view with atleast 1, 5, 15, 30, 60 or 90 minutes.
- K. The client system & software shall capable to selectable in-video PT2 control or dashboard style control.
- L. The system & software shall capable for video export to any accessible media like HDD,DVD or network storage.
- M. The system shall have alarm pop-up featured and playback active alarm. It shall have on motion detection.
- N. The system & software shall have capable for matrix functionality whereby cameras sequences creating on monitor.

ELECTRICAL:

Input Voltage 100-240 VAC, 50Hz, auto ranging

Note:

The active switches (POE type) is the responsibility of Client IT personal.

Passive equipment such as CAT 6 cables and patch panels has been covered in telecom BOQ. Submittal must be submit to consultant / client for review and approval.

EARTHING SYSTEM

1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete earthing system 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 the electrical lines and equipment.

The Earthing system with accessories shall also comply with the General Specifications for Electrical Works, Section E- I and with other relevant provisions of the Tender document.

2.0 GENERAL

The earthing system consists of earth electrodes, earthing leads, earth connecting points, earth continuity conductors and all accessories necessary for the satisfactory operation of the associated electrical system.

3.0 STANDARDS

The latest editions of the following standards / codes shall be applicable for the materials covered within the scope of this specification:

BS 951	Earthing Clamps
BS 1433	Hard drawn bare copper conductor for earthing. BS 2874 Nuts, Bolts, Washers and Rivets for use on copper. BS 6346 PVC Insulated Cables.
CP 1013	Earthing

Any other standard referred to in above standards or these specifications.

4.0 MATERIAL

4.1 Earth Rod Electrodes

Drive extensible rods of the same diameter into the ground, either manually or by power driven hammer, to a suitable depth to obtain low resistivity in the particular soil.

Weld earth connectors to the top of the rods, in sufficient number to take all incoming cables.

4.2 Earthing Lead

The earthing lead shall connect the earth electrode to earth connecting point or equipment in the building. It shall be round hard drawn bare electrolytic copper of size shown on the drawings. The cost of earthing leads deemed to have been included in the price of earth electrode & no separate pavement shall be made for it.

4.3 Earth Continuity Conductor

Earth continuity conductor (E.C.C) shall be hard drawn bare copper wire or single core PVC insulated copper conductor cable of sizes indicated on the drawings. All thimbles, lugs, sockets, nuts, washers and other accessories necessary for the complete installation of ECC shall be provided by the Contractor without any extra cost.

The specifications for single core PVC insulated cables used as E.C.C. PVC insulated cables when used as E.C.C. shall be green,

5.0 INSTALLATION

Complete earthing systems as shown on the drawing shall be installed by the Contractor. The earthing system shall give earth resistance, including resistance of soil, earth leads and E.C.C. equal to less than one ohm, this without ground pits water spraying.

The earthing system shall be loop connected with earthing cables at least 300 mm away from telephone cables. The concept of the main loops and the way they are connected shall be such that equipment / apparatus can be easily removed without requiring a complex disconnection operation nor risking interruption of / or damage to the loop itself. The fastening of the earthing conductors shall be made on a sufficient length so as to prevent crushing or cross section weakening. The parts on which they are connected shall be conveniently cleansed and surface.

Leads sheaths or steel tape armours are not permitted as grounding conductors. The earthing system shall be installed to ensure that when any part of the earthing system is disconnected for the purpose of carrying out periodic testing an alternative path to earth is available.

At all connections of earth continuity conductor to LV Switchboard, LV Distribution Board or any other metallic body, proper size or brass sockets, thimbles or lugs shall be used to which the copper wire shall be connected by copper brazing. The soldering of copper wire at joints or termination shall not be allowed. All tee-off connections shall be by copper brazing using suitable socket and clamps. After brazing, the jointed surface shall be protected by oxide inhibiting compound of low electrical resistance. For connections to metallic body, the surface shall be thoroughly cleaned before bolting the lug or socket.

The earth continuity conductor shall be in general run in cable trench or in conduits / pipes as shown on the drawings. For under floor runs, these shall be installed in pipe / conduit of appropriate sizes. Where laid along under ground cables, these shall be laid directly under ground in unpaved areas and in pipes under paved areas.

The electrode plate shall be installed at a minimum depth of 5 meters from finished ground level or 1 meter below permanent water level, whichever is less. The minimum horizontal distance between earth electrodes shall be 3 meters. Proper mixture of lime and charcoal in the ratio of 1:

3 shall be made and buried along with the copper plate in the ground to increase the soil conductivity. The electrode shall be installed as per details shown on the drawings. The inspection chambers shall be constructed at locations approved by the Engineer.

A 50 mm diameter G.I. shall be provided from inspection chamber to earth plate for watering purposes. The pipe shall have 10 mm diameter holes at 500 mm center to center all along the length. At the ground level an inspection chamber with cast iron cover shall be constructed having dimensions as shown on the drawings. The inspection chamber shall have a copper supported on angle iron frame. The cover shall be hinged type, as approved by the Engineer and shall finish flush with the ground level.

The earth connecting point shall be installed at locations shown on the drawings. It shall be fixed on wall surface by means of brass screws with nuts, washers and other insulating material as instructed by the Engineer.

The earth continuity conductor of sizes shown on the drawing shall be installed all along the cable runs and connected to the earthing bar / terminals provided in the equipment. The body of all Switchboards shall be connected to earth by specified size of E.C.C. All metal work shall also be connected to earth by specified size of E.C.C. At any joint or termination, the E.C.C. shall be connected using proper accessories. No connection shall be made by twisting of earth conductors.

TELEPHONE & DATA CABLING SYSTEM & ACCESSORIES

1.01 WORK DESCRIPTION

- A. This Section specifies the minimum acceptable requirements on the quality, performance and standard for the Telephone Cabling System.
- B. The Contractor shall be responsible for the engineering, supply, installation, testing and commissioning of a cabling system for the complete Telephone System including, lead-in pipes, Local Authority's telecom manholes, cable tray, conduit, intermediate distribution frame (IDF) and telephone wiring between the Telecom riser and the terminal blocks or telephone points in each area.
- C. The Contractor shall install and terminate, where necessary, faceplates, jacks, cables, backboards, connection blocks, hubs, patch panels, patch cords, racks, brackets and all other hardware necessary to meet Local Authority's requirement.
- D. All works shall be performed in accordance with Rules and Regulations of the Local Authority's Guidelines for the provision of Telecommunication Facilities and to the satisfaction of Engineer.
- E. The work shall include all attendance and liaison with the Local Authority for the installation of main distribution frame, running of main cabling and all other telephone equipment.
- F. All equipment shall be current model, no replacement problem of components. All equipment and materials shall be as specified in the contract and to local Authorities acceptance.
- G. The Contractor must be licensed in Tripoli, Libya to carry out the telephone cabling system installation to Local Authority's requirement.

1.02 SUBMISSION

- A. All technical submissions shall be approved by the Engineer prior to the respective stages of construction.
- B. As a minimum requirement, the submission shall include the following:
 - 1. Equipment submission with manufacturer's data.
 - 2. Sample submission including telephone outlets, terminal blocks, cables, etc.
 - 3. Drawings for field equipment showing the co-ordinate routing of cable routings and detailson the equipment mountings.
 - 4. Builder's works requirements.

1.03 REGULATIONS

- A. The whole installation shall be engineering and installed in accordance with the Drawing and Specification and also the regulations of the Local Authority having jurisdiction over the installation work.
- B. The Contractor shall co-ordinate with the Local Authority and submit required shop drawing for Engineer's approval prior to work carried out on site.
- C. The Contractor shall co-ordinate with Local Authorities for the inspection and Handling over of the MDF room, Telephone Risers, Telephone Tray to Local Authority's acceptance. All timeand cost require to arrange for the inspection and carry out the installation to meet inspection requirement shall be included in the Contract.

- D. All work by the Contractor shall be in accordance with the practices set forth in TIA/E1A 568-A and to Local Authority's requirement.

2.01 TELEPHONE CABLES AND TERMINAL BLOCK

- A. The box shall be of heavy duty uPVC modular type with screwed cover similar to 'Egatube' boxes or approved equivalent.
- B. A flush mounted box with approved terminal block shall be installed as specified on drawings. The terminal block shall be able to accommodate the numbers of pair of the block terminals as specified in the Drawings plus 15 percent spare pair terminals for future connection.
- C. Telephone cable shall be Cat 5E 100 ohm, unshielded twisted pair (UTP) plenum rated with solid copper conductors. The cable provided shall comply with Local Authority's requirement. The numbers of pair shall be as per the Drawing.
- D. The termination of telephone cables to the terminal block shall be carried out by skillful personnel by means of proper tools and links. A neat arrangement with proper labeling shall be provided. The Engineer reserve their right to reject any improper termination and arrangement of cables.

2.02 OUTLET

Outlet compatible with telephone equipment approved by Local Authority shall be provided. Light position 11-style modular jack(s), T568B, with wire caps to provide strain relief and contamination protection, and able to accommodate coloured icons shall be provided to Local Authority's specification

2.03 TELEPHONE CABLES

- A. Telephone cables shall generally be multicore polyvinyl chloride insulated and sheathed cables, unless otherwise specified:
 - 1. Designed for communication use. Final sub-circuit wiring of each telephone outlet shall be provided with two (2) spare wires.
 - 2. Conductor – multi strand annealed copper
 - 3. Insulation – polyvinyl chloride to BS 6746

DATA CABLING SYSTEM

1.01 SCOPE OF WORK

- A. The following specifications are for the installation of the communication and data wiring. The Contractor shall provide all labor and materials for installation of the data communications systems as note on drawings and in these specifications. The Contractor will install and terminate, where necessary, faceplates, jacks, cables, backboards, connection blocks, hubs, patch panels, patch cords, racks, brackets and all other hardware necessary to effect a workable cable plant fully compliant with that as described in these specifications and in the drawings, and to the Local Authority's requirement and to the satisfaction of the Engineer. The contractor shall also submit as built drawings that reflect the installed cable routes, port locations and labeling information.

Section 1.01 1.02 GENERAL REQUIREMENTS

- A. The work shall consist of the following:
 - 1. Provide and install conduit, cable, connectors, wall plates, terminators, pullboxes, patch panels, panel racks/brackets, hubs and other items necessary for a complete working data/communications system. All work by the Contractor shall be in accordance with the practices set forth in TIA/EIA 568-A and comply with Local Authority's requirement.
 - 2. Provide electrical services to support the data systems required under this contract.
 - 3. Construct data communication closets as required to comply with these specifications and to Local Authority's requirement.
- B. Provide As-Built drawings identifying the cable path and note any deviations from the original drawings. Also provide all documentation on label and testing information prior to system acceptance.

Section 1.02 1.03 CONTRACTOR QUALIFICATIONS

- A. The Contractor must be licensed in the Tripoli, Libya to carry out the data cabling system installation to Local Authority's requirement.
- B. All the above information must be provided at the time of the contract award, prior to signing the contract.

Article II.

Article III. MATERIALS

Section 3.01

Section 3.02 2.01 SUBMITTALS

- A. Submit for review by the Engineer a compilation of material specifications to be incorporated in the work. Support submittals by descriptive means, i.e.: catalog sheets, product data sheets, and other literature by the manufacturer.
- B. Acceptable materials and manufacturers are listed below and are used only for reference. Materials and products considered as equivalent by the contractor, other than those listed, shall be submitted for Engineer approval. Submittals shall consist of substantiation of Local Authority's acceptance, catalog pages with items marked, referenced part numbers for which the substitution is intended, with specification sections and paragraphs referenced. In addition, samples of cables, connectors, and wall plates are required to be submitted for approval prior to installation.

- C. Manufacturer's cable markings shall consist of manufacturer's name, cable type/catalog No., 1987 NFPA type code compliance, and the 1993 NEC code compliance.
- D. Make submittals for each of the following items as included in the scope of this work:
 - 1. Horizontal cables
 - 2. Jumper cables
 - 3. Patch cords
 - 4. Connectors
 - 5. Wallplates
 - 6. Conduit, bushings, sleeves, raceway, etc.
 - 7. Patch panels
 - 8. Racks and brackets
 - 9. Hubs

Section 3.03 2.02 STATION OUTLETS

- A. Each communication workstation location, except as noted otherwise, shall consist of the following:
 - 1. 2 each single gang 2,4 or 6 port faceplate. Faceplates must have label fields top & bottom.
 - 2. The faceplate for the data communication cable shall be the same color and height coordinate with the electrical faceplate. Only one color faceplate shall be used throughout the project. Only flush mount type jacks are to be used on this project (unless otherwise noted on the drawings).
- B. 2 each Category 5 modular jack with an RJ45 connection, with wire caps to provide strain relief and contamination protection, and also to accommodate colored icons.

Section 3.04 2.03 BACKBOARDS

- A. Backboards shall be 18mm thick plywood, coated with fire-retardant paint. Confer with the Local Authority's specification to ascertain size, placement, etc. Size shall be adequate to support all specified/required devices as minimum.
- B. The backboards shall be painted with fire-retardant paint and color coded to Local Authority's requirement.

Section 3.05 2.04 PATCH CORDS

- A. CATEGORY 6 – Eight position modular plug to eight position modular plug: Patch cords shall be pre-assembled and factory tested, with Category 6 cable & eight position snagless modular plugs.

Section 3.06

Section 3.07 3.01 STATION JACK INSTALLATION – FLUSH MOUNT

- A. All cable installation and termination shall adhere to the provisions in TIA/EIA 568 and TIA/EIA TSB40-A.

1. The Contractor is required to submit a sample of assembled cable, connectors, raceway and accompanying specification sheets prior to installation for approval of quality, workmanship and materials.
2. The length of each station cable shall not exceed 90 meters. Station cable is defined as that length of cable from the back of the workstation outlet to the back of the Patch Panel or connecting block in the telecommunications closet. Station cable shall be a continuous run of cable with no splices, bridges, or other discontinuities.
3. Maintain cable twist-rate at all termination points. The amount of cable untwist shall be no more than 15mm. Do not strip back the cable jacket any more than is necessary to punch down the individual conductors.
4. All 110 connections shall be installed using a single 110 punch down tool and all terminations shall be trimmed flush with connector blocks.
5. Leave enough cable (2 meter at each outlet and 5 meters at the backboard, rack, or hub locations) to allow proper cable connections.
6. Station cable that runs outside the walls shall be in surface-mounted raceway, cable tray, or conduit.
7. Minimum 20mm conduit shall be installed in all walls and shall be run to above ceiling line. Terminate all conduits with plastic bushings. A minimum 200 ts polyline pull string shall be provided the entire length of each conduit.
8. When conduit runs from room to room, provide a metered tape and a minimum 200 ts polyline pull string to run the entire length of the conduit.
9. Conduit bends must be long, sweeping bends with radius not less than: 6 times the internal diameter of conduits 50mm or smaller; or, 10 times the internal diameter of conduits larger than 50mm.
10. Each cable installation shall be accompanied by a minimum 200 ts polyline pull string.
11. Cables shall not be tie wrapped to electrical or gas conduit. Maintain a minimum 100mm separation between low voltage cabling and electrical raceways, lights, etc.
12. D-rings will be provided and mounted to route the station cables at the backboard locations (& in chase locations as designated on the drawings).
13. Enough cable slack will be provided to neatly route the station cable through the “ID” rings to the appropriate 110 type block.
14. No communications or data circuit shall be run in the same conduit or raceway with power conductor except where the raceway is separated by a divider.

15. Cable routing shall follow the routes dictated by the detail while avoiding locations of high RFI/EMI radiation or adverse environmental conditions.
16. All plastic type molding must be anchored to the wall with the appropriate type of wall screw every 1.5 meters.
17. The Voice/Data cable plant shall be grounded and bonded in accordance with ANSI/TIA/EIA-607.
18. All cable coming from ceiling shall be placed in cable trunks..

Section 3.08

Section 3.09 3.02 WIRING TESTING

- A. Contractor shall provide all necessary testing equipment to test all cables.
 1. Each cable terminating in a station jack shall be tested from the telecommunications closet with a 4-pair wire tester. The tester shall verify continuity, faults, reversals, swaps and pairing.
 2. Each Category 5 cable link shall also be tested for near-end and far-end crosstalk and attenuation up to and including 100 Mhz and shall be verified for acceptable length.
 3. A hard copy of the test results for each cable run shall be provided to the Employer. Acceptable test results shall be agreed upon by the Employer and contractor prior to testing. It is the contractor's responsibility to replace or repair any cables, connectors or jacks which test outside the agreed-upon ranges.
- B. Before the system is approved by the Engineer, the Contractor will be required to "walk-through" the installation with the Employer and verify proper installation and conformance to specifications, drawings, and other agreed upon, written details.
- C. All cable-related documentation and As-Built Drawings will also be required for reviewing purposes at this time.

CABLE TRAY, LADDER AND TRUNKING

1.0 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2.0 SUBMITTALS

General: Submit the following according to the Division 1 Specification Sections. Product data for each component. Show tray types, dimensions, and finishes.

Determine the sizes of the cable trays based on the number and size of cables laid on the cable trays plus 20% space for future growth. Cables laid on cable trays shall be spaced twice their overall diameter (consider the largest cable as reference). In case of discrepancy with the contract documents this clause shall prevail, unless approved by the Engineer otherwise.

Shop drawings detailing fabrication and installation of cable tray, including plans, elevations, sections, details of components, and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice plate's connectors, expansion joint assemblies, straight lengths, and fittings.

Co-ordination drawings, including floor plans and sections drawn to accurate scale. Show accurately scaled cable tray layout and relationships between components and adjacent structural and mechanical elements.

3.0 QUALITY ASSURANCE

Manufacturer Qualifications: Select a firm experienced in manufacturing cable trays which has a record of successful in-service performance.

Comply with the relevant standards of BS, NEMA and NEC.

Single-Source Responsibility: All cable tray components shall be the product of a single manufacturer.

4.0 SEQUENCING AND SCHEDULING

Co-ordination: Co-ordinate layout and installation of cable tray with other installations.

Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Engineer.

5.0 CABLE TRAYS

The cable tray system shall be of one manufacturer and shall include factory made trays, tray fittings, connections and necessary accessories and supports to form a complete tray support system.

The cable tray system shall include the following factory-made tray elements. Straight trays and ladders, fittings and horizontal and vertical bends of various angle crosses, tees, wyes, reducers, vertical riser elements, connectors and all necessary fixing accessories.

Cable trays shall be constructed from mild steel of minimum thickness 16 gauge (1.5 mm). Trays in excess of 300 mm width shall be of minimum thickness 14 gauge (2.0mm).

Insert elements, bolts, screws, pins etc., shall be mild steel cadmium plated.

- a. Tray work shall have oval perforations. Ladder type trays shall be used as required and/or approved by the Engineer.
- b. All trays (straight and fittings) to be heavy duty returned flanged type unless specified otherwise.
- c. Tray component are to be accurately rolled or formed to close tolerance and all edges rounded. Flanges are to have full round smooth edges.

- d. Ladder racks of widths up to and including 300mm shall be constructed from rolled steel sections of minimum thickness 16 gauge (1.5 mm). Ladders in excess of 300 mm width shall be C Section construction with a minimum thickness of 14 gauges (2.0mm). The rungs shall be spaced at a maximum 300 mm.
- e. Unless indicated otherwise on drawings, cable trays shall be used in the range 150 mm to 900 mm wide, in fire preferred standard sizes: 150, 300, 450, 600 and 900 mm.
- f. Other sizes shall be used where specified or previously agreed with the Engineer.
- g. Flanges shall be a minimum of 50 mm deep.
- h. Minimum radius at side rails, horizontal and vertical tees and crosses shall be in accordance with the Manufacturer's standard.

Perforated, heavy duty, return flange type, in 2.5m nominal lengths Hot dip galvanized after completion of bending and drilling, complete with all necessary purpose made bends, tees, supports and the like. Width shall be such as to permit adequate access for installation and maintenance of cables and per the requirements of KESC regulations.

6.0 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 2-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 of fitting, and continuity shall not depend on contact through the screws, nor on removal on site paint finish from ferrous metal.

7.0 EXAMINATION

Examine surfaces to receive cable tray, cable trunking and cable ladder for compliance with installation tolerances and other required conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

8.0 WIRING METHODS

Use cable tray of complete with manufacturer's recommended covers, barrier strips, dropouts, fittings, conduit adapters, hold-down devices, grommets, and blind ends.

9.0 INSTALLATION

- a. Install cable tray, cable trunking and cable ladder level and plumb according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.
- b. Remove burrs and sharp edges of cable trays.
- c. Make changes in direction and elevation using standard fittings.

- d. Make cable tray connections using standard fittings.
- e. Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.
- f. Fire stop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.
- g. Working Space: Install cable trays with enough space to permit access for installing cables.

10.0 GROUNDING

Connect cable trays, cable trunking and cable ladder to ground as instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors.

11.0 CLEANING

Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.



VOLUME-III

DRAWINGS

GENERAL NOTES:



NORTH

Rev. No.	Date	Description

REVISION SCHEDULE

CLIENT NAME:

DOW UNIVERSITY OF HEALTH SCIENCES
OHA CAMPUS

PROJECT:

WAREHOUSE
DHS - OHA CAMPUS - WAREHOUSE

PROJECT NO:

DHS-2023

DRAWING TITLE:

LAYOUT PLAN - GF

DATE:

September 07, 2023

SCALE:

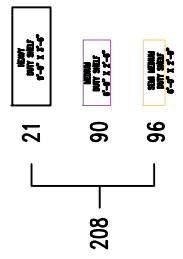
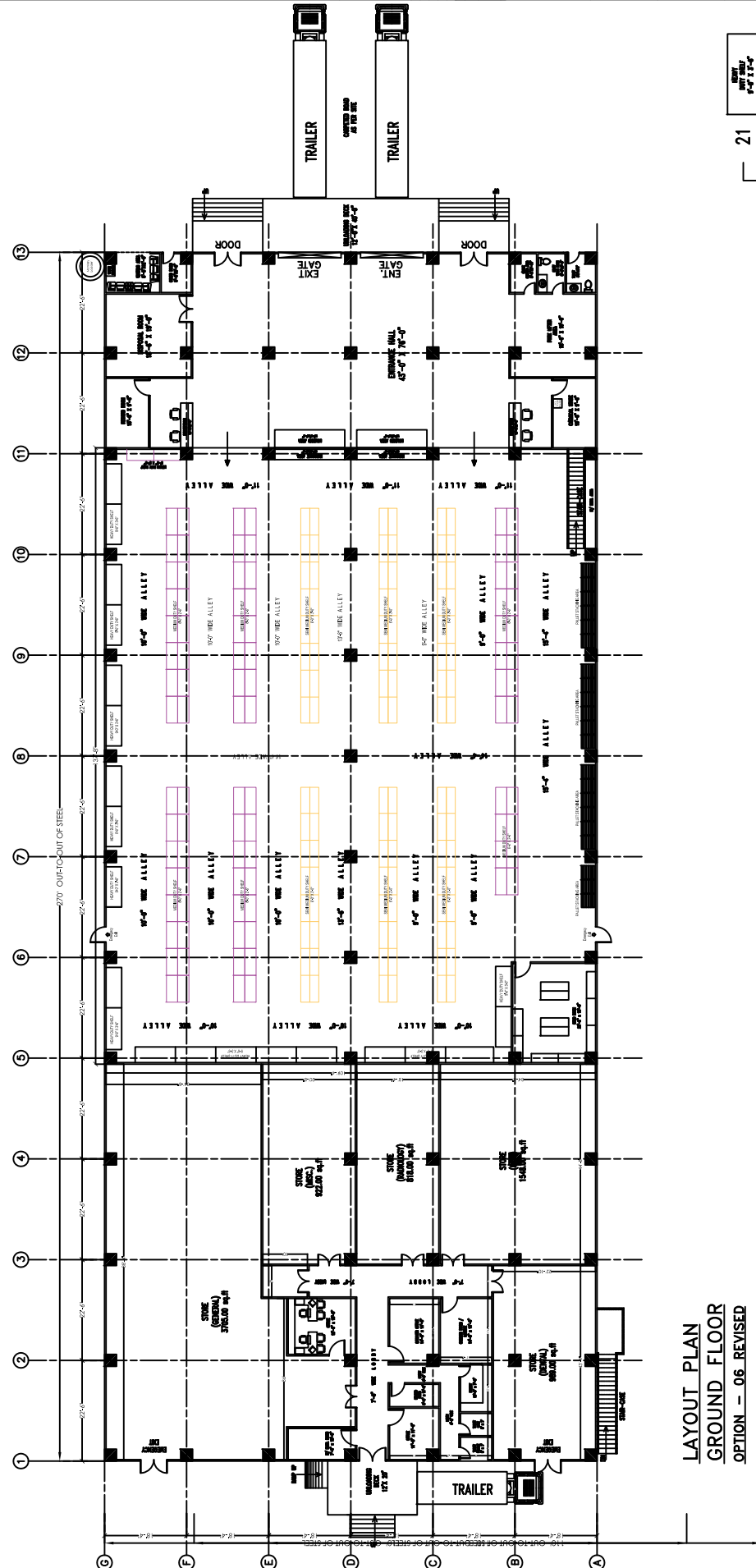
AS SHOWN

DATE PLOTTED:

September 07, 2023

PLANNER:

A-001



LAYOUT PLAN
GROUND FLOOR
OPTION - 06 REVISED

GENERAL NOTES:

NORTH



Date	By	Description

REVISION SCHEDULE

CLIENT NAME:

DOW UNIVERSITY OF HEALTH SCIENCES
OHA CAMPUS

PROJECT:

WAREHOUSE
DHS - OHA CAMPUS - WARCH

PROJECT NO:

DHS-2023

DRAWING TITLE:

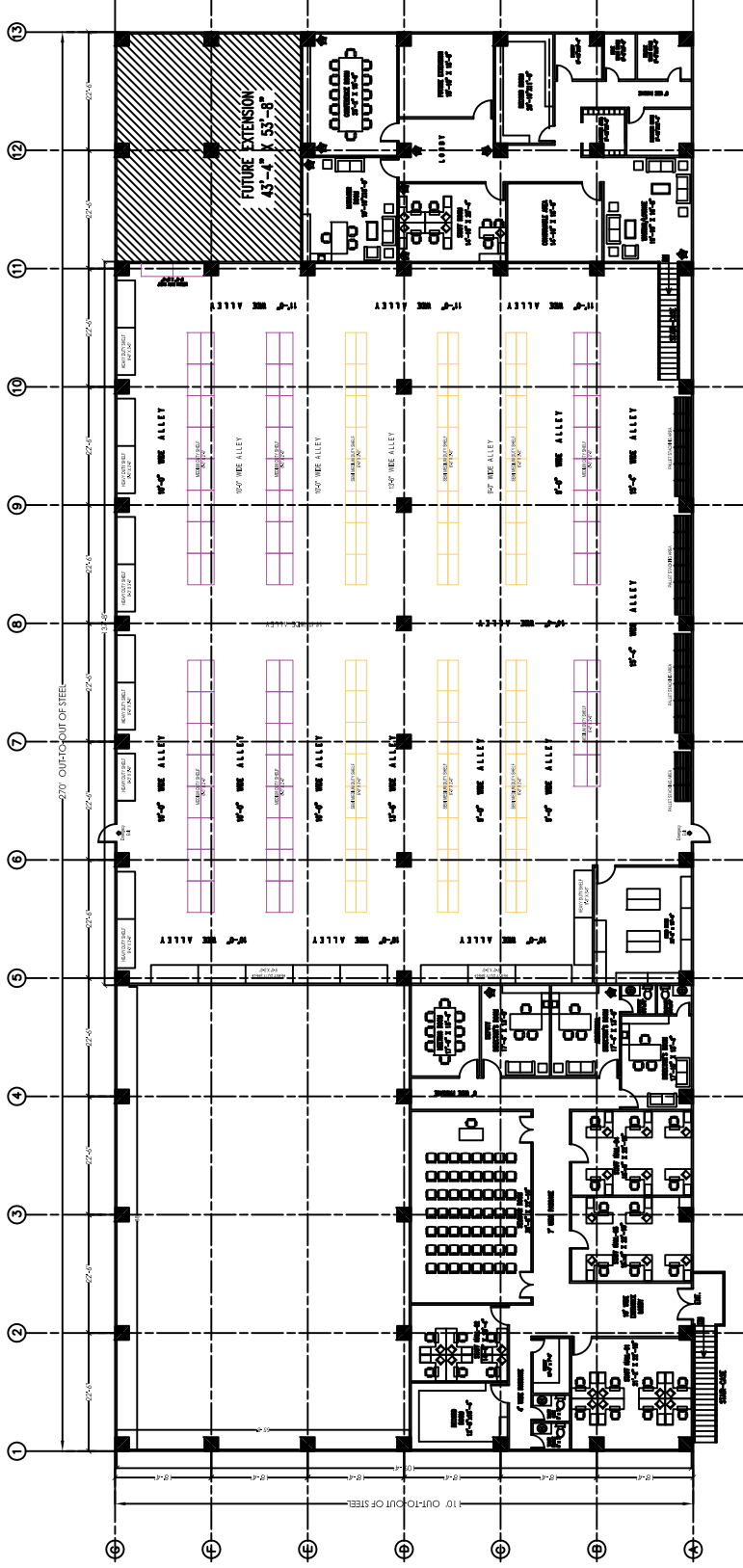
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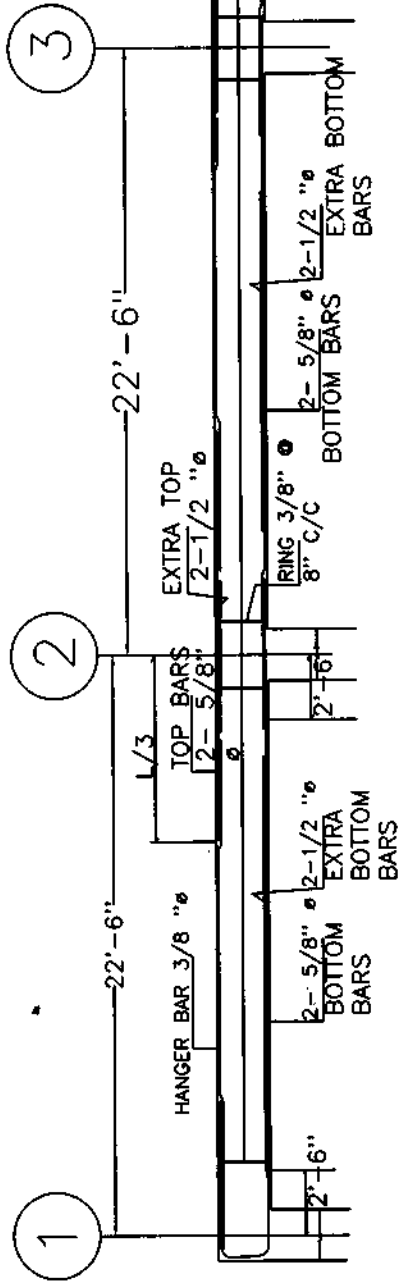
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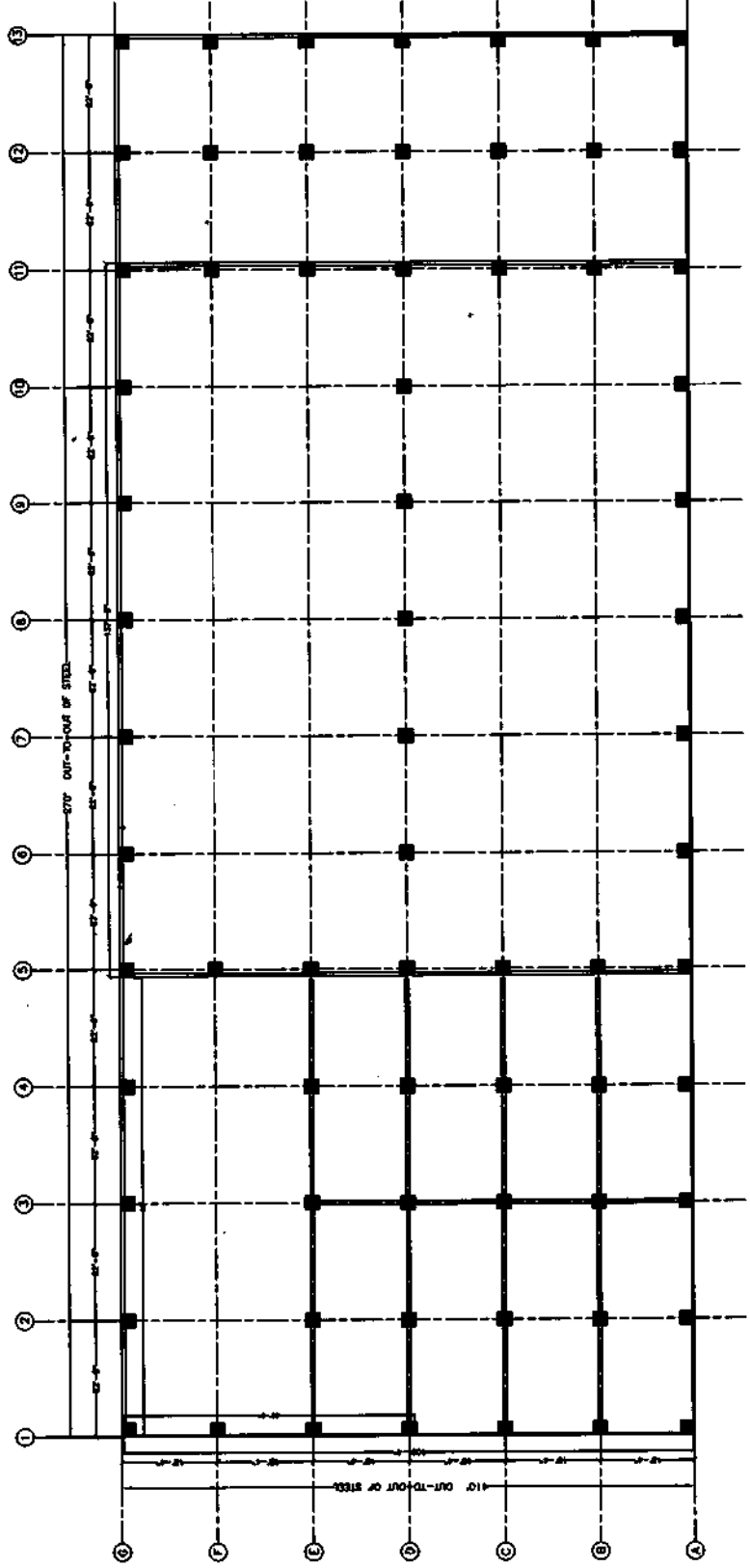
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LAYOUT PLAN
MEZZANINE FLOOR
OPTION - 04 REVISED

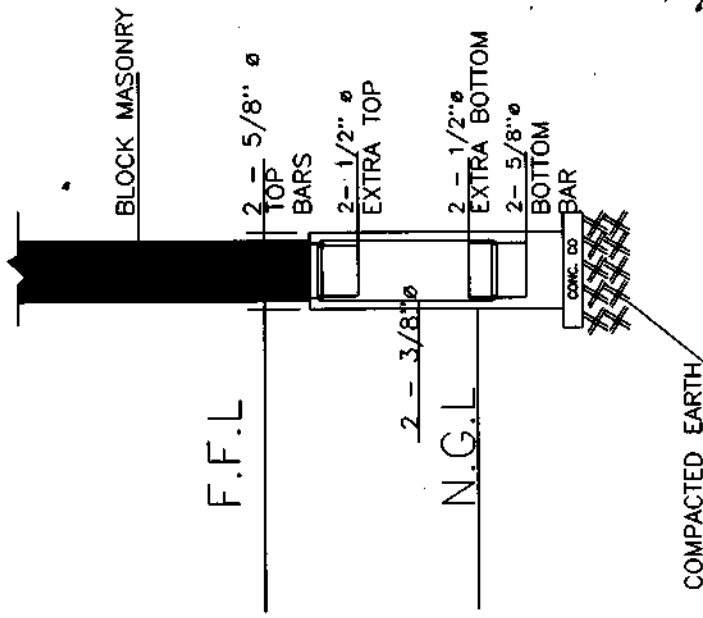


TYPICAL ELEVATION PLINTH BEAM

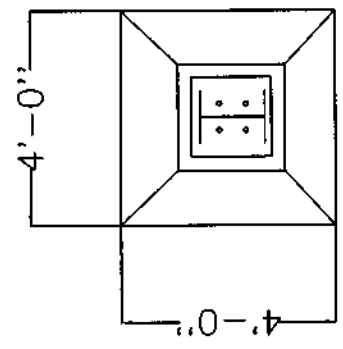
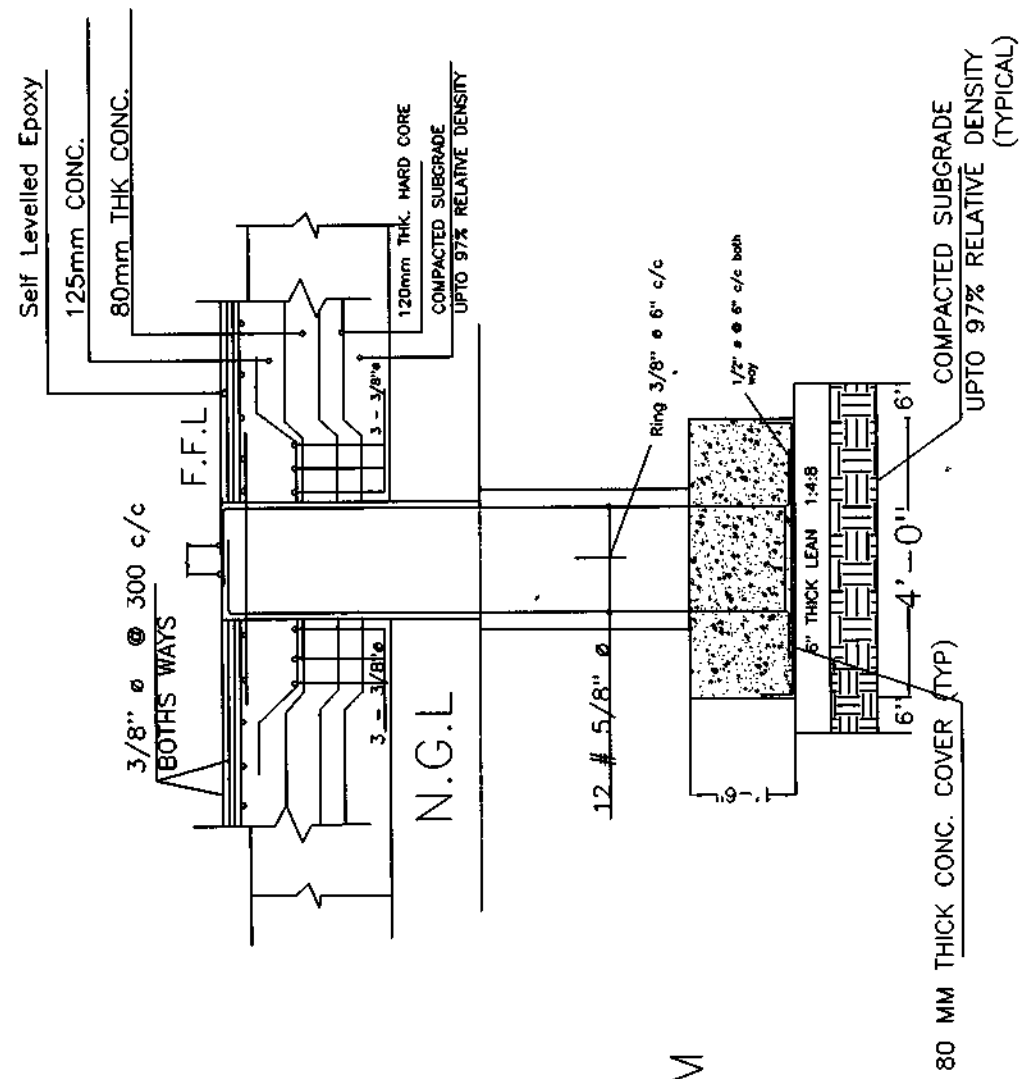


FOUNDATION LAYOUT PLAN

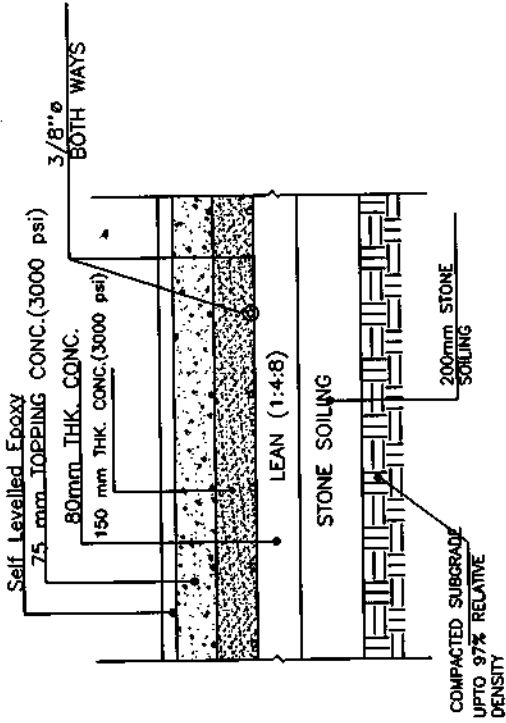
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DESIGNED BY: FOUNDATION LAYOUT PLAN & PLINTH DETAILS			DRAWN BY: Eng. Maher Hassan		CHECKED BY: Eng. Maher Hassan	



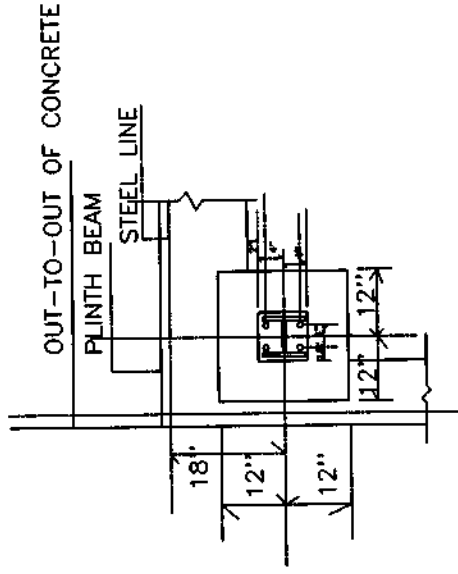
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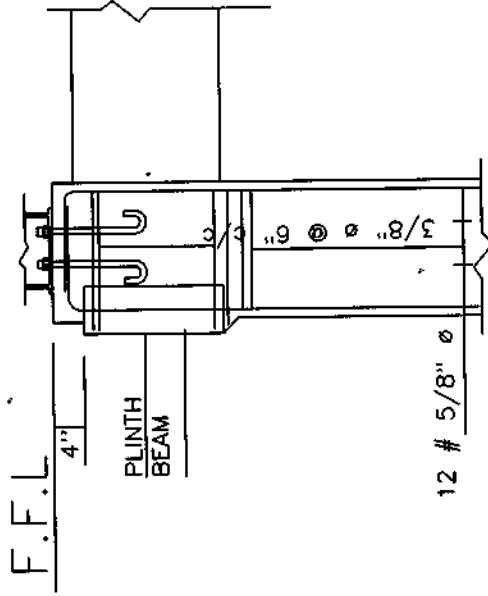
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PROJECT:	CONSTRUCTION OF WAREHOUSE DHS - OAK CAMPUS - KARACHI
PROJECT NO:	DHS-2023
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CHECKED BY:	
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SCALE:	
DATE:	
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DATE:	



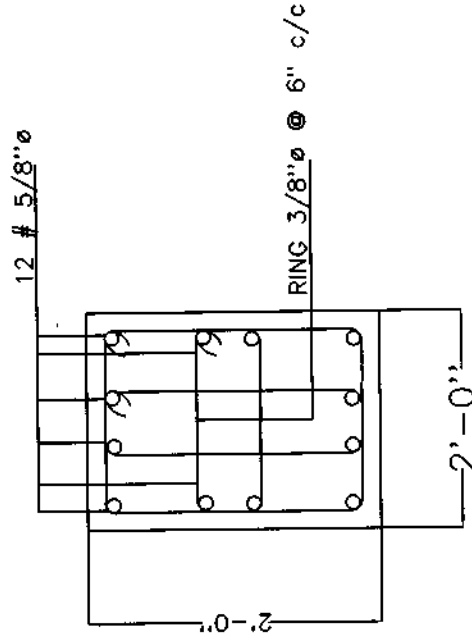
TYP. FLOORING DETAIL



TYPICAL DETAIL PEDESTAL



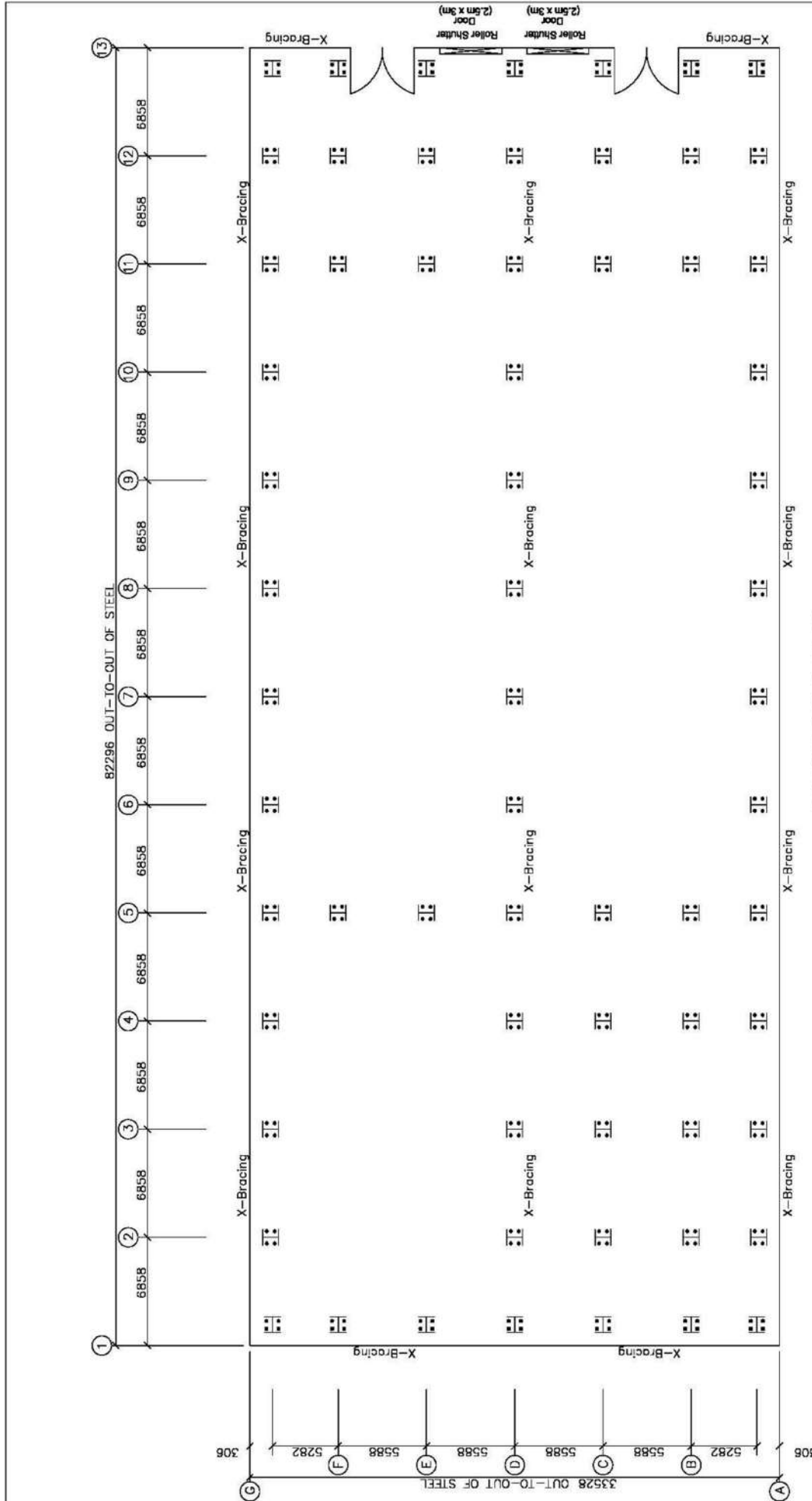
SECTION 1-1



PEDESTAL PD1

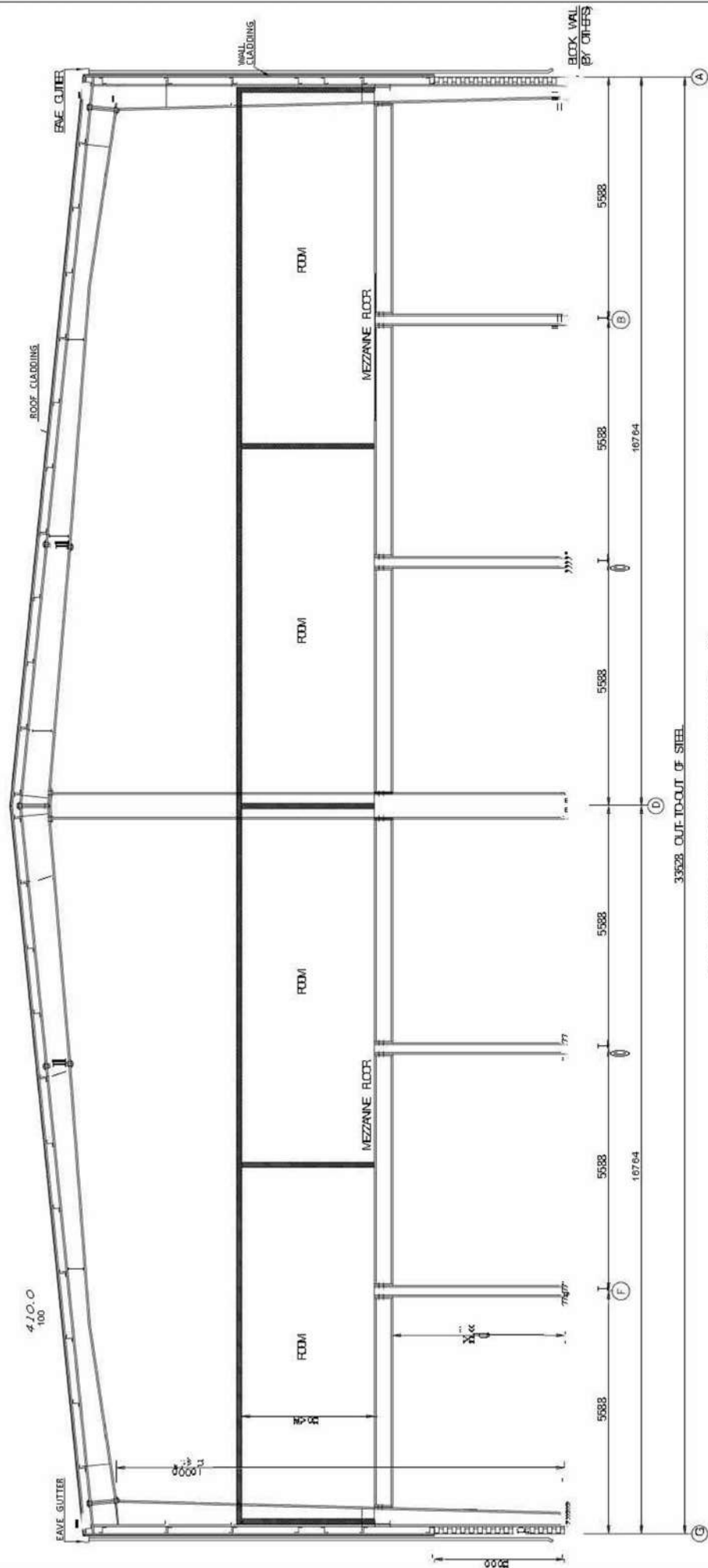
CLIENT NAME: DOW UNIVERSITY OF HEALTH SCIENCES
PROJECT: CONSTRUCTION OF WAREHOUSE DUHS - QJAH CAMPUS - KARACHI
PROJECT NO: DUHS-2023
DESIGNED BY: Engr. Saqib Hussain
CHECKED BY: MRS
DATE: September 07, 2023
SCALE: 1:1
REVISION NO: 1-01

CONCRETE WALL	
PEDESTAL DETAILS & SECTIONS	



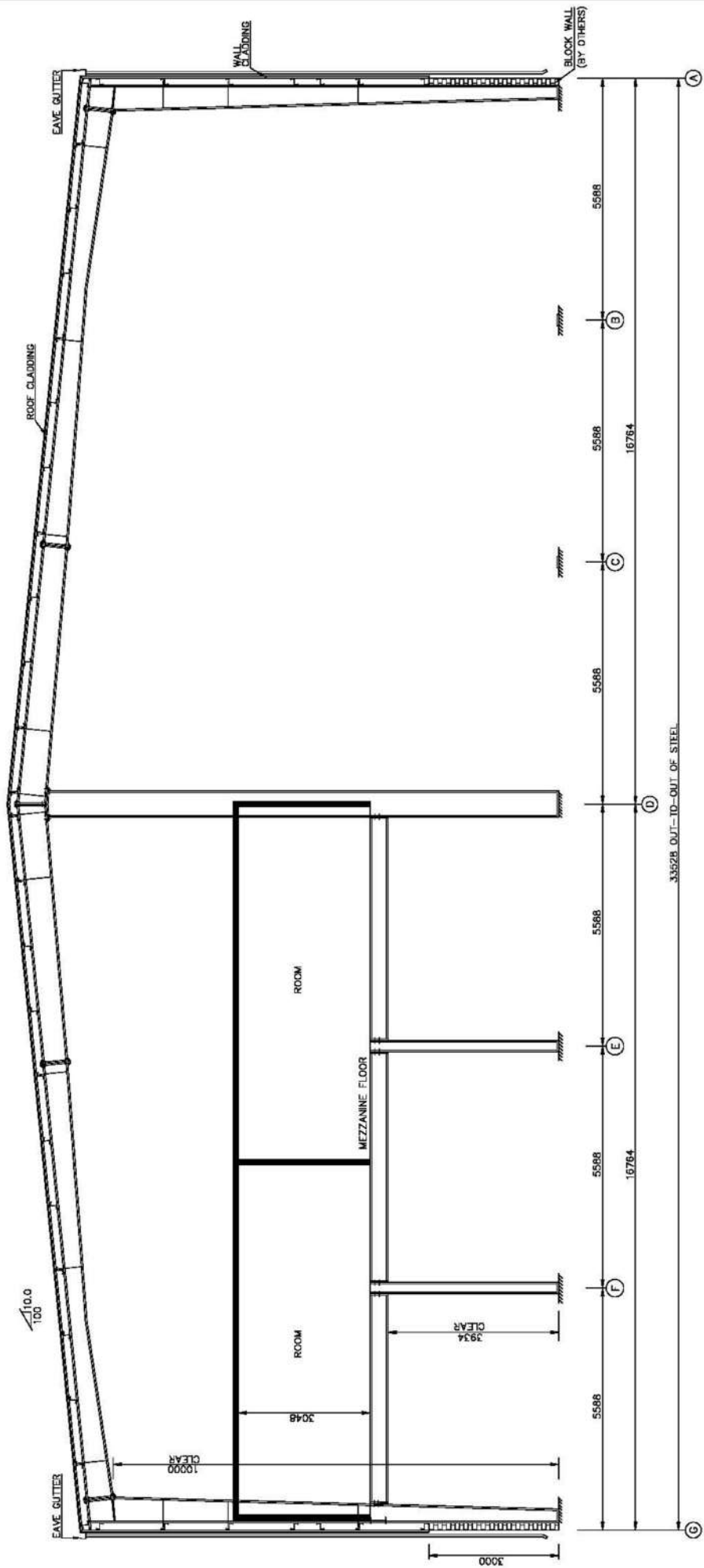
ANCHOR BOLT PLAN
 NOTE: All Base Plates @ 0 (U.N.)

CLIENT	LOCATION	DRAWING NO.	REVISION
DESIGNED BY	DRAWN BY	DATE	TITLE
DUIHS	RA	01	00
RA	RA	22-9-2023	ANCHOR BOLT LAYOUT



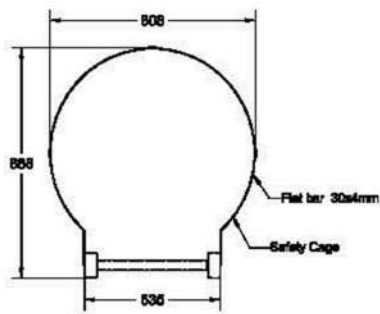
RIGID FRAME ELEVATION: FRAME LINE 11

CLIENT	DUHS	LOCATION	KARACHI	TITLE	RIGID FRAME ELEVATION	DRAWING NO.	05	REVISION	00
DESIGN BY	SI	DRAWN BY	HA	DATE	24-02-2023	QUOTE NO.	PL-23-12	PROJECT	FEB SHED - 68.580m x 33.528m

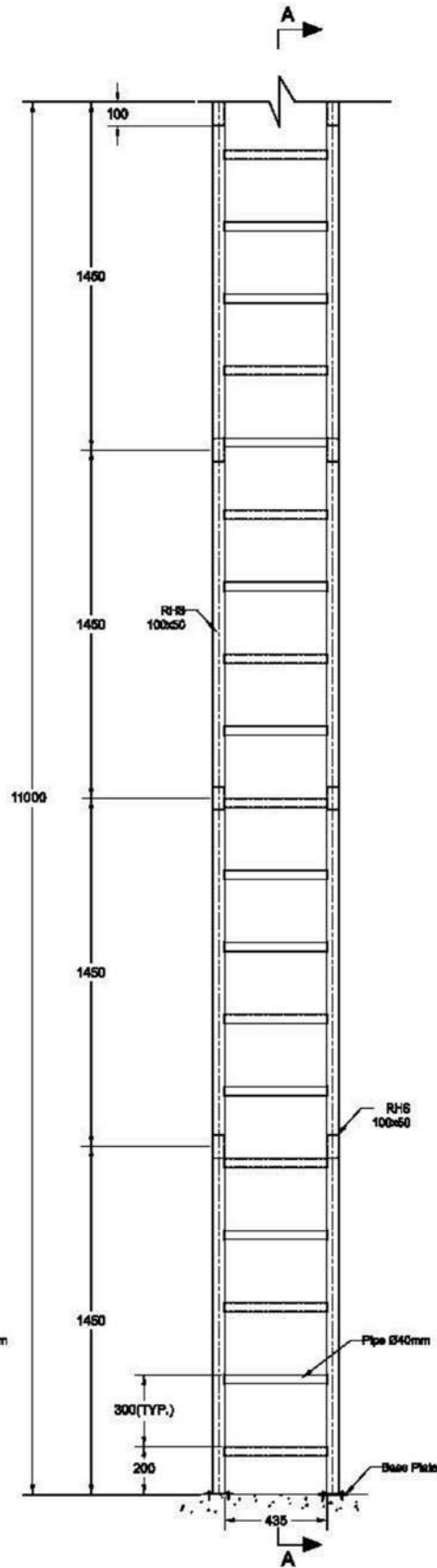


RIGID FRAME ELEVATION: FRAME LINE 5

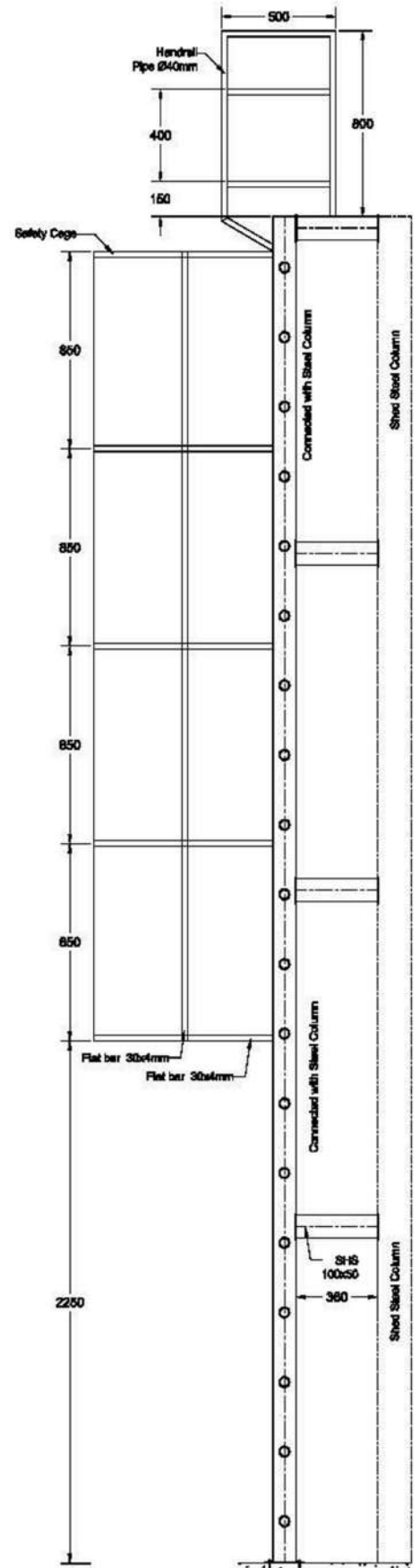
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D.U.H.S	KARACHI	RIGID FRAME ELEVATION	02	00
DESIGN BY	DATE	QUOTE NO.	PROJECT	
S.I	11-9-2023	PI-23-12	PEB SHED - 68.560m x33.528m	
DRAWN BY				
RA				



FRONT VIEW

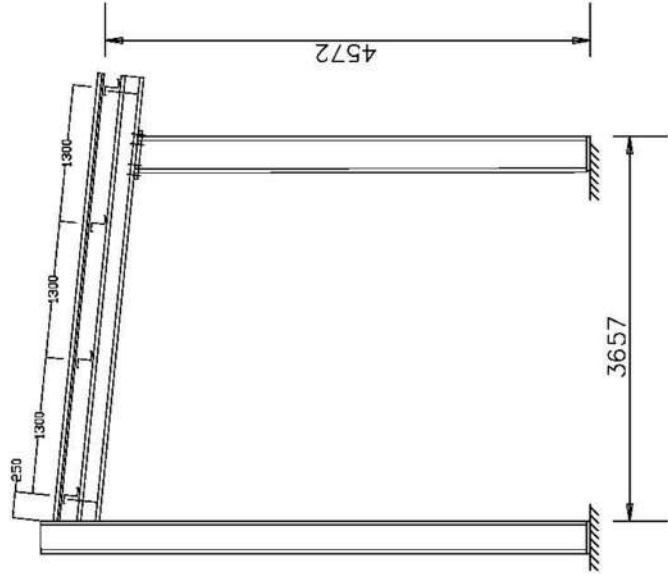


FRONT VIEW

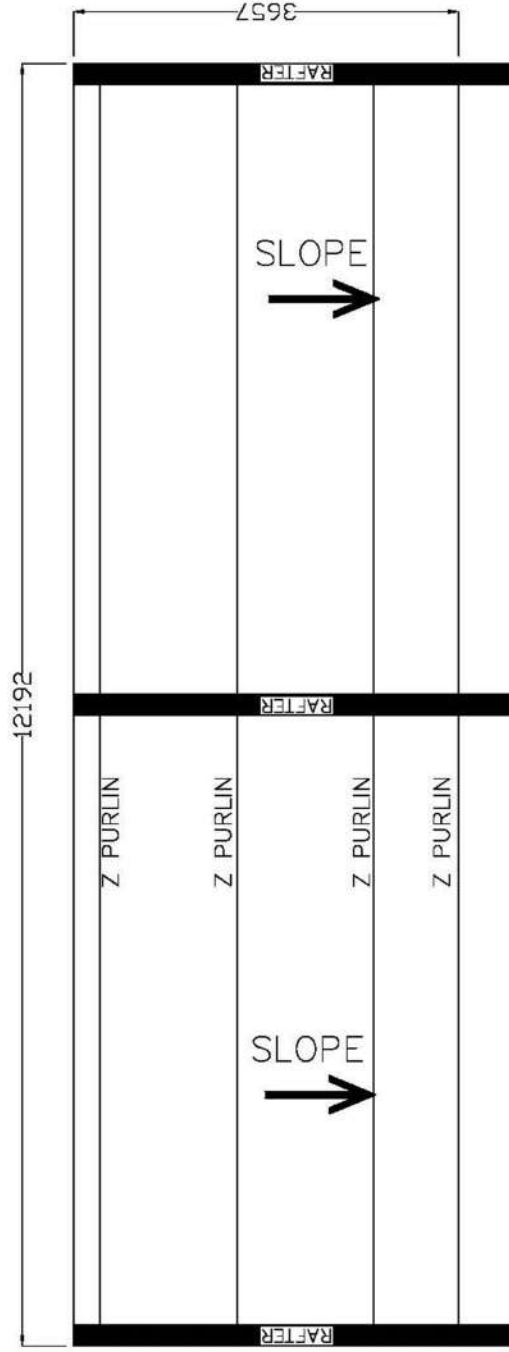


SECTION A-A

CLIENT	LOCATION	TITLE	DRAWING NO.	REVISION
DAIR	KARACHI	MONKEY LADDER	01	01
DRAWN BY	CHECKED BY	DATE	QUOTE NO.	
R.A	IRVAT AHMED		-	



CANOPY SECTION
GRID LINE 13



TOP VIEW

CLIENT	LOCATION	TITLE	CANOPY	DRAWING NO.	REVISION
DESIGN BY	DRAWN BY	DATE	QUOTE NO.	PROJECT	P.E.B
RA	RA	22-0-2023		01	00