(REVISED)
CONTRACT FROM THE EXECUTIVE OF WORKS
GOVERNMENT OF THE PUNJAB

University of agriculture, Faisalabad

TENDER/CONTRACT DOCUMENTS

Name of Work:- _____

_____

_____

_____

_____

Name of Contractor: - _____

_____

Estimated Cost of Work Rs:- _____

Amount of Earnest Money Rs:- _____

Deposit at Call No:- _____

Treasury Challan No:- _____

Time Limit:- _____

THIS COMPLETE SET OF TENDER DOCUMENTS INCLUDES;

VOLUME-1	**Conditions of Contract**
VOLUME-2	**Technical Specifications**
VOLUME-3	**Bill of Quantities (BOQs)**
VOLUME-4	**Tender Drawings**

Issued to:

These tender/Bid Documents are issued to

M/s _____ for bidding purpose for the project **Construction of ISTA Seed Lab under the project "Quality Seed Production and Supply to the Farming Community for Ensuring Food Security in Pakistan" at University of Agriculture, Faisalabad** as per Instructions to bidders, Conditions of Contract, Technical Specifications, Drawings and Special Provisions.

Dated : _____

Issued by : _____

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INVITATION FOR BIDS

Executive Engineer	**UNIVERSITY OF AGRICULTURE, FAISALABAD** Office of the Executive Engineer Engineering Construction Department(Projects)

TENDER NOTICE NO.10/2023

Sealed tender are invited from the firms / contractors Prequalified with the University of Agriculture, Faisalabad for the following works at University of Agriculture, Faisalabad (UAF) and registered with Pakistan Engineering Council (PEC) in the relevant category of the works on the item rate (DNIT-Basis) circulated by the Finance Department Government of the Punjab as per PPRA rules.

Date of Receiving and Opening: **26-06-2023**			**Receiving Time 11:00AM** **Opening Time 11:30AM**		
Sr. #	**Name of work**	**Estimated Cost(in Million)**	**Bid security@ 2% of Estimated Cost in Rs.**	**Tender Fee (In Rs.)**	**Time Limit**
1	Construction of ISTA Seed Lab under the project "Quality Seed Production and Supply to the Farming Community for Ensuring Food Security in Pakistan" at University of Agriculture, Faisalabad	107,848,261/-	2,157,000/-	Rs.1500/-	10 Months

Terms & Conditions

1. Tender documents can be obtained on payment of prescribed tender fee into the account No, 11-9 /NBP (NDIA), Agri, University Branch through E-Challan issued by the office of Treasure, UAF from the office of the Executive Engineer (ECD-P) UAF or free download from the UAF website http://uaf.edu.pk/directorates/dpiv/dpiv_tenders.html and PPRA website.
2. Tender rate and amount should be filled in figure as well as in words and tender should be signed andstamped by the vender.
3. The bid must be dropped in the Tender Box available in the Project Director, (ECD-P) room and not to be handed over to any person of the department ECD-P if the bid is sent by in person and through post, the same instructions be passed on the courier.
4. The UAF will not be responsible for any cost any expense incurred by the bidder in connection with the preparation or deliver of bids. In case of official holiday on the day of submission, the next day will be treated as closing date.
5. Conditional tender or tender without bid security @ 2% of tender estimated cost in shape of CDR issued by bank in favor of Executive Engineer (ECD-P), UAF will not be entertained.
6. Bidding will be carried out by adopting "**Single Stage Two Envelopes**" procedure as per Clause-38(2)(a) of Punjab Procurement Rule-2014.
7. The bid shall be a single package consisting of two separate envelopes, containing separately marked as "Technical Bid" and "Financial Bid".
8. The Technical Bid should accompanied with bid security @ 2% of tender estimated cost in shape of CDR.

9. The Technical Bids will be opened on the same date at 11:30 a.m. in the office of Project Director (ECD-P), University of Agriculture, Faisalabad, in the presence of the bidders who desire to attend. The financial bids of only technically qualified bidders will be opened on the date, time and venue communicated later. The detailed scope of work is given in the Tender /Bidding Documents.

(Engr.Abdul Mannan)
Executive Engineer (ECD-P)
Email: ecdp@uaf.edu.pk
041-9200161-70

EXECUTIVE ENGINEER (ECD-P)
Engineering Construction Department (Projects)
University of Agriculture, Faisalabad
Phone:041-9200161-70, E-mail: ecduaf@qmal.com

THE WORK IS

Construction of ISTA Seed Lab under the project "Quality Seed Production and Supply to the Farming Community for Ensuring Food Security in Pakistan" at University of Agriculture, Faisalabad

BIDDING DOCUMENTS

VOLUME I

- **Instructions to Bidders**
- **Bidding Data**
- **Form of Bid and Appendices to Bid Forms**
- **Part 1; General Conditions of Contract**
- **Part 2; Particular Conditions of Contract**
- **Part 3; Supplementary Conditions of Contract Specifications-Special Provisions**

JUNE 2023

INSTRUCTIONS
TO
BIDDERS

INSTRUCTIONS TO BIDDERS

A. GENERAL

IB.1 Scope of Bid

1.1 The Employer as defined in the Bid data sheet hereinafter called "the Employer" wishes to receive bids for the construction and completion of works and remedying any defects therein as described in these Bidding Documents, and summarized in the Bid data sheet hereinafter referred to as the "Works".

1.2 The successful bidder will be expected to complete the Works within the time specified in Appendix-A to Bid.

IB.2 Source of Funds

2.1 The Employer has applied for/received a loan/credit/scheme from the source (s) indicated in the Bid data sheet in Pak Rupees/ various currencies towards the cost of the project specified in the Bid data sheet and it is intended that the proceeds of this loan/credit/ scheme will be applied to eligible payments under the Contract for which these Bidding Documents are issued.

IB.3 Eligible Bidders

3.1 This Invitation for Bids is open to all bidders meeting the following requirements:

1. **Category C-4 or above as Constructor in Pakistan Engineering Council (PEC).**
2. **Annual Turn over of Rs 100 Million above.**
3. **Experienced of making frame structure buildings and Fair face cladding.**
4. **Not black listed by any Govt or Private agency.**
5. **Have sufficient Tool and plant for the construction of this magnitude of work.**
6. **B.Sc Civil Engineer with min 10 years' experience Site Engineer/ Construction Manager on large building projects.**
7. **Registered on active tax payer list of Income tax (FBR) and Punjab Sale tax (PRA)**

[Detailed Eligibility Criteria for Works Contracts may be specified by the procuring agency as per its requirements]

a. Duly licensed by the Pakistan Engineering Council (PEC) (and enlisted by the Employer or Department concerned, if applicable) in the category relevant to the value of the Works.

b. **Other relevant Authorities/ Forums (tax authorities etc) be mentioned also.**

c. A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be Non-Responsive. A Bidder may be considered to have a conflict of interest with one or more parties in this Bidding process, if they:

i. are associated or have been associated, directly or indirectly with a firm or any of its affiliates which have been engaged by the Procuring Agency to provide consulting services for the preparation of the design and other documents to be used.
ii. have controlling shareholders in common; or
iii. receive or have received any direct or indirect subsidy from any of them; or
iv. have the same legal representative for purposes of this Bid; or
v. have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or influence the decisions of the Procuring Agency regarding this Bidding process;

IB.4 One Bid per Bidder

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

IB.5 Cost of Bidding

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

IB.6 Site Visit

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

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

B. BIDDING DOCUMENTS

IB.7 Contents of Bidding Documents

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

1. Instructions to Bidders.
2. Bid data sheet.
3. General Conditions of Contract, Part-I(GCC).
4. Special Conditions of Contract, Part-II(SCC).
5. Specifications – Special Provisions.
6. Specifications – Technical Provisions.
7. Form of Bid & Appendices to Bid, including a Certificate that the bidder is not blacklisted by any Procuring Agency.
8. Bill of Quantities (Appendix-D to Bid).
9. Form of Bid Security.
10. Form of Contract Agreement.
11. **Forms of Performance Security, Mobilization Advance, Bank Guarantee and Secured Advance.**
12. Drawings.

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

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IB.8 Clarification of Bidding Documents

8.1 Any prospective bidder requiring any clarification (s) in respect of the Bidding Documents may notify the Employer in writing at the Employer's address indicated in the Invitation for Bids. The Employer will respond to any request for clarification which he receives **prior** to the deadline for submission of bids. The exact number of days will be mentioned in the Bid Data Sheet keeping in view the time given for submission of bids.
Copies of the Employer's response will be forwarded to all purchasers of the Bidding Documents, including a description of the enquiry but without identifying its source.

IB.9 Amendment of Bidding Documents

9.1 At any time at least three days prior to the deadline for submission of bids, the Employer may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective bidder, modify the Bidding Documents by issuing addendum.

9.2 Any addendum thus issued shall be part of the Bidding Documents pursuant to IB 7.1 hereof and shall be communicated in writing to all purchasers of the Bidding Documents, **at least three (03) days prior to the closing date of submission of the bid.** Prospective bidders shall acknowledge receipt of each addendum in writing to the Employer.

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

C. PREPARATION OF BIDS

IB.10 Language of Bid

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

IB.11 Documents Comprising the Bid

11.1 The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid and the other the Financial Bid, containing the documents listed in Bid data sheet under the heading of IB 11.1 A & B respectively. Both envelopes to be enclosed together in an outer single envelope called the Bid. Each bidder shall furnish all the documents as specified in Bid data sheet 11.1 A & B.

11.2 Bids submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all partners and submitted with the bid, together with a copy of the proposed agreement. The role to be played by each partner to be specified therein**; and, the concerned partner should have the requisite qualification/ experience to successfully execute the assigned task.** Bids submitted by a joint venture of two (2) or more firms shall also comply with the following requirements:

(a) In case of a successful bid, the Form of JV Agreement shall be signed so as to be legally binding on all partners within 7 days of the receipt of letter of acceptance failing which the contract and the letter of acceptance shall stand void and redundant.

(b) One of the joint venture partners shall be nominated as being in charge/ lead partner; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the joint venture partners;

(c) The partner-in-charge/ lead partner shall always be duly authorized to deal with the Employer regarding all matters related with and/or incidental to the execution of Works as per the terms and Conditions of JV Agreement and in this regard to incur any and all liabilities, receive instructions, give binding undertakings and receive payments on behalf of the joint venture;

(d) All partners of the joint venture shall at all times and under all circumstances be liable jointly and severally for the execution of the Contract in accordance with the Contract terms; and, a statement to this effect shall be included in the authorization mentioned under Sub-Para (b) above as well as in the Form of Bid and in the Form of JV Agreement (in case of a successful bid); and

(e) A copy of JV agreement shall be submitted before signing of the Contract, stating the conditions under which JV will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly

responsible for due performance of the Contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. The JV Agreement shall be made part of the contract. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partners without prior written consent of the Employer.

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

IB.12 Bid Prices

12.1 Unless stated otherwise in the Bidding Documents, the Contract shall be for the whole of the Works as described in IB 1.1 hereof, based on the unit rates and / or prices submitted by the bidder.

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12.2 The bidders shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by a bidder will not be paid for by the Employer when executed and shall be deemed covered by rates and prices for other items in the Bill of Quantities.

12.3 All duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as on the date **of opening of the bids** shall be included in the rates and prices and the total Bid Price submitted by a bidder.
Additional / reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 70.2 of the General Conditions of Contract Part-I.

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

IB.13 Currencies of Bid and Payment

13.1 The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country (referred to as the "Foreign Currency Requirements") shall indicate the same in Appendix-B to Bid. However, subject to GCC clause 71.1, payments in foreign currency are not permissible.

13.2 The rates of exchange to be used by the bidder for currency conversion shall be the TT & OD Selling Rates published or authorized by the State Bank of Pakistan prevailing on the date **of opening of the bids.** For the purpose of payments, the exchange rates used in bid preparation shall apply for the duration of the Contract. Rule 32(2) of PPR-14 shall be applicable for rate of exchange of foreign currencies.

IB.14 Bid Validity

14.1 Bids shall remain valid for the period stipulated in the Bid data sheet after the Date of Bid Opening specified in Clause IB.23.

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14.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request that the bidders extend the period of validity for a specified additional period which shall in no case be more than the original bid validity period or 180 days whichever is more. The request and the responses thereto shall be made in writing. A bidder may refuse the request without forfeiting his Bid Security. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his Bid Security for the period of the extension, and in compliance with Clause IB.15 in all respects. Rule 28 of PPR-14 shall be applicable for Bid Validity period.

IB.15 Bid Security

15.1 Each bidder shall furnish, as part of his bid, a Bid Security in the amount stipulated in the Bid data sheet in Pak Rupees or an equivalent amount in a freely convertible currency.

15.2 The Bid Security shall be, at the option of the bidder, in the form of Deposit at Call or a Bank Guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan in favor of the Employer valid for a period 30 days beyond the Bid Validity date.

15.3 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Employer as non-responsive.

15.4 The bid securities of unsuccessful bidders will be returned as promptly as possible, after expiry of grievance period or disposal of complaint if any, complying with the relevant provisions of PPR-14.

15.5 The Bid Security of the successful bidder will be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.

15.6 The Bid Security may be forfeited:

(a) If the bidder withdraws his bid except as provided in IB 22.1;

(b) If the bidder does not accept the correction of his Bid Price pursuant to IB 27.2 hereof; or

(c) In the case of successful bidder, if he fails within the specified time limit to:

(i) Furnish the required Performance Security;

(ii) Sign the Contract Agreement, or

(iii) Furnish the required JV agreement within 7 days of the receipt of letter of acceptance.

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IB.16 Alternate Proposals by Bidder

16.1 No alternate proposals are allowed in single stage two envelope method.

IB.17 Pre-Bid Meeting

17.1 The Employer may, on his own motion or at the request of any prospective bidder(s), hold a pre-bid meeting to clarify issues and to answer any questions on matters related to the Bidding Documents. The date, time and venue of pre-bid meeting, if convened, is as stipulated in the Bid data sheet. All prospective bidders or their authorized representatives shall be invited to attend such a pre-bid meeting.

17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Employer not later than seven (7) days before the proposed pre-bid meeting.

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

17.4 Absence at the pre-bid meeting will not be a cause for disqualification of a bidder.

IB.18 Format and Signing of Bid

18.1 Bidders are particularly directed that the amount entered on the Letter of Financial 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.

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18.3 No alteration is to be made in the Financial Bids and Technical Bids nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.

18.4 The Bidder shall prepare one original of the Technical Bid and one original of the Financial Bid comprising the Bid as described in Bid data sheet against IB 11 and clearly mark it “ORIGINAL - TECHNICAL BID” and “ORIGINAL - FINANCIAL BID”. In addition, the

Bidder shall submit two (2) copies of the Bid and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

18.5 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the Bid data sheet and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the Bid, except for unamended printed literature, shall be signed or initialed by the person signing the bid.

18.6 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.

18.7 Bidders shall indicate in the space provided in the Letter of Technical and Financial Bids, their full and proper addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the Contract is to be sent.

18.8 Bidders should retain a copy of the Bidding Documents as their file copy.

D. SUBMISSION OF BIDS FOR SINGLE STAGE TWO ENVELOPE BIDDING PROCEDURE

IB.19 Sealing and Marking of Bids

19.1 Each bidder shall submit his bid as under:

(a) ORIGINAL and each copy of the Bid shall be separately sealed and put in separate envelopes and marked as such.

(b) The envelopes containing the ORIGINAL and copies will be put in one sealed envelope and addressed / identified as given in IB 19.2 hereof.

(c) The technical bid should comprise of documents listed in IB11.1 (A) & the Financial Bid should comprise of documents listed in IB 11.1 (B) which shall be placed in separate envelopes in accordance with IB 11.1.

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19.2 The inner and outer envelopes shall:

(a) Be addressed to the Employer at the address provided in the Bid data sheet;

(b) Bear the name and identification number of the contract as defined in the Bid data sheet; and

(c) Provide a warning not to open before the time and date for bid opening, as specified in the Bid data sheet.

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

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

IB.20 Deadline for Submission of Bids

20.1 (a) Bids must be received by the Employer at the address specified no later than the time and date stipulated in the Bid data sheet.

(b) Bids with charges payable will not be accepted, nor will arrangements be undertaken to collect the bids from any delivery point other than that specified above. Bidders shall bear all expenses incurred in the preparation and delivery of bids. No claims will be entertained for refund of such expenses.

(c) Where delivery of a bid is by mail and the bidder wishes to receive an acknowledgment of receipt of such bid, he shall make a request for such acknowledgment in a separate letter attached to but not included in the sealed bid package.

(d) Upon request, acknowledgment of receipt of bids will be provided to those making delivery in person or by messenger.

20.2 The Employer may, at his discretion, extend the deadline for submission of Bids by issuing an amendment in accordance with Clause IB.9, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

IB.21 Late Bids

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

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

IB.22 Modification, Substitution and Withdrawal of Bids

22.1 Any bidder may modify**,** substitute or withdraw his bid after bid submission provided that the modification, substitution or written notice of withdrawal is received by the Employer prior to the deadline for submission of bids.

22.2 The modification, substitution, or notice for withdrawal of any bid shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause IB.19 with the outer and inner envelopes additionally marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" as appropriate.

22.3 No bid may be modified by a bidder after the deadline for submission of bids except in accordance with IB 22.1 and 27.2.

22.4 Withdrawal of a bid during the interval between the deadline for submission of bids and the expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the Bid Security in pursuance to Clause IB.15.

E BID OPENING AND EVALUATION FOR SINGLE STAGE TWO ENVELOPE BIDDING PROCEDUR

IB. 23 Bid Opening

23.1 The Employer will open the Technical Bids in public at the address, date and time specified in the Bid data sheet in the presence of Bidders` designated representatives and anyone who choose to attend. The Financial Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening.

23.2 First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be permitted unless the corresponding Withdrawal Notice contains a valid authorization to request the withdrawal and is read out at bid opening.

23.3 Second, outer envelopes marked "SUBSTITUTION" shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Financial Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Financial Bid will remain unopened in accordance with IB 23.1. No envelope shall be substituted unless the corresponding

Substitution Notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.

23.4 Next, outer envelopes marked "MODIFICATION" shall be opened. No Technical Bid and/or Financial Bid shall be modified unless the corresponding Modification Notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Bids. Only the Technical Bids, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Financial Bids, both Original and Modification, will remain unopened in accordance with IB 23.1. The

Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders.

23.5 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, if required; and

(d) Any other details as the Employer may consider appropriate.

No Bid shall be rejected at the opening of Technical Bids except for late bids, in accordance with IB 21.1. Only Technical Bids read out and recorded at bid opening, shall be considered for evaluation.

Preliminary Examination of Technical Bids

23.6 a) The Employer shall first examine qualification and experience Data as per appendix M and N submitted by the Bidder. The technical proposal examination of those bidders only shall be taken in hand who meet the minimum requirement as mentioned in appendix M and N. Only substantially responsive qualification shall be considered for further evaluation.

b) The Employer shall examine the Technical Bid to confirm that all the documents have been provided, and to determine the completeness of each document submitted.

23.7 The Employer shall confirm that all the documents and information have been provided for evaluation of Technical bid as required under these bidding documents.

23.8 At the end of the evaluation of the Technical Bids, the Employer will invite only those bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Financial Bids.

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The date, time, and location of the opening of Financial Bids will be advised in writing by the Employer. Bidders shall be given reasonable notice for the opening of Financial Bids.

23.9 The Employer 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 Financial Bids unopened as per rule 38(2)(a)(vii) of PPR-14.

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

23.11 All envelopes containing Financial 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

(d) Any other details as the Employer may consider appropriate.

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

23.12 If this Bidding Document allows Bidders to quote separate prices for different contracts, and the award to a single Bidder of multiple contracts, the methodology to determine the lowest evaluated price of the contract combinations is that which is most economical to the Employer.

IB.24 Process to be Confidential

24.1 Information relating to the examination, clarification, evaluation and comparison of bid and recommendations for the award of a contract shall not be disclosed to bidders or any other person not officially concerned with such process before the announcement of final bid evaluation report which shall be done at least 10 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 (if applicable), final evaluated prices and recommendations against all the bids evaluated. Any effort by a bidder to influence the Employer's processing of bids or award decisions may result in the rejection of such bidder's bid. Whereas any bidder feeling aggrieved may lodge a written complaint not later than ten 10 days after the announcement of Technical and Financial Bids. No bidder will be allowed to file grievance petition w.r.t. Technical Evaluation after announcement/ uploading of Financial Evaluation Report. However mere fact of lodging a complaint shall not warrant suspension of the procurement process.

IB.25 Clarification of Bids

25.1 To assist in the examination, evaluation and comparison of bids, the Employer may, at his discretion, ask any bidder for clarification of his bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing but no change in the price or substance of the bid shall be sought, offered or permitted except as required to

confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the bids in accordance with Clause IB.28.

25.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its bid may be rejected. Rule 33 of PPR-14 shall be applicable for clarifications.

IB.26 Examination of Bids and Determination of Responsiveness

26.1 Prior to the detailed evaluation of bids, the Employer will determine whether each bid is substantially responsive to the requirements of the Bidding Documents.

26.2 A substantially responsive bid is one which (i) meets the eligibility criteria; (ii) has been properly signed; (iii) is accompanied by the required Bid Security; (iv) Includes signed Integrity Pact where required as per clause IB.35; and (v) conforms to all the terms, conditions and specifications of the Bidding Documents, without material deviation or reservation (vi) meets the qualification criteria as specified in Appendix-M & N. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the Works; (ii) which limits in any substantial way, inconsistent with the Bidding Documents, the Employer's rights or the bidder's obligations under the Contract; (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids. Only substantially responsive bid shall be considered for further evaluation.

26.3 If a bid is not substantially responsive, it may not subsequently be made responsive by correction or withdrawal of the non-conforming material deviation or reservation. The Employer may, however, seek confirmation/ clarification in writing which shall be responded in writing.

IB.27 Correction of Errors

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

(a) Where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; and

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

27.2 The amount stated in the Letter of Financial Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and with the

concurrence of the bidder, shall be considered as binding upon the bidder. If the bidder does not accept the corrected Bid Price, his Bid will be rejected, and the Bid Security shall be forfeited in accordance with IB.15.6 (b) hereof.

IB.28 Evaluation and Comparison of Bids

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

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

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

(b) Excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including competitively priced Day work; and

(c) Making an appropriate adjustment for any other acceptable variation or deviation.

28.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in Bid evaluation.

28.4 If the Bid of the successful bidder is seriously unbalanced in relation to the Employer's estimate of the cost of work to be performed under the Contract, the Employer may require the bidder to produce detailed price analyses for any or all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the Performance Security set forth in Clause IB.32 be increased at the expense of the successful bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful bidder under the Contract.

F. AWARD OF CONTRACT

IB.29 Award

29.1 Subject to Clauses IB.30 and IB.34, the Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid Price, provided that such bidder has been determined to be eligible in accordance with the provisions of Clause IB.3 and qualify pursuant to IB 29.2.

29.2 The Employer, at any stage of the bid evaluation, having credible reasons for or prima facie evidence of any defect in bidder's capacities, may require the bidders to provide

information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not:

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

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

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

IB.31 Notification of Award

31.1 Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder in writing ("Letter of Acceptance") that his Bid has been accepted. This letter shall name the sum which the Employer will pay the Contractor in consideration of the execution and completion of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called the "Contract Price").

31.2 No Negotiation with the bidder having evaluated as lowest responsive or any other bidder shall be permitted. However, the lowest evaluated bidder may further reduce the Bid Price voluntarily without compromising the quality/ quantity.

31.3 The notification of award and its acceptance by the bidder will constitute the formation of the Contract, binding the Employer and the bidder till signing of the formal Contract Agreement.

31.4 Upon furnishing by the successful bidder of a Performance Security, the Employer will promptly notify the other bidders that their Bids have been unsuccessful and return their bid securities. No bid security can be returned without exhausting the grievance period or without finally disposing off the complaint of the non-responsive bidder. However, bid security may be returned earlier if any bidder submits affidavit that he is satisfied with the proceedings and hence his bid security may be returned.

IB.32 Performance Security

32.1 The successful bidder shall furnish to the Employer a Performance Security in the form and the amount stipulated in the Bid data sheet and the Conditions of Contract within a period of 14 days after the receipt of Letter of Acceptance. On submission of Performance Security, the bid security of the successful bidder may be returned.

32.2 Failure of the successful bidder to comply with the requirements of IB.32.1 or IB.33 or IB.35 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security. Rule 56 of PPR-14 shall be applicable for performance Security.

IB.33 Signing of Contract Agreement

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

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

IB. 34 General Performance of the Bidders

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

IB.35 Integrity Pact

The Bidder shall sign and stamp the Integrity Pact provided at Appendix-L to Bid in the Bidding Documents for all 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. Submission of Bids shall be construed as evidence that the bidder has admitted all provisions of the Instruction to the Bidders.

IB.37 PPRA Act, 2009 and PPR-14 will have over-riding effect

PPRA Act, 2009 and PPR-14 as amended upto date will supersede and will have an over-riding effect in case in case of any contradiction with these Instructions, the Contract or any other part of the Bidding Documents.

BID DATA SHEET

BDS-1

BDS-2

BID DATA SHEET

1.1 Name and address of the Employer:

1.1 Name of the Project & Summary of the Works:

Construction of ISTA Seed Lab under the project "Quality Seed Production and Supply to the Farming Community for Ensuring Food Security in Pakistan" at University of Agriculture, Faisalabad

2.1 *HEC Funded Project*

2.1 The Estimated cost of work is **RS. 107,848,261/-**

8.1 Time limit for clarification:

07 days prior to the date of submission of bids

10.1 Bid language:

English

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

(a) Letter of Technical Bid
(b) Original Bid Security (@2% of estimated cost i-e Rs. 2,157,000/- in shape of CDR) (IB.15)
(c) Written confirmation authorizing the signatory of the Bid to commit the Bidder (IB.18.5)

BDS-3

(d) Pending litigation information
(e) Certificate that the bidder is not blacklisted by any Procuring Agency

(f) Proposed Construction Schedule (appendix –E)
(g) Method of Performing the Work (appendix –F)
(h) Integrity Pact (appendix)
(i) Any other documents required to be submitted with Technical Bid in accordance with these Bidding Documents.

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

(a) Duly filled-in Form of Price Bid

(b) Duly filled-in Appendix-D to Bid (Bill of Quantities); and

(c) Any other documents required to be submitted with Price Bid in accordance with these Bidding Documents

BDS-4

413.1 Bidders to quote entirely in Pak. rupees

14.1 Period of Bid Validity:

90 days

15.1 Amount of Bid Security:

Rs 2,157,000/-

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

Not Applicable

18.4 Number of copies of the Bid to be completed and returned:
One Original Technical proposal and 1 Original Financial Proposal

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

Project Director, Engineering Construction Department, University of Agriculture, Faisalabad

20.1(a) Deadline for submission of bids:

June 26, 2023 at 11:00 am

BDS-5

23.1 Venue, time, and date of Bid opening:

June 26, 2023 at 11:30 am

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

A bank guarantee equal to 10 percent of the Contract Price is required from any Scheduled bank of Pakistan.

"The Employer, at any stage of the bid evaluation, having credible reasons for or prima facie evidence of any defect in Bidder's capacities, may require the Bidder to provide information concerning their professional, technical, financial, legal or managerial competence whether already declared substantially responsive."

32 Performance Security

The lowest evaluated bidder will be required to furnish the Performance Guarantee/Quality Assuarance Security **(where ever required) before entering into a contract. Should the evaluated bidder refuse or failed for any reson to furnish** the performance guarantee/ quality Assurance Security**,** it should constitute a just cause for rejection of his tender / annulment of award and in event of such rejection/ annulment, the entire earnest money shall be forfeited to Government, as compensation for such default.

32.1 In case the total tendered amount is less than 5% of the approved Estimated (DNIT) amount, the lowest bidder will have to deposit Quality Assuarance Security from the Scheduled Bank equal to the amount of difference between approved DNIT amount and the quoted bid amount as given below, within 15 days of issuance of the notice or within expiry period of bid, whichever is earlier.

TOTAL TENDERED AMOUNTBELOW CORRESPONDINGESTIMATED COST.	ADDITIONAL PERFORMANCE SECURITY.
5%	5%
6%	6%
7%	7%
8%	8%
9%	9%
10%	10%
& so on….	& so on….

At the time, the Engineer-in-charge informs the lowest bidder in writing, bidder will provide performance guareenttee/ Quality assuarance Security (wherever required) within 15 days from the recipt of letter, failing which his bid wil be rejected and bid securioty will be forfeited.

TECHNICAL EVALUATION CRITERIA

I. Mandatory Requirements

Pre-qualification with the client is necessary. However, the firm should meet the following requirements

(a) The Bidder shall be duly licensed by the Pakistan Engineering Council (PEC) in the C-4 category or above or in case validity of license has expired, the Bidder had applied for renewal of license before submission of its Bid.
(b) The bidder shall be registered with SECP in the case of private limited or registrar of the firms.
(c) The firm must be registered with Income Tax and Sales Tax Departments (FBR & PRA) and must be on Active Taxpayer List of the Federal Board of Revenue at the time of submission of its Bid. (A certificate of being active tax payer is required to be attached in the technical proposal)
(d) A firm /Bidder, JV partner or Subcontractor) shall not be eligible to participate in this bidding process while under temporary suspension or debarment/ blacklisting by the Employer, any Government/Semi Government/Public Department in Pakistan (whether notified or not by PPRA on its website) or in the Bidder's home country." (An affidavit to this effect on non-judicial stamp paper of Rs. 100 value is required to be attached in the technical proposal)
(e) Status of Firm (Sole Proprietorship, Partnership, Company etc.)
(f) Bank Certificate providing necessary information about Firm's Bank Account
(g) List of Completed and In-Hand projects of Similar nature executed with brief detail.
(h) List of name and Designation of Owner/Director and Engineer of Firm.
(i) Annual Turn over of Rs 100 Million above.
(j) Proposed Construction Schedule (appendix –E)
(k) Method of Performing the Work (appendix –F)

Letters of Technical Bid/ Financial Bid,
And
Appendices to Bid

Letter of Technical Bid

LTB-1

Date: .....

Bid Reference No: .....

(Name of Contract/Works)

To: .....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (IB). Complete bidding document is binding upon us and we fully understand that the PPRA Act, 2009 and the PPR-14 as amended upto date supercedes this bidding document, in case of any contradiction, and the same are also binding upon us;

(b) We offer to execute and complete in conformity with the Bidding Documents the following Works:……..

(c) Our Bid consisting of the Technical Bid and the Financial Bid shall be valid for a period of …… days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) As security for due performance of the under takings and obligations of our bid, we submit here with a Bid security, in the amount specified in Bid data sheet, which is valid (at least) 30 days beyond validity of Bid itself.

(e) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process.

LTB-2

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

Name .....

In the capacity of .....

Signed .....

.....

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

Date .....

.....

Address……..

Letter of Financial Bid

LPB-1

Date: .....

Bid Reference No: .....

(Name of Contract/Works)

To: .....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (IB)9;

(b) The total price of our Bid, excluding any discounts offered in item (c) below is:_____

(c) The discounts offered and the methodology for their application are:_____

(d) Our Bid shall be valid for a period of …….. days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(e) If our Bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;

LPB-2

(f) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed and we do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other bidder for the Works.

(g) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

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

(i) If awarded the contract, the person named below shall act as Contractor's Representative.

Name .....

In the capacity of .....

Signed .....

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

Date .....

Address……..

SPECIAL STIPULATIONS

BA-1

Clause

Appendix-A to Bid

Conditions of Contract

1.	Engineer's Authority to issue Variation in emergency *{if applicable}*	2.1	Up-to **20%** of the Accepted Contract Amount for each variation and up-to **15%** of the accepted Contract amount of the complete contract for all variations.
2	Variation *{if applicable}*	2.1(b)(viii)(b)	No approval is required by the engineerif the amount needed is up to or less than _____
3.	Law applicable	5.1(b)	The relevant laws applied in the Province of Punjab
4.	Amount of Performance Security	10.1	**10%** of Contract Price stated in the Letter of Acceptance.
5.	Time for Furnishing Programme	14.1	Within **30 days** from the date of receipt of Letter of Acceptance.
6.	Minimum amount of Third Party Insurance	23.2	Rs. **100,000/-** per occurrence with number of occurrences unlimited.
7.	Time for Commencement	41.1	Within **15 days** from the date of receipt of Engineer's Notice to Commence which shall be issued within **7 (Seven)** days after signing of Contract Agreement.
8.	Time for Completion	43.1, 48.2	**500 days** from the date of receipt of Engineer's Notice to Commence.
9.	a) Amount of Liquidated Damages	47.1	**Rs. 15,000/-** for each day of delay in completion of the Works subject to a maximum of **10%** of Contract Price stated in the Letter of Acceptance.
	b) Amount of Bonus *{if applicable}*	47.3	Rs. (NIL) for each day the Works are completed before the specified completion date of the Works subject to a maximum of_____% of Contract Price.
10.	Defects Liability Period	49.1	**365 Days** from the effective date of Taking Over Certificate.
11.	**Percentage of Retention Money** *{if applicable}*	**60.2**	**10% of the amount of Interim Payment Certificate upto a max of 5% of contract price**
12.	Limit of Retention Money *{if applicable}*	60.2	**5 %** of Contract Price stated in the Letter of Acceptance.
13.	Minimum amount of Interim Payment Certificates (Running Bills)	60.2	**05** Percentage of Contract Price depending on completion period of the Works.
14.	Time of Payment from delivery of Engineer's Interim Payment Certificate to the Employer.	60.10	30 days in case of local currency

15.	Mobilization Advance * (Interest Free) *{if applicable}*	60.12	_____% of Contract Price as stated in the Letter of Acceptance in two parts: i) First Part:_____% before the commencement of works: and ii) Second Part:____% within_____days from the date of payment of the First Part, subject to the deployment of adequate staff/equipment, plants, the establishment of the Contractor's colony, and submission of Insurance Policies to the satisfaction of the Engineer or interest on delay payments.

***Delete it if Alternative one is not adopted.**

BB-1
Appendix-B to Bid

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

1. The Bidder may indicate here in below his requirements of foreign currency (if any), with reference to various inputs to the Works.

2. Foreign Currency Requirement as percentage of the Bid Price excluding Provisional Sums _____%.

3. Table of Exchange Rates

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

BC-1
Appendix-C to Bid

PRICE ADJUSTMENT UNDER CLAUSE 70 OF CONDITIONS OF CONTRACT

The source of indices and the weightages or coefficients for use in the adjustment formula under Clause 70 shall be as follows:
(To be filled by the Employer)

Cost Element	Description	Weightages	Applicable index
1	2	3	4
(i)	Fixed Portion		
(ii)	Local Labour (Skilled & Unskilled) With unskilled as representative items.		Rates issued by Finance Department, Government of Punjab
(iii)	Cement – in bags. Portland cement shall be considered representative items for all types of cement.		" " "
(iv)	Reinforcing Steel. ½ "diameter round bar is the representative item for all types of steel to be used in this project.		" " "
(v)	High Speed Diesel (HSD)		" " "
(vi)	Bricks		.
(vii)	Bitumen		" " "
(viii)			" " "
	Total	1.000	" " "

Notes:

1) Indices for "(ii)" to "(vii)" are taken from Rates issued by Finance Department, Government of Punjab. The base cost indices or prices shall be those applying on the date for submission of bids. Current indices or prices shall be those applying 30 days prior to the last day of the billing period.

2) Any fluctuation in the indices or prices of materials other than those given above shall not be subject to adjustment of the Contract Price.

3) Fixed portion shown here is for typical road project, Employer to determine the weightage of Fixed Portion considering only those cost elements having cost impact of seven (7) percent or more on his specific project.

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

BILL OF QUANTITIES

A. Preamble

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

BILL OF QUANTITIES

B. Work Items

1. The Bill of Quantities contains the following Bills and Schedule:

		(by way of example)
Bill No. 1	-	Earthworks
Bill No. 2	-	Brick works
Bill No. 3	-	Concrete works
Bill No. 4	-	Plaster, Fair face and finishing works
Bill No. 5	-	Miscellaneous Items
Daywork Schedule		
Summary Bill of Quantities		

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

BILL OF QUANTITIES

B. Work Items

Item	Description	Unit	Quantity	Rate		Amount Rupees
				Rupees in figures	Rupees in words	
1	2	3	4	5		6
	Refer to Volume – 3 Bill of Quantities					
101						
102						
103						
104						
105						
106						
Total (in words & Figure):						_____

Daywork Schedule
Summary Bill of Quantities

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

Appendix-D to Bid

BILL OF QUANTITIES

C. Day work Schedule

General

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

Day work Labour

2. In calculating payments due to the Contractor for the execution of Day work, the actual time of classes of labour directly doing the Day work ordered by the Engineer and for which they are competent to perform will be measured excluding meal breaks and rest periods. The time of gangers (charge hands) actually doing work with the gang will also be measured but not the time of foreman or other supervisory personnel.

3. The Contractor shall be entitled to payment in respect of the total time that labour is employed on Day work, calculated at the basic rates entered by him in the Schedule of Day work Rates for labour together with an additional percentage, payment on basic rates representing the Contractor's profit, overheads, etc., as described below:

   a) the basic rates for labour shall cover all direct costs to the Contractor, including (but not limited to) the amount of wages paid to such labour, transportation time, overtime, subsistence allowances and any sums paid to or on behalf of such labour for social benefits in accordance with Pakistan law. The basic rates will be payable in local currency only; and

   b) the additional percentage payment to be quoted by the Bidder and applied to costs incurred under (a) above shall be deemed to cover the Contractor's profit, overheads, superintendence, liabilities and insurances and allowances to labour timekeeping and clerical and office work; the use of consumable stores, water, lighting and power; the use and repair of stagings, scaffolding, workshops and stores, portable power tools, manual plant and tools; supervision by the Contractor's staff, foremen and other supervisory personnel; and charges incidental to the foregoing.

BD-

Appendix-D to Bid

SCHEDULE OF DAYWORK RATES

I. Labour

Item No.	Description	Unit	Nominal Quantity	Rate (Rs) in Figures	Rate (Rs) in Words	Extended Amount (Rs.)
1	2	3	4	5	6	7
D101	Ganger	Hr	500			
D102	Labourer	Hr	5,000			
D103	Brick layer	Hr	500			
D104	Mason	Hr	500			
D105	Carpenter	Hr	500			
D106	Steel work Erector	Hr	500			
	------etc-------	Hr	500			
D113	Driver for vehicle up to 10 tons	Hr	1,000			
D114	Operator for excavator, dragline, shovel or crane	Hr	500			
D115	Operator for tractor, (tracked) with dozer blade or ripper	Hr	500			
D122	**Sub Total** Allow_____percent of subtotal for Contractor's overhead, profit, etc, in accordance with Paragraph 3(b) of Day work Schedule _____ Total for Day work: Labour : _____ (Carried forward to Day work Summary)					

Day work Material

4. The Contractor shall be entitled to payment in respect of materials used for Day work (except for materials for which the cost is included in the percentage addition to labour costs as detailed heretofore), at the basic rates entered by him in the Schedule of Day work Rates for materials together with an additional percentage payment on the basic rates to cover overhead charges and profit, as follows:

   a) the basic rates for materials shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, losses, etc., and shall provide for delivery to store for stockpiling at the site. The basic rates shall be stated in local currency but payment will be made in the currency or currencies expended upon presentation of supporting documentation;

   b) the additional percentage payment shall be quoted by the Bidder and applied to the equivalent local currency payments made under Sub-Para(a) above; and

   c) the cost of hauling materials used on work ordered to be carried out as Day work from the store or stockpile on the site to the place where it is to be used will be paid in accordance with the terms for Labour and Constructional Plant in this Schedule.

SCHEDULE OF DAYWORK RATES

II. Materials

Item No.	Description	Unit	Nominal Quantity	Rate (Rs) in Figure	Rate (Rs) in Words)	Extended Amount (Rs.)
1	2	3	4	5	6	7
D201	Cement, ordinary Portland or equivalent in bags	M.Ton	200			
D202	Mild Steel reinforcing bar upto 16mm diameter to BS 4449 or equivalent	M.Ton	100			
D203	Fine aggregate for concrete as specified in Clause_____	Cu.M	1,000			
D204	..... etc					
D222	Gelignite (Noble Special Gelatine 60 % or equivalent) including caps, fuse, wire and requisite accessories	M.Ton	10			
D223	**Sub Total** Allow_____percent of subtotal for Contractor's overhead, profit, etc., in accordance with Paragraph 4(b) of Daywork Schedule _____ Total for Daywork: Materials _____ (Carried forward to Daywork Summary)					

Day work Constructional Plant

5. The Contractor shall be entitled to payments in respect of constructional plant already on Site and employed on Day work at the basic rental rates entered by him in the Schedule of Day work Rates for constructional plant. The said rates shall be deemed to include complete allowance for depreciation, interest, indemnity and insurance, repairs, maintenance, supplies, fuel, lubricants, and other consumables, and all overhead, profit and administrative costs related to the use of such equipment. The cost of drivers, operators and assistants will be paid for separately as described under the section on Day work Labour.

6. In calculating the payment due to the Contractor for constructional plant employed on Day work, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Engineer, the travelling time from the part of the Site where the constructional plant was located when ordered by the Engineer to be employed on Day work and the time for return journey thereto shall be included for payment.

7. The basic rental rates for constructional plant employed on Day work shall be stated in Pakistani Rupees.

Appendix-D to Bid

SCHEDULE OF DAYWORK RATES

III. Constructional Plant

Item No.	Description	Unit	Nominal Quantity	Rate (Rs.) in Figure	Rate Rs.) in Words	Extended Amount (Rs.)
1	2	3	4		5	6
D301	Excavator ,face shovel or dragline:					
	1. Up-to and including 1 Cu.M.	Hr	500			
	2. Over 1 Cu.M to 2 Cu. M.	Hr	400			
	3. Over 2 Cu. M	Hr	100			
D302	Tractor (tracked) including bull or angle dozer:					
	1. Up-to and including 150 HP	Hr	500			
	2. Over 150 to 200 HP	Hr	400			
	3. Over 200 to 250 HP	Hr	200			
D303	Tractor with ripper:					
	1. Up-to and including 200 HP	Hr	400			
	2. Over 200 to 250 HP	Hr	200			
D304	.....etc.....					
	Total for Day work: Constructional Plant _____ (Carried forward to Day work Summary)					

DAYWORK

Summary (Day work)

		Amount (Rs.)
(I)	Total for Day work: Labour	_____
(II)	Total for Day work : Materials	_____
(III)	Total for Day work: Constructional Plant	_____
	Total for Day work (Carried forward to Summary Page of Bill of Quantities)	

Appendix-D to Bid

BILL OF QUANTITIES

SUMMARY

		Amount (Rs.)
Bill No. 1:	Earthworks	_____
Bill No. 2:	Culverts and Bridges	_____
Bill No. 3:	Subsurface Drains	_____
Bill No. 4:	Tube wells and Pump Houses	_____
Bill No. 5:	Miscellaneous Items	_____
	Sub-Total of Bills	_____
	Day work	_____
	Bid Price	_____

Note: All Provisional Sums are to be expended in whole or, in part at the direction and discretion of the Engineer in accordance with Sub-Clauses 52.4 and 58.2 of the General Conditions of Contract Part- I.

BE-1

Appendix-E to Bid

PROPOSED CONSTRUCTION SCHEDULE

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

	Description	**Time for Completion**
a)	Whole Works	_____days
b)	Part-A	_____days (If applicable)
c)	Part-B	_____days (If applicable)
d)	_____	_____days
e)	_____	_____days

BF-1

Appendix-F to Bid

METHOD OF PERFORMING THE WORK

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

1. Organization Chart indicating head office and field office personnel involved in management and supervision, engineering, equipment maintenance and purchasing.

2. Mobilization in Pakistan, the type of facilities including personnel accommodation, office accommodation, provision for maintenance and for storage, communications, security and other services to be used.

3. The method of executing the Works, the procedures for installation of equipment and machinery and transportation of equipment and materials to the site.

4. Quality control / Quality assurance measures to be adopted including procedures to be followed for carrying out all tests required under specifications.

BG-50

Appendix-G to Bid

LIST OF MAJOR EQUIPMENT – RELATED ITEMS

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

LIST OF MAJOR EQUIPMENT

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						

Equipment:

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

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

CONSTRUCTION CAMP AND HOUSING FACILITIES

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

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

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

1. Site Preparation (clearing, land preparation, etc.).
2. Provision of Services.
    a) Power (expected power load, etc.).
    b) Water (required amount and system proposed).
    c) Sanitation (sewage disposal system, etc.).
3. Construction of Facilities
    a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type of construction of buildings, etc.).
    b) Warehouses and Storage Areas (area required, type of construction and layout).
    c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction, etc.).
4. Construction Equipment Assembly and Preparation (detailed plans for carrying out this activity).
5. Other Items Proposed (Security services, etc.). The Contractor should mention here what are his proposed environmental measures for the project as per EPA rules like treatment of wastewater and water quality etc. The Contractor shall submit a detailed EMP (Environmental Management Plan) to describe how materials are removed from site and disposed off at a safe location, prevention for the contamination of ground and surface water in neighboring areas etc. including remedial measures for adoption.
6. Detail of testing Lab with testing equipment etc.

BI-1

Appendix-I to Bid

LIST OF SUBCONTRACTORS

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

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

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

BJ-1

Appendix-J to Bid

ESTIMATED PROGRESS PAYMENTS

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

Quarter/ Year/ Period	**Amounts (Rs in Millions)**
1	**2**
1st Quarter	
2nd Quarter	
3rd Quarter	
4th Quarter	
…….	
…….	
…….	
…….	
…….	
Bid Price	

BK-1

Appendix-K to Bid

ORGANIZATION CHART

FOR THE
SUPERVISORY STAFF AND LABOUR

BL-1
Appendix-L to Bid

(INTEGRITY PACT)

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

Contract No._____Dated_____
Contract Value: _____
Contract Title: _____

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

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

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

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

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

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

BM-1

Appendix-M to Bid

FINANCIAL COMPETENCE AND ACCESS TO FINANCIAL RESOURCES

The financial position of the bidder shall be checked as per following details:

1. <u>SOUNDNESS AND ACCESS TO FINANCIAL RESOURCES:</u>

"The Bidder must demonstrate access to, or availability of, financial resources such as liquid assets, unencumbered real assets, lines of credits, and other financial means, other than any contractual advance payments, to meet the financial requirements of the contract in the amount of his bid. As a minimum, the Bidder must show that his resources, in terms of at least his latest years working capital and line of credits, will be adequate to cover an amount equivalent to his bid price and current work commitments i.e.

[5 x working capital + Project/General *{to be decided by the procuring agency}* specific lines of credit*– 40% of current contract commitments] ≥ Estimated Price of the works/PC-1.

{above said formula is just for an example, however, the procuring agency may make changes in above said formula judiciously keeping in view the requirement of any specific project}

Working capital is the difference between current assets and current liabilities and measures the firm's ability to generate cash in the short term."

**Any line of credit indicated for this (tendered) project needs to have been certified by the Bank and the said certificate is enclosed with this Appendix.*

2. <u>AVERAGE ANNUAL CONSTRUCTION TURNOVER</u>

Criteria	**Bidders' to list their certified yearly turnover for last____years** (Authenticated audited financial statements may be required)
Minimum average **annual construction turnover** of Pak Rupees 100 Million. Calculated as total certified payments received for contracts in progress or completed, within the last **05** years.	

Note:- If JV is allowed then this Appendix has to be modified accordingly listing all the information for financial competence and access to financial resource of the lead partner/JV

members.

BN-1
Appendix-N to Bid

PAST PERFORMANCE, CURRENT COMMITMENT, QUALIFICATION AND EXPERIENCE

1) General Construction Experience

Requirement	Bidder to Provide details	Role
Experience under construction contracts in the role of contractor, subcontractor, or management contractor for at least the last **10** years prior to the bid submission deadline.		

2) Contracts of Similar Size and Nature

Requirement	Bidder to provide specific details	Role
Participation as contractor, management contractor, or subcontractor, in at least 2 Contracts within the last **10** years, each with a value of at least Rs 100 Million that has been successfully or is substantially completed and that are similar to the proposed works. **The similarity shall be based on the physical size, complexity, methods, technology or other characteristics as indicated in these Bidding Documents.**		

Note:- If JV is allowed then this Appendix has to be modified accordingly listing all the information for past performance, current commitments, qualification and experience of the lead partner/JV members.

BN-2
Appendix-N to Bid

3) Personnel

No.	Position	Total No in the Firm	Minimum requirement for the Project*	Total Work Experience [years]	Nos. already posted on other projects	Nos. being allocated for this project	Professional credits points*
1							
2							
3							
4							
5							

- The Bidder must demonstrate that it has the personnel for the **key positions** that meet the following requirements:

- 01 page CV need to be added for each key staff

BN-3

Appendix-N to Bid

4) Data regarding past performance and present commitment of the Bidders:

Present Commitment								
Sr No.	Name of ongoing project(s)	Name of Employer	Date of		Progress		Remarks regarding delays if applicable	Satisfactory performance certificate from employer (Minimum requirement)
			Start	Completion	%Age as planned	%Age at actual		
1.								
2.								
3.								
4.								
5.								
6.								

Number of projects that a bidder can undertake to construct as per PEC works by laws is aggregate Professional Credit Points (PCPs) authorized for a category of licensee divided by the PCP of construction and capital cost of single project under consideration.
For example C-3 category contractor should have a minimum of 15 PCPs as per table 'A' below from the Bye Laws/S.R.O. 568(I)/87 at all times and the PCP of individual project (costing say 100 Million rupees) is 5 calculated on the basis of 1 PCP for every 20 Million project cost. It means the contractor can have ongoing projects up to 3 (15 ÷ 5) number of this size.

Table A:-

Contractor's Category	Limit of Construction Cost of Project (Million rupees)	Average annual value of work for last 3 years (Million rupees)	Largest project value during last 5 years (Million rupees)	Paid up capital or net/capital worth (Million rupees)	Minimum requirement of professional credit points (PCP credit)
C-3	Up to 100	10	20	5	15

The evaluation of the personnel shall be carried out as per PEC Engineering Bye Laws 1987 and review his qualification accordingly. PCP/ minimum requirement of staff required for the contractor's works in hand should be in accordance with the provisions of PEC's works byelaws. For example, subject to the other conditional points and limits, a single registered Engineer is given 1 PCP for each year of experience in the construction and operation of engineering works (subject to a minimum of 10 PCPs and maximum of 30 PCPs). The contractor setup has to meet the minimum PCP requirements all time during the currency of the contract for engineering staff to be deployed/ already deployed.

FORMS

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

BS-1

BID SECURITY
(**Bank Guarantee)**

Security Executed on _____
(Date)
Name of Surety (Bank) with Address: _____
(Scheduled Bank in Pakistan)
Name of Principal (Bidder) with Address _____
_____
Penal Sum of Security Rupees ._____(Rs._____)
Bid Reference No. _____
KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bid and at the request of the said Principal (Bidder) we, the Surety above named, are held and firmly bound unto _____
(hereinafter called the 'Employer') in the sum stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

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

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

(1) that the Bid Security shall remain in force up to and including the date 30 days after the deadline for validity of bids as stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Surety is hereby waived;

(2) that the Bid Security of unsuccessful Bidders will be returned by the Employer after expiry of its validity or upon signing of the Contract Agreement; and

(3) that in the event of failure of the successful Bidder to execute the proposed Contract Agreement for such work and furnish the required Performance Security, the entire said sum be paid immediately to the said Employer pursuant to Clause 15.6 of the Instruction to Bidders for the successful Bidder's failure to perform.

NOW THEREFORE, if the successful Bidder shall, within the period specified therefore, on the prescribed form presented to him for signature enter into a formal Contract with the said Employer in accordance with his Bid as accepted and furnish within fourteen (14) days of his being requested to do so, a Performance Security with good and sufficient surety, as may be required, upon the form prescribed by the said Employer for the faithful performance and proper fulfilment of the said Contract or in the event of non-withdrawal of the said Bid within

the time specified for its validity then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

BS-2

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

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

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

SURETY (Bank)

WITNESS: Signature _____

1. _____ Name _____

_____ Title _____

Corporate Secretary (Seal) Corporate Guarantor (Seal)

2. _____

_____

Name, Title & Address

PS-

FORM OF PERFORMANCE SECURITY
(Bank Guarantee)

Guarantee No._____
Executed on _____
Expiry date _____

[Letter by the Guarantor to the Employer]

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

Name of Principal (Contractor) with address:_____

_____

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

_____

Letter of Acceptance No._____Dated _____

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

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

_____(Name of Project).

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

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

PS-

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

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

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

_____
Guarantor (Bank)

Witness:

1. _____ Signature _____

_____ Name_____
Corporate Secretary (Seal)

Title _____

2. _____

_____ _____
Name, Title & Address Corporate Guarantor (Seal)

CA-1

FORM OF CONTRACT AGREEMENT

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

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

NOW this Agreement 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 / Clarification as agreed or otherwise, if any, except those parts relating to Instructions to Bidders shall be deemed to form and be read and construed as part of this Contract, viz:

   (a) The Contract Agreement;
   (b) The Letter of Acceptance;
   (c) The completed Form of Bid (Technical & Financial);
   (d) Special Stipulations (Appendix-A to Bid);
   (e) The Special Conditions of Contract – Part II;
   (f) The General Conditions – Part I;
   (g) The Drawings;
   (h) The priced Bill of Quantities (Appendix-D to Bid);
   (i) The completed Appendices to Bid (B, C, E to O);
   (j) The Specifications.
   (k) _____(any other)

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy defects therein in conformity and in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works as per provisions of the Contract, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

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

Signature of the Contactor	Signature of Employer
_____	_____
(Seal)	(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:	Witness:
_____	_____
(Name, Title and Address)	(Name, Title and Address)

MG-1

MOBILIZATION ADVANCE GUARANTEE

(Unconditional Bank Guarantee)

Guarantee No._____ Date _____

WHEREAS_____(hereinafter called the 'Employer') has entered into a Contract for _____

(Particulars of Contract)

with_____(hereinafter called the "Contractor').

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

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

AND WHEREAS, _____

(Scheduled Bank in Pakistan acceptable to the Employer)

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

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

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

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

(Date)

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

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

GUARANTOR

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

WITNESS

1. _____
   _____
   Corporate Secretary (Seal)

2. _____ _____
   (Name Title & Address) Corporate Guarantor(Seal)

IB-1

INDEMNITY BOND

FOR SECURED ADVANCE

AGAINST MATERIALS BROUGHT AT SITE

(ON RS.40 NON-JUDICIAL STAMP PAPER)

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

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

1. _____ at Rs._____ per _____ = Rs.
2. _____ at Rs._____ per _____ = Rs.
3. _____ at Rs._____ per _____ = Rs.
4. _____ at Rs._____ per _____ = Rs.

THEREFORE THIS DEED OF INDEMNITY WITHNESSETH AS FOLLOWS:

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

I/We_____shall indemnify_____against any or all claims, action damages arising out of or resulting to the said material.

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

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

Place_____Dated _____

Contractor _____

[Notes on the Conditions of Contract]

The Conditions of Contract comprise two parts:

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

Over the years, a number of "model" General Conditions of Contract have evolved. Assistance has been obtained for the one used in these Standard Bidding Documents from the International Federation of Consulting Engineers (Federation Internationale des Ingenieurs-Conseils, or FIDIC), making the same compatible with the PPRA, Act, 2009 and the PPR-14.

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

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

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

CONDITIONS OF CONTRACT

FOR WORKS OF CIVIL

ENGINEERING CONSTRUCTION

PART I GENERAL CONDITIONS

WITH FORMS OF TENDER AND AGREEMENT

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PART I - GENERAL CONDITIONS

Definitions and Interpretation

1.1 Definitions

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

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

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

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

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

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

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

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

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

operation and maintenance manuals and other technical information of a like nature submitted by the Contractor and approved by the Engineer.

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

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

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

(vii) "Contract Agreement" means the contract agreement (if any) referred to in Sub-Clause 9.1.

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

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

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

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

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

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

(ii) "Retention Money" means the aggregate of all monies retained by the Employer pursuant to Sub-Clause 60.2(a).

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

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

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

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

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

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

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

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

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

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

(ii) "day" means calendar day.

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

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

1.2 Headings and Marginal Notes

The headings and marginal notes in these Conditions shall not be deemed part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.

1.3 Interpretation

Words importing persons or parties shall include firms and corporations and any organization having legal capacity. Interpretation by PPRA shall be final w.r.t. the legal provisions. The PPRA Act, 2009 and the PPR-14 shall supersede the provisions/ text in this document in case of any conflict.

1.4 Singular and Plural

Words importing the singular only also include the plural and vice versa where the context requires.

1.5 Notices, Consents, Approvals, Certificates and Determinations

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

Engineer and Engineer's Representative

2.1 Engineer's Duties and Authority

(a) The Engineer shall carry out the duties specified in the Contract.

(b) The Engineer may exercise the authority specified in or necessarily to be implied from the Contract, provided, however, that if the Engineer is required, under the terms of his appointment by the Employer, to obtain the specific approval of the Employer before exercising any such authority, particulars of such requirements shall be set out in Part II of these Conditions. Provided further that any requisite approval shall be deemed to have been given by the Employer for any such authority exercised by the Engineer.

(c) Except as expressly stated in the Contract, the Engineer shall have no authority to relieve the Contractor of any of his obligations under the Contract.

2.2 Engineer's Representative

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

2.3 Engineer's Authority to Delegate

The Engineer may from time to time delegate to the Engineer's Representative any of the duties and authorities vested in the Engineer and he may at any time

revoke such delegation. Any such delegation or revocation shall be in writing and shall not take effect until a copy thereof has been delivered to the Employer and the Contractor.

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

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

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

2.4 Appointment of Assistants

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

2.5 Instructions in Writing

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

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

2.6 Engineer to Act Impartially

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

(a) giving his decision, opinion or consent,
(b) expressing his satisfaction or approval,
(c) determining value, or
(d) otherwise taking action which may affect the rights and obligations of the Employer or the Contractor

He shall exercise such discretion impartially within the terms of the Contract and having regard to all the circumstances. Any such decision, opinion, consent expression of satisfaction, or approval, determination of value or action may be opened up, reviewed or revised as provided in Clause 67.

Assignment and Subcontracting

3.1 Assignment of Contract

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

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

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

4.1 Subcontracting

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

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

(a) the provision of labour,

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

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

4.2 Assignment of Subcontractors' Obligations

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

Contract Documents

5.1 Language/s and Law

There is stated in Part II of these Conditions:

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

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

If the said documents are written in more than one language, the language according to which the Contract shall be construed and interpreted is also stated in Part II of these Conditions, being therein designated the "Ruling Language". Interpretation by PPRA shall be final w.r.t. the legal provisions. The PPRA Act, 2009 and the PPR-14 shall supersede the provisions/ text in this document in case of any conflict.

5.2 Priority of Contract Documents

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

(1) The Contract Agreement (if completed);
(2) The Letter of Acceptance;
(3) The Tender;

(4) Part II of these Conditions;
(5) Part I of these Conditions; and
(6) Any other document forming part of the Contract.

6.1 Custody and Supply of Drawings and Documents

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

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

6.2 One Copy of Drawings to be Kept on Site

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

6.3 Disruption of Progress

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

6.4 Delay and Cost of Delay of Drawings

If, by reason of any failure or inability of the Engineer to issue, within a time reasonable in all the circumstances, any drawing or instruction for which notice

has been given by the Contractor in accordance with Sub-Clause 6.3, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Employer and the Contractor, determine:

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

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

6.5 Failure by Contractor to Submit Drawings

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

7.1 Supplementary Drawings and Instructions

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

7.2 Permanent Works Designed by Contractor

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

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

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

7.3 Responsibility Unaffected by Approval

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

General Obligations

8.1 Contractor's General Responsibilities

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

8.2 Site Operations and Methods of Construction

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

9.1 Contract Agreement

The Contractor shall, if called upon so to do, enter into and execute the Contract Agreement, to be prepared and completed at the cost of the Employer, in the form annexed to these Conditions with such modification as may be necessary.

10.1 Performance Security

If the Contract requires the Contractor to obtain security for his proper performance of the Contract, he shall obtain and provide to the Employer, such security within 30 days after the receipt of the Letter of Acceptance, in the sum stated in the Appendix to Tender. When providing such security to the Employer, the Contractor shall notify the Engineer of so doing. Such security shall be in the form annexed to these Conditions or in such other form as may be agreed between the Employer and the Contractor. The institution providing such security shall be subject to the approval of the Employer. The cost of complying with the requirements of this Clause shall be borne by the Contractor, unless the Contract otherwise provides.

10.2 Period of Validity of Performance Security

The performance security shall be valid until the Contractor has executed and completed the Works and remedied any defects therein in accordance with the Contract. No claim shall be made against such security after the issue of the Defects Liability Certificate in accordance with Sub-Clause 62.1 and such security shall be returned to the Contractor within 14 days of the issue of the said Defects Liability Certificate.

10.3 Claims under Performance Security

Prior to making a claim under the performance security the Employer shall, in every case, notify the Contractor stating the nature of the default in respect of which the claim is to be made.

11.1 Inspection of Site

The Employer shall have made available to the Contractor, before the submission by the Contractor of the Tender, such data on hydrological and sub-surface conditions as have been obtained by or on behalf of the Employer from investigations undertaken relevant to the Works but the Contractor shall be responsible for his own interpretation thereof.

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

(a) the form and nature thereof, including the sub-surface conditions,

(b) the hydrological and climatic conditions,

(c) the extent and nature of work and materials necessary for the execution and completion of the Works and the remedying of any defects therein, and

(d) the means of access to the Site and the accommodation he may require,

and, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

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

12.1 Sufficiency of Tender

The Contractor shall be deemed to have satisfied himself as to the correctness and sufficiency of the Tender and of the rates and prices stated in the Bill of

Quantities, all of which shall, except insofar as it is otherwise provided in the Contract, cover all his obligations under the Contract (including those in respect of the supply of goods, materials, Plant or services or of contingencies for which there is a Provisional Sum) and all matters and things necessary for the proper execution and completion of the Works and the remedying of any defects therein.

12.2 Not Foreseeable Physical Obstructions or Conditions

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

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

(b) the amount of any costs which may have been incurred by the Contractor by reason of such obstructions or conditions having been encountered, which shall be added to the Contract Price,

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

13.1 **Work to be in Accordance with Contract**

Unless it is legally or physically impossible, the Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the Contract to the satisfaction of the Engineer. The Contractor shall comply with and adhere strictly to the Engineer's instructions on any matter, whether mentioned in the Contract or not, touching or concerning the Works. The Contractor shall take instructions only from the Engineer (or his delegate).

14.1 Programme to be Submitted

The Contractor shall, within the time stated in Part II of these Conditions after the date of the Letter of Acceptance, submit to the Engineer for his consent a programme, in such form and detail as the Engineer shall reasonably prescribe, for the execution of the Works. The Contractor shall, whenever required by the

Engineer, also provide in writing for his information a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. The Employer shall also be provided a copy of each document provided by the Contractor for record and information.

14.2 Revised Programme

If at any time it should appear to the Engineer that the actual progress of the Works does not conform to the programme to which consent has been given under Sub-Clause 14.1, the Contractor shall produce, at the request of the Engineer, a revised programme showing the modifications to such programme necessary to ensure completion of the Works within the Time for Completion. The Employer shall also be provided a copy of each document provided by the Contractor for record and information.

14.3 Cash Flow Estimate to be Submitted

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

14.4 Contractor not Relieved of Duties or Responsibilities

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

15.1 **Contractor's Superintendence**

The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorised representative approved of by the Engineer, which approval may at any time be withdrawn, shall give his whole time to the superintendence of the Works. Such authorised representative shall receive, on behalf of the Contractor, instructions from the Engineer.

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

16.1 Contractor's Employees

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

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

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

16.2 Engineer at Liberty to Object

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

17.1 Setting-out

The Contractor shall be responsible for:

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

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

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

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

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

18.1 **Boreholes and Exploratory Excavation**

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

19.1 Safety, Security and Protection of the Environment

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

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

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

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

19.2 Employer's Responsibilities

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

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

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

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

20.1 Care of Works

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

(a) if the Engineer issues a Taking-Over Certificate for any Section or part of the Permanent Works the Contractor shall cease to be liable for the care of that Section or part from the date of issue of the Taking-Over Certificate, when the responsibility for the care of that Section or part shall pass to the Employer, and

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

20.2 Responsibility to Rectify Loss or Damage

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

20.3 Loss or Damage Due to Employer's Risks

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

20.4 Employer's Risks

The Employer's risks are:

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

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

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

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

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

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

(g) loss or damage to the extent that it is due to the design of the Works, other than any part of the design provided by the Contractor or for which the Contractor is responsible. [It shall be ensured that the Design Consultants remain available for Top Supervision and rectification of any subsequent faults/ issues till the successful completion of the project/ closing of the contract including defect liability period if any];

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

21.1 Insurance of Works and Contractor's Equipment

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

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

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

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

21.2 Scope of Cover

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

(a) the Employer and the Contractor against all loss or damage from whatsoever cause arising, other than as provided in Sub-Clause 21.4, form the start of

work at the Site until the date of issue of the relevant Taking-Over Certificate in respect of the Works or any Section or part thereof as the case may be, and

(b) the Contractor for his liability:

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

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

21.3 Responsibility for Amounts not Recovered

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

21.4 Exclusions

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

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

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

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

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

22.1 Damage to Persons and Property

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

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

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

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

22.2 Exceptions

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

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

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

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

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

22.3 Indemnity by Employer

The Employer shall indemnify the Contractor against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the exceptions defined in Sub-Clause 22.2

23.1 Third Party Insurance (including Employer's Property)

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

23.2 Minimum Amount of Insurance

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

23.3 Cross Liabilities

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

24.1 Accident or Injury to Workmen

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

24.2 Insurance Against Accident to Workmen

The Contractor shall insure against such liability and shall continue such insurance during the whole of the time that any persons are employed by him on the Works. Provided that, in respect of any persons employed by any Subcontractor, the Contractor's obligations to insure as aforesaid under the Sub-Clause shall be satisfied if the Subcontractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy, but the Contractor shall require such Subcontractor to produce to the Employer, when required, such policy of insurance and the receipt for the payment of the current premium.

25.1 Evidence and Terms of Insurances

The Contractor shall provide evidence to the Employer prior to the start of work at the Site that the insurances required under the Contract have been effected and shall, within 84 days of the Commencement Date, provide the insurance policies to the Employer. When providing such evidence and such policies to the Employer, the Contractor shall notify the Engineer of so doing. Such insurance policies shall be consistent with the general terms agreed prior to the issue of the Letter of Acceptance. The Contractor shall effect all insurances for which he is responsible with insurers and in terms approved by the Employer.

25.2 Adequacy of Insurances

The Contractor shall notify the insurers of changes in the nature, extent or programme for the execution of the Works and ensure the adequacy of the

insurances at all times in accordance with the terms of the Contract and shall, when required, produce to the Employer the insurance policies in force and the receipts for payment of the current premiums.

25.3 Remedy on Contractor's Failure to Insure

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

25.4 Compliance with Policy Conditions

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

26.1 Compliance with Statutes, Regulations

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

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

(b) the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works,

and the Contractor shall keep the Employer indemnified against all penalties and liability of every kind for breach of any such provisions. Provided always that the Employer shall be responsible for obtaining any planning, zoning or other similar permission required for the Works to proceed and shall indemnify the Contractor in accordance with Sub-Clause 22.3.

27.1 Fossil

All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall, as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before

removal, acquaint the Engineer of such discovery and carry out the Engineer's instructions for dealing with the same. If, by reason of such instructions, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Employer and the Contractor, determine:

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

28.1 Patent Rights

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

28.2 Royalties

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

29.1 Interference with Traffic and Adjoining Properties

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

(a) the convenience of the public, or

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

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

30.1 Avoidance of Damage to Roads

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

30.2 Transport of Contractor's Equipment or Temporary Works

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

30.3 Transport of Materials or Plant

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

30.4 Waterborne Traffic

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

31.1 Opportunities for Other Contractors

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

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

(b) the workmen of the Employer, and

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

31.2 Facilities for Other Contractors

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

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

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

(c) provide any other service of whatsoever nature for any such,

the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.

32.1 **Contractor to Keep Site Clear**

During the execution of the Works the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment and surplus materials and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required.

33.1 **Clearance of Site on Completion**

Upon the issue of any Taking-Over Certificate the Contractor shall clear away and remove from that part of the Site to which such Taking-Over Certificate relates all Contractor's Equipment, surplus materials, rubbish and Temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike condition to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period.

Labour

34.1 **Engagement of Staffs and Labour**

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

35.1 **Returns of Labour and Contractor's Equipment**

The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and at such intervals as the Engineer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such information respecting Contractor's Equipment as the Engineer may require.

Materials, Plant and Workmanship

36.1 Quality of Materials, Plant and Workmanship

All materials, Plant and workmanship shall be:

(a) of the respective kinds described in the Contract and in accordance with the Engineer's instructions, and

(b) subjected from time to time to such tests as the Engineer may require at the place of manufacture, fabrication or preparation, or on the Site or at such other place or places as may be specified in the Contract, or at all or any of such places.

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

36.2 Cost of Samples

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

36.3 Cost of Tests

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

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

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

36.4 Cost of Tests not Provided for

If any test required by the Engineer which is:

(a) not intended by or provided for,

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

(c) (through so intended or provided for) required by the Engineer to be carried out at any place other than the Site or the place of manufacture, fabrication or preparation of the materials or Plant tested,

shows the materials, Plant or workmanship not to be in accordance with the provisions of the Contract to the satisfaction of the Engineer, then the cost of such test shall be borne by the Contractor, but in any other case Sub-Clause 36.5 shall apply.

36.5 Engineer's Determination where Tests not Provided for

Where, pursuant to Sub-Clause 36.4, this Sub-Clause applies the Engineer shall, after due consultation with the Employer and the Contractor, determine:

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

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

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

37.1 Inspection of Operations

The Engineer, and any person authorised by him, shall at all reasonable times have access to the Site and to all workshops and places where materials or Plant are being manufactured, fabricated or prepared for the Works and the Contractor shall afford every facility for and every assistance in obtaining the right to such access. The Employer may also inspect the site/ works anytime and may record and duly communicate the observations, specially w.r.t. quality and quantity, for reasonable and just decision by the Engineer for which the Engineer shall be personally held responsible along-with the Resident Supervision firm if any which employed the Engineer.

37.2 Inspection and Testing

The Engineer shall be entitled, during manufacture, fabrication or preparation to inspect and test the materials and Plant to be supplied under the Contract. If materials or Plant are being manufactured, fabricated or prepared in workshops or places other than those of the Contractor, the Contractor shall obtain permission for the Engineer to carry out such inspection and testing in those workshops or places. Such inspection or testing shall not release the Contractor from any obligation under the Contract. The Employer may also inspect the site/ works anytime and may record and duly communicate the observations, specially w.r.t. quality and quantity, for reasonable and just decision by the Engineer for which the Engineer shall be personally held responsible along-with the Resident Supervision firm if any which employed the Engineer.

37.3 Dates for Inspection and Testing

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

37.4 Rejection

If, at the time and place agreed in accordance with Sub-Clause 37.3, the materials or Plant are not ready for inspection or testing or if, as a result of the inspection or testing referred to in this Clause, the Engineer determines that the materials or Plant are defective or otherwise not in accordance with the Contract, he may

reject the materials or Plant and shall notify the Contractor thereof immediately. The notice shall state the Engineer's objections with reasons. The Contractor shall then promptly make good the defect or ensure that rejected materials or Plant comply with the Contract. If the Engineer so requests, the tests of rejected materials or Plant shall be made or repeated under the same terms and conditions. All costs incurred by the Employer by the repetition of the test shall after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer and may be deducted from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

37.5 Independent Inspection

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

38.1 Examination of Work before Covering up

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

38.2 Uncovering and Making Openings

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

39.1 Removal of Improper Work, Materials or Plant

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

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

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

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

(i) materials, Plant or workmanship, or

(ii) design by the Contractor or for which he is responsible,

is not, in the opinion of the Engineer, in accordance with the Contract.

39.2 Default of Contractor in Compliance

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

Suspension

40.1 Suspension of Work

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

(a) otherwise provided for in the Contract,

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

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

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

40.2 Engineer's Determination following Suspension

Where, if specifically mentioned in the SCC, pursuant to Sub-Clause 40.1, this Sub-Clause applies the Engineer shall, after due consultation with the Employer and the Contractor, determine:

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

(b) the amount, which shall be added to the Contract Price, in respect of the cost incurred by the Contractor by reason of such suspension,

and shall notify the Contractor accordingly, with a copy to the Employer *{inclusion of this clause is to be decided by the procuring agency}*.

40.3 Suspension lasting more than 84 Days

If the progress of the Works or any part thereof is suspended on the written instructions of the Engineer and if permission to resume work is not given by the Engineer within a period for 84 days from the date of suspension then, unless such suspension is within paragraph (a), (b), (c) or (d) of Sub-Clause 40.1, the Contractor may give notice to the Engineer requiring permission, within 30 days from the receipt thereof, to proceed with the Works or that part thereof in regard to which progress is suspended. If, within the said time, such permission is not granted, the Contractor may, but is not bound to, elect to treat the suspension, where it affects part only of the Works, as an omission of such part under Clause 51 by giving a further notice to the Engineer to that effect, or, where it affects the whole of the Works, treat the suspension as an event of default by the Employer and terminates his employment under the Contract in accordance with the provisions of Sub-Clause 69.1, whereupon the provisions of Sub-Clause 69.2 and 69.3 shall apply. The above course may be adopted if specifically given in the SCC.

Commencement and Delays

41.1 **Commencement of Works**

The Contractor shall commence the Works as soon as is reasonably possible after the receipt by him of notice to this effect from the Engineer, which notice shall be issued within the time stated in the Appendix to Tender after the date of the Letter of Acceptance. Thereafter, the Contractor shall proceeded with the Works with due expedition and without delay.

42.1 Possession of Site and Access Thereto

Save insofar as the Contract may prescribe:

(a) the extent of portions of the Site of which the Contractor is to be given possession from time to time,

(b) the order in which such portions shall be made available to the Contractor,

and, subject to any requirement in the Contract as to the order in which the Works shall be executed, the Employer will, with the Engineer's notice to commence the Works, give to the Contractor possession of

(c) so much of the Site, and

(d) such access as, in accordance with the Contract, is to be provided by the Employer as may be required to enable the Contractor to commence and proceed with the execution of the Works in accordance with the programme referred to in Clause 14, if any, and otherwise in accordance with such reasonable proposals as the Contractor shall, by notice to the Engineer with a copy to the Employer, make. The Employer will, from time to time as the Works proceed, give to the Contractor possession of such further portions of the Site as may be required to enable the Contractor to proceed with the execution of the Works with due dispatch in accordance with such programme or proposals, as the case may be.

42.2 Failure to Give Possession

If the Contractor suffers delay and/or incurs costs from failure on the part of the Employer to give possession in accordance with the terms of Sub-Clause 42.1, the Engineer may, after due consultation with the Employer and the Contractor, determine:

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

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

and shall notify the Contractor accordingly, with a copy to the Employer.
{inclusion of this clause is to be decided by the procuring agency}.

42.3 Rights of Way and Facilities

The Contractor shall bear all costs and charges for special or temporary wayleaves required by him in connection with access to the Site. The Contractor shall also

provide at his own cost any additional facilities outside the Site required by him for the purposes of the Works.

43.1 **Time for Completion**

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

44.1 Extension of Time for Completion

In the event of:

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

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

(c) exceptionally adverse climatic conditions,

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

(e) other special circumstances which may occur, other than through a default of or breach of contract by the Contractor or for which he is responsible,

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

44.2 Contractor to Provide Notification and Detailed Particulars

Provided that the Engineer is not bound to make any determination unless the Contractor has

(a) within 30 days after such event has first arisen notified the Engineer with a copy to the Employer, and

(b) within 30 days or such other reasonable time as may be agreed by the Engineer, after such notification submitted to the Engineer detailed

particulars of any extension of time to which he may consider himself entitled in order that such submission may be investigated at the time.

44.3 Interim Determination of Extension

Provided also that where an event has a continuing effect such that it is not practicable for the Contractor to submit detailed particulars within the period of 30 days referred to in Sub-Clause 44.2(b), he shall nevertheless be entitled to an extension of time provided that he has submitted to the Engineer interim particulars at intervals of not more than 30 days and final particulars within 30 days of the end of the effects resulting from the event. On receipt of such interim particulars, the Engineer shall, without undue delay, make an interim determination of extension of time and, on receipt of the final particulars, the Engineer shall review all the circumstances and shall determine an overall extension of time in regard to the event. In both such cases the Engineer shall make his determination after due consultation with the Employer and the Contractor and shall notify the Contractor of the determination, with a copy to the Employer. No final review shall result in a decrease of any extension of time already determined by the Engineer.

45.1 **Restriction on Working Hours**

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

46.1 **Rate of Progress**

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

monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

47.1 Liquidated Damages for Delay

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

47.2 Reduction of Liquidated Damages

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

48.1 Taking-Over Certificate

When the whole of the Works have been substantially completed and have satisfactorily passed any Tests on Completion prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer with a copy to the Employer, accompanied by a written undertaking to finish with due expedition any outstanding work during the Defects Liability Period. Such notice and undertaking shall be deemed to be a request by the Contractor for the Engineer to issue a Taking-Over Certificate in respect of the Works. The Engineer shall within 21 days of the date of delivery of such notice, either issue to the Contractor, with a copy to the Employer, a Taking-Over Certificate, stating the date on which, in his opinion, the Works were substantially completed in accordance with the Contract, or give instructions in writing to the Contractor specifying all the work which, in the Engineer's opinion, is required to be done by the Contractor before the issue of such Certificate. The Engineer shall also notify

the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the Woks specified therein. The Contractor shall be entitled to receive such Taking-Over Certificate within 21 days of completion, to the satisfaction of the Engineer, of the Works so specified and remedying any defects so notified.

48.2 Taking Over of Sections or Parts

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

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

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

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

48.3 Substantial Completion of Parts

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

48.4 Surfaces Requiring Reinstatement

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

Defects Liability

49.1 Defects Liability Period

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

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

(b) in the event of more than one certificate having issued by the Engineer under Clause 48, the respective dates so certified,

and in relation to the Defects Liability Period the expression "the Works" shall be construed accordingly.

49.2 Completion of Outstanding Work and Remedying Defects

To the intent that the Works shall, at or as soon as practicable after the expiration of the Defects Liability Period, be delivered to the Employer in the condition required by the Contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall:
(a) complete the work, if any, outstanding on the date stated in the Taking-Over Certificate as soon as practicable after such date, and
(b) execute all such work of amendment, reconstruction, and remedying defects, shrinkages or other faults as the Engineer may, during the Defects Liability Period or within 14 days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration, instruct the Contractor to execute.

49.3 Cost of Remedying Defects

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

(a) the use of materials, Plant or workmanship not in accordance with the Contract,
(b) where the Contractor is responsible for the design of part of the Permanent Works, any fault i n such design, or
(c) the neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the Contract.

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

49.4 Contractor's Failure to Carry Out Instructions

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

50.1 **Contractor to Search**

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

Alterations, Additions and Omissions

51.1 Variations

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

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

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

51.2 Instructions for Variations

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

52.1 Valuation of Variations

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

52.2 Power of Engineer to Fix Rates

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

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

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

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

52.3 Variations Exceeding 15 per cent

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

(a) all varied work valued under Sub-Clauses 52.1 and 52.2, and
(b) all adjustments upon measurement of the estimated quantities set out in the Bill of Quantities, excluding Provisional Sums, dayworks and adjustment of price made under Clause 70.

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

52.4 Daywork

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

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

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

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

Procedure for Claims

{inclusion of any one or all of the following clauses 53.1 to 53.5 is to be decided by the procuring agency}.

53.1 Notice of Claims

Notwithstanding any other provision of the Contract, if the Contractor intends to claim any additional payment pursuant to any Clause of these Conditions or otherwise, he shall give notice of his intention to the Engineer with a copy to the Employer, within 30 days after the event giving rise to the claim has first arisen; provided this is expressly provided in the SCC.

53.2 Contemporary Records

Upon the happening of the event referred to in Sub-Clause 53.1, the Contractor shall keep such contemporary records as may reasonably be necessary to support any claim he may subsequently wish to make. Without necessarily admitting the Employer's liability, the Engineer shall, on receipt of a notice under Sub-Clause 53.1, inspect such contemporary records and may instruct the Contractor to keep any further contemporary records as are reasonable and may be material to the claim of which notice has been given. The Contractor shall permit the Engineer,

the Employer and the Administrative Department, to inspect all records kept pursuant to this Sub-Clause and shall supply him with copies thereof as and when the Engineer so instructs.

53.3 Substantiation of Claims

Within 30 days, or such other reasonable time as may be agreed by the Engineer, of giving notice under Sub-Clause 53.1, the Contractor shall send to the Engineer an account giving detailed particulars of the amount claimed and the grounds upon which the claim is based; provided this is expressly provided in the SCC. Where the event giving rise to the claim has a continuing effect, such account shall be considered to be an interim account and the Contractor shall, at such intervals as the Engineer may reasonably require, send further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. In cases where interim accounts are sent to the Engineer, the Contractor shall send a final account within 30 days of the end of the effects resulting from the event. The Contractor shall send a copy to the Employer and the Administrative Department all accounts sent to the Engineer pursuant to this Sub-Clause.

53.4 Failure to Comply

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

53.5 Payment of Claims

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

Contractor's Equipment, Temporary Works and Materials

54.1 Contractor's Equipment, Temporary Works and Materials; Exclusive Use for the Works

All Contractor's Equipment, Temporary Works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof, except for the purpose of moving it from one part of the Site to another, without the consent of the Engineer. Provided that consent shall not be required for vehicles engaged in transporting any staff, labour, Contractor's Equipment, Temporary Works, Plant or materials to or from the Site.

54.2 Employer not Liable for Damage

The Employer shall not at any time be liable, save as mentioned in Clauses 20 and 65, for the loss of or damage to any of the said Contractor's Equipment, Temporary Works or materials.

54.3 Customs Clearance

The Employer will use his best endeavours in assisting the Contractor, where required, in obtaining clearance through the Customs of Contractor's Equipment, materials and other things required for the Works.

54.4 Re-export of Contractor's Equipment

In respect of any Contractor's Equipment which the Contractor has imported for the purposes of the Works, the Employer will use his best endeavours to assist the Contractor, where required, in procuring any necessary Government consent to the re-export of such Contractor's Equipment by the Contractor upon the removal thereof pursuant to the terms of Contract.

54.5 Conditions of Hire of Contractor's Equipment

With a view to securing, in the event of termination under Clause 63, the continued availability, for the purpose of executing the Works, of any hired Contractor's Equipment, the Contractor shall not bring on to the Site any hired Contractor's Equipment unless there is an agreement for hire thereof (which agreement shall be deemed not to include an agreement for hire purchase) which contains a provision that the owner thereof will, on request in writing made by the Employer within 7 days after the date on which any termination has become effective, and on the Employer undertaking to pay all hire charges in respect thereof from such date, hire such Contractor's Equipment to the Employer on the same terms in all respect as the same was hired to the Contractor save that the Employer shall be entitled to permit the use thereof by any other contractor employed by him for the purpose of execution and completing the Works and remedying any defects therein, under the terms of the said Clause 63.

54.6 Costs for the Purpose of Clause 63

In the event of the Employer entering into any agreement for the hire of Contractor's Equipment pursuant to Sub-Clause 54.5, all sums properly paid by the Employer under the provision of any such agreement and all costs incurred by him (including stamp duties) in entering into such agreement shall be deemed, for the purpose of Clause 63, to be part of the cost of executing and completing the Works and the remedying of any defects therein.

54.7 Incorporation of Clause in Subcontracts

The Contractor shall, where entering into any subcontract for the execution of any part of the Works, incorporate in such subcontract (by reference or otherwise) the provisions of this Clause in relation to Contractor's Equipment, Temporary Works or materials brought on to the Site by the Subcontractor.

54.8 Approval of Materials not Implied

The operation of this Clause shall not be deemed to imply any approval by the Engineer of the materials or other matters referred to therein nor shall it prevent the rejection of any such materials at any time by the Engineer.

Measurement

55.1 **Quantities**

The quantities set out in the Bill of Quantities are the estimated quantities for the Works, and they are not to be taken as the actual and correct quantities of the Works to be executed by the Contractor in fulfillment of his obligations under the Contract.

56.1 Works to be Measured

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

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

(b) supply all particulars required by the Engineer.

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

57.1 Method of Measurement

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

57.2 Breakdown of Lump Sum Items

For the purposes of statements submitted in accordance with Sub-Clause 60.1, the Contractor shall submit to the Engineer, within 30 days after the receipt of the Letter of Acceptance, a breakdown for each of the lump sum items contained in the Tender. Such breakdowns shall be subject to the approval of the Engineer.

Provisional Sums

58.1 Definition of "Provisional Sum"

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

58.2 Use of Provisional Sums

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

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

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

58.3 Production of Vouchers

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

Nominated Subcontractors

59.1 Definition of "Nominated Subcontractors"

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

59.2 Nominated Subcontractors; Objection to Nomination

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

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

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

59.3 Design Requirements to be Expressly Stated

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

59.4 Payments to Nominated Subcontractors

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

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

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

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

59.5 Certification of Payments to Nominated Subcontractors

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

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

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

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

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

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

Certificates and Payment

60.1 Monthly Statements

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

(a) the value of the Permanent Works executed,

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

(c) the percentage of the invoice value of listed materials, all as stated in the Appendix to Tender, and Plant delivered by the Contractor on the Site for incorporation in the Permanent Works but not incorporated in such Works,

(d) adjustments under Clause 70, and

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

60.2 Monthly Payments

The Engineer shall, within 30 days of receiving such statement, certify to the Employer the amount of payment to the Contractor which he considers due and payable in respect thereof, subject:

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

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

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

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

60.3 Payment of Retention Money

(a) Upon the issue of the Taking-Over Certificate with respect to the whole of the Works, one half of the Retention Money, or upon the issue of a Taking-Over Certificate with respect to a Section or part of the Permanent

Works only such proportion thereof as the Engineer determines having regard to the relative value of such Section or part of the Permanent Works, shall be certified by the Engineer for payment to the Contractor.

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

60.4 Correction of Certificates

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

60.5 Statement at Completion

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

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

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

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

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

60.6 Final Statement

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

(a) the value of all work done in accordance with the Contract, and
(b) any further sums which the Contractor considers to be due to him under the Contract.

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

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

60.7 Discharge

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

60.8 Final Payment Certificate

Within 30 days after receipt of the Final Statement, and the written discharge, the Engineer shall issue to the Employer (with a copy to the Contractor) a Final Payment Certificate stating:

(a) the amount which, in the opinion of the Engineer, is finally due under the Contract or otherwise, and

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

60.9 Cessation of Employer's Liability

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

60.10 Time for Payment

The amount due to the Contractor under any Interim Payment Certificate or final payment issued by the Engineer pursuant to this Clause, or to any other term of the Contract, shall, subject to Clause 47, be paid by the Employer to the Contractor within 30 days after such Interim Payment Certificate or final payment has been delivered to the Employer, provided the work is satisfactory.

61.1 **Approval only by Defects Liability Certificate**

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

62.1 Defects Liability Certificate

The Contract shall not be considered as completed until a Defects Liability Certificate shall have been signed by the Engineer and delivered to the Employer, with a copy to the Contractor, stating the date on which the Contractor shall have completed his obligations to execute and complete the Works and remedy any defects therein to the Engineer's satisfaction. The Defects Liability Certificate shall be given by the Engineer within 30 days after the expiration of the Defects Liability Period, or, if different defects liability periods shall become applicable to different Sections or parts of the Permanent Works, the expiration of the latest such period, or as soon thereafter as any works instructed, pursuant to Clause 49 and 50, have been completed to the satisfaction of the Engineer. Provided that the issue of the Defects Liability Certificate shall not be a condition precedent to payment to the Contractor of

the second portion of the Retention Money in accordance with the conditions set out in Sub-Clause 60.3.

62.2 Unfulfilled Obligations

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

Remedies

63.1 Default of Contractor

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

(a) has repudiated the Contract, or

(b) without reasonable excuse has failed

(i) to commence the Works in accordance with Sub-Clause 41.1,
(ii) to proceed with the Works, or any Section thereof, within 30 days after receiving notice pursuant to Sub-Clause 46.1,

(c) has failed to comply with a notice issued pursuant to Sub-Clause 37.4 or an instruction issued pursuant to Sub-Clause 39.1 within 30 days after having received it

(d) despite previous warning from the Engineer, in writing, is otherwise persistently or flagrantly neglecting to comply with any of his obligations under the Contract, or

(e) has contravened Sub-Clause 4.1,
then the Employer may, after giving 14 days' notice to the Contractor, enter upon the Site and the Works and terminate the employment of the Contractor without thereby releasing the Contractor from any of his obligations or liabilities under the Contract, or affecting the rights and authorities conferred on the Employer or the Engineer by the Contract, and may himself complete the Works or may employ any other contractor to complete the Works. The Employer or such other contractor may use for such completion so much of the Contractor's Equipment, Temporary Works and materials as he or they may think proper.

63.2 Valuation at Date of Termination

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

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

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

63.3 Payment after Termination

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

63.4 Assignment of Benefit of Agreement

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

64.1 **Urgent Remedial Work**

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

Special Risks

65.1 No Liability for Special Risks

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

(a) destruction of or damage to the Works, save to work condemned under the provisions of Clause 39 prior to the occurrence of any of the said special risks,
(b) destruction of or damage to property, whether of the Employer or third parties, or
(c) injury or loss of life.

65.2 Special Risks

The Special Risks are:

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

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

65.3 Damage to Works by Special Risks

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

(a) rectifying any such destruction or damage to the Works, and
(b) replacing or rectifying such materials or Contractor's Equipment,

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

65.4 Projectile, Missile

Destruction, damage, injury or loss of life caused by the explosion or impact, whenever and wherever occurring, of any mine, bomb, shell, grenade, or other projectile, missile, munition, or explosive of war, outside the reasonable control of the contractor, shall be deemed to be a consequence of the said special risks, provided the same is not in consequence of any lack of diligence on the part of Contractor.

65.5 Increased Costs arising from Special Risks

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

65.6 Outbreak of War

If, during the currency of the Contract, there is an outbreak of war, whether war is declared or not, in any part of the world which, whether financially or otherwise, materially affects the execution of the Works, the Contractor shall, unless and until the Contract is terminated under the provisions of this Clause, continue to use his best endeavour to complete the execution of the Works. Provided that the Employer shall be entitled, at any time after such outbreak of war, to terminate the Contract by giving notice to the Contractor and, upon such notice being given, the Contract shall, except as to the rights of the parties under this clause and Clause 67, terminate, but without prejudice to the rights of either party in respect of any antecedent breach thereof.

65.7 Removal of Contractor's Equipment on Termination

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

65.8 Payment if Contract Terminated

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

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

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

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

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

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

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

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

Release from Performance

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

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

Settlement of Disputes

67.1 Engineer's Decision

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

eighty-fourth day after the day on which he received such reference the Engineer shall give notice of his decision to the Employer and the Contractor. Such decision shall state that it is made pursuant to this Clause.

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

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

If the Engineer has given notice of his decision as to a matter in dispute to the Employer and the Contractor and no notice of intention to commence arbitration as to such dispute has been given by either the Employer or the Contractor on or before the seventieth day after the day on which the parties received notice as to such decision from the Engineer, the said decision shall become final and binding upon the Employer and the Contractor. However, the Blacklisting regime given in section 17-A of PPRA Act, 2009 and rule 21 of PPR-14 read with Schedule appended with the PPR-14 shall have an over-riding effect and shall be applicable in letter and spirit.

67.2 Amicable Settlement

Where notice of intention to commence arbitration as to a dispute has been given in accordance with Sub-Clause 67.1, the parties shall attempt to settle such dispute amicably before the commencement of arbitration. Provided that, unless the parties otherwise agree, arbitration may be commenced on or after the fifty-sixth day after the day on which notice of intention to commence arbitration of such dispute was given, even if no attempt at amicable settlement thereof has been made.

67.3 Arbitration

Any dispute in respect of which:

(a) the decision, if any, of the Engineer has not become final and binding pursuant to Sub-Clause 67.1, and
(b) amicable settlement has not been reached within the period stated in Sub-Clause 67.2,

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

Neither party shall be limited in the proceedings before such arbitrator/s to the evidence or arguments put before the Engineer for the purpose of obtaining his said decision pursuant to Sub-Clause 67.1. No such decision shall disqualify the Engineer from being called as a witness and giving evidence before the arbitrator/s on any matter whatsoever relevant to the dispute.
Arbitration may be commenced prior to or after completion of the Works, provided that the obligations of the Employer, the Engineer and the Contractor shall not be altered by reason of the arbitration being conducted during the progress of the Works.

67.4 Failure to Comply with Engineer's Decision

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

Notices

68.1 Notice to Contractor

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

68.2 Notice to Employer and Engineer

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

68.3 Change of Address

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

Default of Employer

69.1 Default of Employer

In the event of the Employer:

(a) failing to pay to the Contractor the amount due under any certificate of the Engineer within 30 days after the expiry of the time stated in Sub-Clause 60.10 within which payment is to be made, subject to any deduction that the Employer is entitled to make under the Contract, provided work is satisfactory and the Contractor has not indulged in corrupt or fraudulent practices as defined in rule 2 of PPR-14,

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

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

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

the Contractor may resort to the dispute resolution mechanism given in clauses 67.1 to 67.3 above.

69.2 Removal of Contractor's Equipment

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

69.3 Payment on Termination

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

69.4 Contractor's Entitlement to Suspend Work

Without prejudice to the Contractor's entitlement to interest under Sub-Clause 60.10, if any, the Contractor may, if the Employer fails to pay the Contractor the amount due under any certificate of the Engineer within 30 days after the expiry of the time stated in Sub-Clause 60.10 within which payment is to be made, subject to any deduction that the Employer is entitled to make under the Contract, after giving 30 days' prior notice to the Employer, with a copy to the Engineer, suspend work or reduce the rate of work; provided the previously done work is satisfactory and the Contractor has not indulged in Corrupt practices as given in rule 2 of PPR-14.

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

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

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

69.5 Resumption of Work

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

Changes in Cost and Legislation

70.1 Increase or Decrease of Cost

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

70.2 Subsequent Legislation

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

Currency and Rates of Exchange

71.1 **Currency Restrictions**

If, after the date for submission of tenders for the Contract, the Government or authorized agency of the Government of the country in which the Works are being or are to be executed imposes currency restrictions and/or transfer of currency restrictions in relation to the currency or currencies in which the Contract Price is to be paid, the Employer shall reimburse any loss or damage to the Contractor arising therefrom, without prejudice to the right of the Contractor to exercise any other rights or remedies to which he is entitled in such event. As a principle, payments in foreign currency are not allowed. In exceptional circumstances, payments may only be allowed if all codal formalities

have been fulfilled and approval of the Finance department has been obtained and such provision is given in the SCC.

72.1 Rates of Exchange

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

72.2 Currency Proportions

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

72.3 Currencies of Payment for Provisional Sums

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

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PART II - SPECIAL CONDITIONS OF CONTRACT

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

1.1 Definitions

(a) (i) The Employer is: …….. ….. …….. ……
……..(insert name along with his full address).
……..

(a) (iv) The Engineer is …….
…….. (insert name of

the Firm/Company/Person nominated as Engineer alongwith his full address), or any other competent person appointed by the Employer, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineers is to formulate his certifications/ recommendations in relation to all outstanding matters, disputes and claims relating to the execution of the Works during his tenure.

The following paragraph is added:

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

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

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

The following paragraph is added:

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

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

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

2.1 Engineer's Duties and Authority

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

The Engineer shall obtain the specific approval of the Employer before carrying out his duties in accordance with the following Clauses. The Employer may further vary according to need of the project;

(i) Consenting to the sub-letting of any part of the Works under Sub-Clause 4.1 "Subcontracting".

(ii) Certifying additional cost determined under Sub-Clauses 12.2 "Not Foreseeable Physical Obstructions or conditions"

(iii) Any action under Clause 10 "Performance Security" and Clauses 21,23,24 & 25 " Insurance" of sorts.

(iv) Any action under Clause 40 "Suspension"

(v) Any action under Clause 44 "Extension of Time for Completion"

(vi) Any action under Clause 47 "Liquidated Damages for Delay" or payment of Bonus for Early Completion of Works (SCC Sub-Clause 47.3)

(vii) Issuance of "Taking over Certificate" under Clause 48.

(viii) Issuing a Variation Order under Clause 51 except:

a) in an emergency* situation, as stated here below, or

b) if such variation would increase the Contract Price by the amount stated in the Appendix-A to Bid.

(ix) Fixing rates or prices under Clause 52.

(x) Extra payment as a result of Contractor's claims Clause

(xi) Release of Retention Money to the Contractor under Sub-Clause 60.3 "Payment of Retention Money".

(xii) Issuance of "Final Payment Certificate" under Sub-Clause 60.8.

(xiii) Issuance of "Defect Liability Certificate" under Sub-Clause 62.1.

(xiv) Any change in the ratios of Contract currency proportions and payments thereof under clause 72 "Currency and Rate of Exchange".

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

* (If in the opinion of the Engineer an emergency occurs affecting the safety of life or of the Works or of adjoining property, the Engineer may, without relieving the

Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.)

2.2 Engineer's Representative

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

The following Sub-Clauses 2.7 and 2.8 are added:

2.7 Engineer Not Liable

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

2.8 Replacement of the Engineer

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

5.1 Language(s) and Law

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

5.2 Priority of Contract Documents

The documents listed at (1) to (6) of the Sub-Clause are deleted and substituted with the following:
(1) The Contract Agreement (if completed);
(2) The Letter of Acceptance;

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

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

The following Sub-Clauses 6.6 and 6.7 are added

6.6 Shop Drawings

The Contractor shall submit to the Engineer for review 3 copies of all shop and erection drawings applicable to this Contract as per provision of relevant Sub-Clause of the Contract. A copy shall be submitted to the Employer as well.
Review and approval by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory and that the Engineer's review or approval shall not relieve the Contractor of any of his responsibilities under the Contract.

6.7 As-Built Drawings

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

10.1 Performance Security

The text is deleted and substituted with the following:

The Contractor shall provide Performance Security to the Employer in the prescribed form. The said Security shall be furnished or caused to be furnished by the Contractor within 30 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 10% of the Contract Price stated in the Letter of Acceptance. Such Security shall, at the option of the bidder, be in the form of either (a) bank guarantee from any Scheduled Bank in Pakistan or (b) bank guarantee from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan.

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

The following Sub-Clause10.4 is added:

10.4 Performance Security Binding on Variations and Changes

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

14.1 Programme to be Submitted

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

i) a Bar Chart identifying the critical activities.

ii) a CPM identifying the critical path/activities.

(Employer to select appropriate one)

14.3 Cash Flow Estimate to be Submitted

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

The following Sub-Clause 14.5 is added:

14.5 Detailed Programme and Monthly Progress Report

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

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

(b) During the period of the Contract, the Contractor shall submit to the Engineer, the Employer and the Administrative Department, not later than the 8^{th} day of the following month, 10 copies each of Monthly Progress Reports covering with a copy to the employer:

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

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

The following Sub-Clauses 15.2 and 15.3 are added:

15.2 Language Ability of Contractor's Representative

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

15.3 Contractor's Representative

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

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

The following Sub-Clauses 16.3 and 16.4 are added:

16.3 Language Ability of Superintending Staff of Contractor

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

16.4 Employment of Local Personnel

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour from sources within Pakistan.

The following Sub-Clauses 19.3 and 19.4 are added:

19.3 Safety Precautions

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

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

19.4 Lighting Work at Night

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

20.4 Employer's Risks

The Employer's risks are:

Delete the text and substitute with the following:

(a) insofar as they directly affect the execution of the Works in Pakistan:

- (i) war and hostilities (whether war be declared or not), invasion, act of foreign enemies,
- (ii) rebellion, revolution, insurrection, or military or usurped power, or civil war,
- (iii) ionizing radiations, or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof,
- (iv) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,
- (v) riot, commotion or disorder, unless solely restricted to the employees of the Contractor or of his Subcontractors and arising from the conduct of the Works;

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

(c) loss or damage to the extent that it is due to the design of the Works, other than any part of the design provided by the Contractor or for which the Contractor is responsible; [For all those projects where funding is available, the Design Consultants shall be made responsible for any design faults. It shall be ensured that the Design Consultants remain available for Top Supervision and rectification of any subsequent faults/ issues till the successful completion of the project/ closing of the contract including defect liability period if any];

(d) any operation of the forces of nature (insofar as it occurs on the Site) which an experienced contractor:

(i) could not have reasonably foreseen, or
(ii) could reasonably have foreseen, but against which he could not reasonably have taken at least one of the following measures:
(a) prevent loss or damage to physical property from occurring by taking appropriate measures, or
(b) insure against.

21.1 Insurance of Works and Contractor's Equipment

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

21.4 Exclusions

The text is deleted and substituted with the following:

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

The following Sub-Clause 25.5 is added:

25.5 Insurance Company

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

Costs of such insurances shall be borne by the Contractor.

The following Sub-Clause 31.3 is added:

31.3 Co-operation with other Contractors

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

The following Sub-Clauses 34.2 to 34.12 are added:

34.2 Rates of Wages and Conditions of Labour

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

34.3 Employment of Persons in the Service of Others

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

34.4 Housing for Labour

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

34.5 Health and Safety

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

34.6 Epidemics

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be

made by the Government, or the local medical or sanitary authorities, for purpose of dealing with and overcoming the same.

34.7 Supply of Water

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

34.8 Alcoholic Liquor or Drugs

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

34.9 Arms and Ammunition

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

34.10 Festivals and Religious Customs

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

34.11 Disorderly Conduct

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

34.12 Compliance by Subcontractors

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

The following Sub-Clauses 35.2 and 35.3 are added:

35.2 Records of Safety and Health

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

35.3 Reporting of Accidents

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

The following Sub-Clause 36.6 is added:

36.6 Use of Pakistani Materials and Services

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

41.1 Commencement of Works

The text is deleted and substituted with the following:

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

The following Sub-Clause 47.3 is added:

47.3 Bonus for Early Completion of Works

The Contractor may, in case of earlier completion for either whole or part(s) of the Works pursuant to Sub-Clauses 48.1 and 48.2(a) respectively of the General Conditions of Contract, be paid bonus up-to a limit and at a rate equivalent to 50% of the relevant limit and rate of liquidated damages prescribed in Appendix-A to Bid "Special Stipulations"; provided such provision is given in project approval documents.

48.2 Taking Over of Sections or Parts

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

51.2 Instructions for Variations

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

52.1 Valuation of Variations

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

53.4 Failure to Comply

This Sub-Clause is deleted in its entirety.

54.3 Customs Clearance

(Employer may vary this Sub-Clause)

54.5 Conditions of Hire of Contractor’s Equipment

The following paragraph is added:

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

The following Sub-Clauses 59.4 & 59.5 are added:

59.4 Payments to Nominated Subcontractors

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

59.5 Certification of Payments & Nominated Subcontractors

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

a) submits reasonable evidence to the Engineer, or

b) i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and

ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

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

60.1 Monthly Statements

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

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

In Para (c) the words "the Appendix to Tender" are deleted and substituted with the words "Sub-Cause 60.11 (a)(6) hereof".

(in case Clause 60.11 is applicable)

60.2 Monthly Payments

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

60.10 Time for Payment

The text is deleted and substituted with the following:

The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other terms of the Contract, shall , subject to Clause 47, be paid by the Employer to the Contractor within 30 days after such Interim Payment Certificate or the Final Certificate as has been jointly verified by Employer and Contractor, provided that the work is satisfactory and the Contractor has not indulged in Corrupt Practices as defined in Section 2 of the PPRA Act 2009; and provided further that the provisions of the donor documents shall prevail in case of foreign funded projects. In the event of the failure of the Employer to make payment within the times stated, the provisions w.r.t. dispute resolution may be invoked.

The following Sub-Clause 60.11is added:

60.11 Secured Advance on Materials

a) The Contractor shall be entitled to receive from the Employer Secured Advance against an indemnity bond acceptable to the Employer of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the Site but not yet incorporated in the Permanent Works provided that:

(1) The materials are in accordance with the Specifications for the Permanent Works;

(2) Such materials have been delivered to the Site and are properly stored and protected against loss or damage or deterioration to the satisfaction of the Engineer but at the risk and cost of the Contractor;

(3) The Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records shall be available for inspection by the Engineer;

(4) The Contractor shall submit with his monthly statement the estimated value of the materials on Site together with such documents as may be required by the Engineer for the purpose of valuation of materials and providing evidence of ownership and payment therefor;

(5) Ownership of such materials shall be deemed to vest in the Employer and these materials shall not be removed from the Site or otherwise disposed of without written permission of the Employer; and

(6) The sum payable for such materials on Site shall not exceed 75 % of the (i) landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of locally manufactured or produced materials, or (iii) market price of other materials.

(b) The recovery of Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis.

60.12 Financial Assistance to Contractor

Financial assistance shall be made available to the Contractor by the Employer by adopting any one of the following three Alternatives, upon submission by the Contractor of a Mobilization Advance Guarantee for the full amount of the Advance in the specified form from a Scheduled Bank in Pakistan**:**

(Appropriate alternative only to be retained)

Alternative One: Mobilization Advance

(a) An interest-free Mobilization Advance up to 15 % of the Contract Price stated in the Letter of Acceptance in two parts: a) First part, 10% before the commencement of works; and, b) Second part, 5% within 42 days from the date of payment of the first part, subject to the deployment of adequate staff/ equipment, plants, establishment of Contractor' colony and submission of Insurance Policies to the satisfaction of the Engineer.

(b) This Advance shall be recovered in equal instalments; first instalment at the expiry of third month after the date of payment of first part of Advance and the last instalment two months before the date of completion of the Works as per Clause 43 hereof.

Alternative Two: Mobilization/ Demobilization Cost

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

(i) 80 % of the Mobilization Cost shall be paid for mobilization at Site. This payment shall be in three stages as follows:

Stage I: 20 % of Mobilization Cost upon obtaining and furnishing of Performance Security and insurance policies and construction of camp and housing facilities as required under the Contract;

Stage II: 30 % of Mobilization Cost upon providing & installing preliminary requirements of Contractor's Equipment, materials and temporary structures for the commencement of Works to the

satisfaction of the Engineer and achieving 3 % value of the Works (excluding payment under Stage-I);

Stage III: 30 % of Mobilization Cost upon providing balance Contractor's Equipment to complete full requirement for the entire work and after achievement of progress to the extent of 6 % value of the Works (excluding payments under Stages I and II); and

(ii) 20 % of Mobilization Cost shall be paid for operation and maintenance of the constructed facilities and for demobilization as per schedule of payment to be submitted by the Contractor in accordance with Clause 57.2 and approved by the Engineer.

Alternative Three: Materials Supplied by Employer

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

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

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

63.1 Default of Contractor

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

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

65.2 Special Risks

The text is deleted and substituted with the following:

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

67. 3 Arbitration

In the sixth to eight lines, the words "shall be finally settled..... appointed under such Rules" are deleted and substituted with the following:

shall be finally settled under the provisions of the Arbitration Act, 1940 as amended or any statutory modification or re-enactment thereof for the time being in force.

The following paragraph is added:

The place of arbitration shall be ..... , Pakistan.

68.1 Notice to Contractor

The following paragraph is added:

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

68.2 Notice to Employer and Engineer

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

a) The Employer :

…….....

(to be filled in by the Employer as appropriate)

b) The Engineer:

…….....

(to be filled in by the Employer as appropriate)

70.1 Increase or Decrease of Cost

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

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

(a) Other Changes in Cost

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

(b) Adjustment Formula

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

$$Pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + \ldots\ldots\ldots\ldots\ldots$$

Where:

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

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

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

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

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

(c) Sources of Indices and Weightages

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

(d) Base, Current, and Provisional Indices

The base cost indices or prices shall be those prevailing on the day 30 days prior to the latest date for submission of bids. Current indices or prices shall be those prevailing on the day 30 days prior to the last day of the period to which a particular monthly statement is related. If at any time the current indices are not available, Provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.

(e) Adjustment after Completion

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

(f) Weightages

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

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

73.1 Payment of all taxes/ rates/ fees: Income Tax, Sales tax etc.

The Contractor, Subcontractors and their employees shall be responsible for payment of all applicable (federal & provincial) taxes**/** rates/ fees: income tax, sales tax and other taxes/ rates/ fees etc. arising out of the Contract and the rates and prices stated in the Contract shall be deemed to cover all such expenses till the closing of contract, including the defect liability period if any.

73.2 Customs Duty & Taxes

(Employer may incorporate provisions where applicable)

74.1 Integrity Pact

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

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

(b) terminate the Contract; and

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

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

75.1 Termination of Contract for Employer's Convenience

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

(a) shall proceed as provided in Sub-Clause 65.7 hereof; and

(b) shall be paid by the Employer as provided in Sub-Clause 65.8 hereof.

76.1 Liability of Contractor

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

77.1 Joint and Several Liability

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

78.1 Details to be Confidential

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

PART II –SPECIAL CONDITIONS OF CONTRACT

CONSTRUCTION OF SEED BUILDING

AT UNIVERSITY OF AGRICULTURE, FAISLABAD

TENDER DOCUMENTS (VOLUME-III)

TECHNICAL SPECIFICATIONS (CIVIL WORKS)

FOR

SEED BUILDING
AT
UNIVERSITY OF AGRICULTURE FAISALABAD

(JUNE 05, 2023)

ONSULTING SERVICES (Pvt.) Ltd.
34- A, Main Gulberg, Lahore

TECHNICAL SPECIFICATIONS
CIVIL WORKS

TECHNICAL SPECIFICATIONS

A. GENERAL REQUIREMENTS

1) STANDARDS

Where no reference is made to a code, standard or Specifications in Section "B" Specifications of the Contract Documents, the Standard Specifications of the American Society of Testing Materials, (ASTM), British Standard Codes of Practice (BSCP) or any other relevant standard as approved by the ENGINEER shall govern.

2) DRAWINGS

The WORKS shall agree in all particulars with the Drawings or any approved modifications of them or such other drawings as may be issued during the CONTRACT.

The ENGINEER will supply one set of each of the drawings to the CONTRACTOR free of charge.

The CONTRACTOR will make any further copies required by him at his own expense.

The CONTRACTOR will keep one set of all drawings duly mounted with muslin cloth and hanged on the wooden drawings stand when not in use.

3) CONTRACTOR'S DRAWINGS & DOCUMENTS

The CONTRACTOR shall be provided copies of all drawings, documents, specifications prepared by the Consultant. These will be of a standard size and format acceptable to the ENGINEER. All such submission to the CONTRACTOR shall be accompanied by a letter of submittal.

4) RECORD DRAWINGS

The CONTRACTOR shall prepare during the progress of the CONTRACT, drawings showing the WORKS "as built" including the positions of all services, plant and equipment. The drawings shall be prepared to a form & detail to the satisfaction of the ENGINEER and prints shall be submitted to the ENGINEER'S REPRESENTATIVE for his approval as the WORKS proceed. At the completion of the CONTRACT the SUB-CONTRACTOR shall supply to the ENGINEER reproducible of each drawing.

5) SUPPLY OF WATER AND ELECTRICITY

The CONTRACTOR shall make his own arrangements for the provision of water & electricity whether for use in the execution and construction of the WORKS or otherwise. In the event of the source of water being from any existing piped supply the CONTRACTOR shall comply with any regulations laid down by the Water Authority and shall pay for such supply, stand-pipe connections, meter rents and all other charges as required all at his own expense. Similarly he will be responsible for all costs in providing electricity. Where electricity is not available for 24 hours, diesel/petrol driven electricity generators in good and reliable condition and of sufficient capacity to meet the requirements of construction equipment and lighting and other facilities at Site will be used by the CONTRACTOR.

6) DISPOSAL OF WASTES

The CONTRACTOR shall make adequate arrangements to the satisfaction of the ENGINEER'S REPRESENTATIVE and as per approved EDF for disposal of all sewage, rubbish and all other waste material arising from or connected with the execution of the WORKS.

7) OTHER SERVICES

The CONTRACTOR shall make his own arrangements for and shall provide any service (including telephone) which may require in addition to the foregoing.

8) BENCH MARKS AND CONTROL POINTS

All levels, lines, grades and measurements shown on the Drawings shall be measured from a Bench Mark and points to be established by the ENGINEER within the Points Site of the WORKS. The CONTRACTOR shall be responsible for ensuring the levels of all parts of the work are accurately related to this Bench Mark which shall be notified to the CONTRACTOR by the ENGINEER immediately after commencement of the WORKS.

9) SURVEY

The CONTRACTOR shall furnish and maintain at his own expense survey instruments stakes and other such materials and give such assistance, including qualified staff as may be required by the ENGINEER who will establish Bench Marks base lines, grades and other principal control points. The CONTRACTOR shall, however, call the ENGINEER'S attention to any inaccuracies and discrepancies of such controlling points etc., before proceeding with the work. The CONTRACTOR shall at his own expense, establish working or construction lines and grades as required, which shall be

frequently checked by the ENGINEER'S REPRESENTATIVE but the CONTRACTOR shall be solely responsible for the accuracy thereof.

10) *SAFEGUARDING BENCH MARKS & CONTROL POINTS*

The CONTRACTOR shall safeguard all points, stakes, grade marks and bench marks made or established on the work. If disturbed he shall bear the cost of re-establishing them and also the entire Points expense of rectifying the work rendered defective due to such disturbance.

11) *PROGRESS PHOTOGRAPH*

The CONTRACTOR shall, throughout the construction of the WORKS use digital camera for photography and provide the progress photographs in colour to the ENGINEER. He will also submit three prints each of size 5"x7" along with the recorded data at two week intervals. All such photographs will be taken under the direction of the ENGINEER.

12) *MATERIALS AND WORKMANSHIP*

As soon as possible after the CONTRACT has been awarded, the CONTRACTOR shall submit to ENGINEER list of suppliers from whom he proposes to purchase the materials necessary for the execution of the WORKS. The information regarding the names of suppliers may be submitted at different times, as may be convenient, but no approved source of supply shall be changed without the prior permission of the ENGINEER'S REPRESENTATIVE.

Preference shall be given to the use of materials and fittings manufactured in Pakistan which comply with the CONTRACT and are competitive in price. Foreign materials shall only be used with the consent of the ENGINEER.

All materials incorporated in the Works shall be new and of the best quality and description of their respective kinds and shall comply with all relevant specifications. Similarly the workmanship in every case shall be of the best character, and the whole shall be subject to the approval of the ENGINEER.

Materials whose quality and construction are not covered by the Technical Specifications shall be of equal or better quality than the relevant sample accepted by the ENGINEER'S REPRESENTATIVE.

13) *SAMPLES*

In addition to any special provisions herein for the sampling and testing of materials, the CONTRACTOR shall submit to the ENGINEER as he may require samples of all

materials and goods which he proposes to use or employ in or for the WORKS. Such samples, if approved, will be retained by the ENGINEER'S REPRESENTATIVE, and no materials or goods of which samples have been submitted shall be used on the Works unless and until such samples have been approved in writing by the ENGINEER.

The ENGINEER'S REPRESENTATIVE may reject any materials and goods which in his opinion are inferior to the samples thereof previously approved and the SUB-CONTRACTOR shall promptly remove such materials and goods from the Site.

The cost of supplying all such samples and of conveying same to such place of inspection or testing as the ENGINEER may designate within the country of origin shall be deemed to be included in the tendered rates and prices.

Samples will be retained by the ENGINEER and when directed by the ENGINEER'S REPRESENTATIVE the CONTRACTOR shall dispose of the samples. Except for those which may be incorporated into the works after approval, such as plumbing and electric fixtures.

14) TESTS GENERALLY, ACCESS TO PREMISES

The ENGINEER may examine and may require to be tested any materials or goods required in or for the WORKS such as he may decide from time to time and shall have unrestricted access to the CONTRACTOR'S, Sub-CONTRACTOR's and supplier's premises for such purpose at all times and the CONTRACTOR shall specify this requirement when placing all orders.

The ENGINEER will notify the CONTRACTOR whether materials and goods will be inspected at the manufacturer's or supplier's premises or at the Site. No materials or goods shall be dispatched from such premises until such notification is given and, if appropriate, inspection is complete and a release certificate is given to this effect. In both cases the CONTRACTOR is to notify the ENGINEER when materials and good will be ready for inspection and shall do so adequately in advance for him to make the necessary arrangement for inspection.

The CONTRACTOR shall afford the ENGINEER all facilities, assistance, labour and appliances necessary for the convenient examination, testing weighing or analysis of all such materials or goods. The CONTRACTOR shall provide and prepare such test pieces of any such materials or goods as the ENGINEER may require.

Notwithstanding any tests which may have been carried out off the Site the ENGINEER shall be empowered to order further tests of any materials or goods to be made on the Site and to reject such materials or goods should they fail to pass such test on the site.

The full cost of providing all facilities, labor, consumable stores and appliances required in connection with all testing on the Site shall be deemed to be included in the tendered rates and prices.

15) TEST CERTIFICATES

Should the ENGINEER not inspect any materials or goods at the place of manufacture, the CONTRACTOR shall, if required, obtain certificates of test from the suppliers of such materials or goods and shall send such certificates to the ENGINEER. Such certificates shall certify that the materials or goods concerned have been tested in accordance with the requirements of the Technical Specifications and shall show the results of all the tests carried out. The CONTRACTOR shall provide adequate means of identifying the materials & goods delivered to the Site with the corresponding certificates.

16) TESTING AT AN INDEPENDENT LABORATORY

Where tests are specified or directed by the ENGINEER to be carried out in an independent testing laboratory, the CONTRACTOR shall supply and deliver the samples and shall arrange for the relevant tests to be carried out. The independent testing laboratory shall be nominated by the CONTRACTOR and acceptable to the ENGINEER. Unless otherwise specified the CONTRACTOR shall arrange for one copy each of the independent testing laboratory's test certificates to be delivered to the ENGINEER and to the ENGINEER not less than 3 working days before the materials covered by the relevant test certificates are to be incorporated in the WORKS. Each test certificate shall be relatable to the materials from which the sample was taken.

17) SITE TESTING

The CONTRACTOR shall carry out such laboratory and field test (including tests to check the accuracy of testing equipment and methods but excluding tests specified to be carried out in an independent testing laboratory) as specified or as can reasonably be inferred from herein, as may be necessary to ensure and satisfy the ENGINEER that the requirements of the Technical Specifications are met. The type and frequency of testing shall be in accordance with the relevant standards except as otherwise specified herein or directed by the ENGINEER.

The CONTRACTOR`S attention is drawn to the fact that the frequencies of testing specified in the relevant clauses are intended to represent only a general guide. The ENGINEER shall be empowered to vary the frequencies at which tests are conducted should he deem this necessary for the proper control of the quality of the WORKS. Should the ENGINEER'S REPRESENTATIVE vary the frequencies stated in the relevant clauses of the Technical Specifications, the CONTRACTOR shall not be entitled to extra payments thereof.

Unless otherwise agreed or directed by the ENGINEER methods of sampling and test procedures shall be in accordance with the relevant Standard Methods of ASTM, British Standard Codes of Practice or any other relevant standard approved by the ENGINEERS. Sample will be selected by the ENGINEER'S REPRESENTATIVE.

The CONTRACTOR shall keep clear, accurate and up-to-date records of tests and immediately any test is completed shall supply two copies and summaries of the results thereof to the ENGINEER'S REPRESENTATIVE in such form as he may require. Testing equipment operations and records shall be available for inspection by the ENGINEER'S REPRESENTATIVE at all times.

18) *REMOVAL OF CONDEMNED MATERIALS*

The ENGINEER'S REPRESENTATIVE may require the CONTRACTOR to remove and dispose of any materials employed of the ENGINEER'S REPRESENTATIVE, are unsuitable or have been incorrectly deposited or have suffered damage by exposure to the weather or otherwise are not in accordance with the specified requirements for such materials. The CONTRACTOR shall be entitled to no payment whatsoever in respect of such materials.

19) *SITE OFFICE FOR THE CONTRACTOR*

The CONTRACTOR shall provide, erect and maintain in good repair, service and light a substantial weatherproof temporary site office for his site office.

When instructed by the ENGINEER, the CONTRACTOR shall remove and dispose of the building, fittings and floor and make good any damage to the site and leave it clean and tidy.

20) *SITE OFFICE AND FURNITURE, EQUIPMENT FOR ENGINEER'S REPRESENTATIVE*

The CONTRACTOR shall provide, install, maintain in good repair and on completion take away all at for the direction of the ENGINEER'S REPRESENTATIVE, the site offices as mentioned in the Sub-Contract Agreement (SC-07 and Annex. 10 Tender Documents Volume I), the furniture, equipment and fittings for the site office of the ENGINEER'S REPRESENTATIVE as desired by the ENGINEER.

The foregoing furniture, equipment and miscellaneous items shall be provided and installed by the CONTRACTOR within 15 days of the Letter of Intent from the ENGINEER.

21) *SANITARY ACCOMMODATION FOR SITE*

The CONTRACTOR shall also maintain and service a suitable sanitary accommodation facility and provide consumable stores including soap, etc.

22) *SURVEYING EQUIPMENT*

The CONTRACTOR shall provide & maintain in an accurate and serviceable condition the following new surveying equipment at Site at all times during the execution of the Works:

1 No. theodolite to read to 20 seconds complete with tripod and accessories. 1

No. reversible level complete with tripod and accessories.

1 No. 14 ft. telescopic leveling staff graduated in feet.

1 No. 100 ft. steel tapes.

1 No. 50 ft. steel tapes.

1 No. 12 Ft. flexible steel tapes.

1 No. Steel tape repair kit.

2 Nos. Plumb bobs.

The foregoing equipment shall be inspected at the Site of Works by the ENGINEER'S REPRESENTATIVE within 15 days of the receipt by the CONTRACTOR of the Letter of Intent from the ENGINEER.

In addition to the specified list of equipment, the CONTRACTOR shall also provide and renew from time to time such miscellaneous materials and equipment as might reasonably be required at the Site.

23) TRAFFIC ROUTES TO BE MAINTAINED

23.1 The CONTRACTOR shall not cause unnecessary obstruction of roads, footpaths or waterway at any time during the course of the WORKS and in no circumstances shall closure, in whole or in part, of these or any other "right of way" be permitted except with the prior permission of the ENGINEER'S REPRESENTATIVE in writing and the concurrence of the ENGINEER. All disturbances are to be negotiated with the affected community in advance.
The CONTRACTOR shall maintain adequate, through safe traffic routes for vehicles and pedestrians on public highways within and adjacent to the Site of the WORKS,

including such diversions of highways as may be required, and make arrangement for watching, signaling, and control of traffic by day and night and for adequate lighting all to the satisfaction of the ENGINEER'S REPRESENTATIVE.

All temporary diversions shall be constructed to adequate widths and maintained in good condition at all time by the CONTRACTOR to the satisfaction of the ENGINEER'S REPRESENTATIVE and on completion of the CONTRACT all such road shall be left in a condition approved by the ENGINEER. The temporary diversions shall be removed and reinstated to the satisfaction of the ENGINEER/ENGINEER when no longer required.

The CONTRACTOR shall make arrangements and co- operate with all other SUB-CONTRACTORs working in the area for directing, routing, marshalling, controlling and circulating the traffic connected with the WORKS in accordance with the ENGINEER'S REPRESENTATIVE requirements in order that the flow of all traffic may be facilitated, that all obstruction, inconvenience & delay may be minimized and that the interest of all concerned including the general public may be promoted.

The CONTRACTOR shall, before commencing work affect any public highway or right of way, submit to the ENGINEER'S REPRESENTATIVE his proposals for the control of traffic, access for residents & diversions in respect of the area in which he proposes to work. The ENGINEER'S REPRESENTATIVE will consult with the ENGINEER before giving his consent and will require the CONTRACTOR to make such amendments as are considered necessary.

The CONTRACTOR shall pay all cost and expenses, attendant upon the employment of any Police, which the Local Magistrate/Government may appoint for the preservation of peace, or the prevention of trespass and theft, or for any other purpose on or near the site of the WORKS.

24) *PROTECTION OF LIVESTOCK*

The CONTRACTOR shall be responsible for protection of livestock against damage or accidents because of the WORKS, during day and night. All gaps made in fences and hedges etc. to be closed when WORKS are not in progress and all trenches and excavations to be suitably protected.

25) *HAULAGE ROUTES*

The CONTRACTOR shall submit to the ENGINEER'S REPRESENTATIVE as soon as possible after the acceptance of the Tender and from time to time thereafter as required, proposals for the routing of traffic in connection with the execution of WORKS being the traffic of the CONTRACTOR, his CONTRACTORs and suppliers in the movement or haulage of heavy loads, construction plant, materials and spoil

(hereinafter referred to as "the construction traffic") including particulars of the public roads of the public roads which he, the CONTRACTOR, proposes to select as routes to be used by the construction traffic.

The ENGINEER'S REPRESENTATIVE will consult the ENGINEER and comment on all such proposal as may be submitted by the CONTRACTOR.

26) *SUPPORT*

The CONTRACTOR shall provide ample shoring to all poles, buildings, walls, roads, railings and structures etc., adjacent to the trenches and shall carry out the trench work in close-timbered lengths near such property at his own expense.

27) *PROTECTION MAINS, SERVICES & APPARATUS*

The information given on the Drawings relating to existing services is given for general guidance only and is not guaranteed and no responsibility & Apparatus whatsoever is accepted by the ENGINEER or the ENGINEER for the accuracy thereof. The SUB-CONTRACTOR shall refer directly to the concerned authorities for more detailed information on any of the services within the working spaces of the site.

The CONTRACTOR shall not cause or permit interference with mains, services or apparatus whether indicated on the Drawings or not & shall be responsible for their protection. He shall give notice and provide reasonable facilities in accordance with

Clause 3.31 of the CONDITIONS OF CONTRACT to the owners and/or their servants to enable them to do alterations, repairs or maintenance works if so required.

If during the course of the WORKS underground services are uncovered they shall be carefully protected and shall be immediately referred to the ENGINEER'S REPRESENTATIVE.

28) DIVERSION OF MAINS, SERVICES & APPARATUS

The CONTRACTOR shall make arrangements with the appropriate owners/authorities and pay all costs for any temporary diversions of mains, services and apparatus which may be required in carrying out the WORKS.

29) DEALING WITH WATER

The CONTRACTOR shall take al necessary measures to prevent water from the Site causing a nuisance on or in any neighboring land or property either by causing flooding or by depositing sediment on the surface of the ground or in drains or water-courses. Wherever necessary to prevent this, the CONTRACTOR shall construct temporary drainage channels, layers, sumps and traps in addition to those shown on the

Drawings discharging into existing drains, ditches or water-courses. The SUB-CONTRACTOR shall remove all sediment which may accumulate on any land or in any drains, ditches or water-courses or in any other property as a result of his operations.

All WORKS including those below subsoil standing water level shall be carried out in the dry unless specified otherwise. The CONTRACTOR'S arrangements for controlling the inflow of water into the parts of the excavation being worked and during the placing of concrete and other WORKS therein and for the collection and disposal of water shall be to the ENGINEER'S approval.

Water flowing into excavations shall be carried by trenches, drainage layers or open jointed drains to sumps from which it shall be pumped. Such trenches, drains or sumps shall generally be clear of the Works unless approved otherwise by the ENGINEER'S REPRESENTATIVE.

The CONTRACTOR shall keep all surfaces upon or against which concrete is to be deposited free from running water and no concrete shall be placed until such surfaces are properly drained. Suitable precautions shall be taken to prevent running water from washing out cement or concrete while it is setting or from injuring the WORKS in any other way.

Notwithstanding the approval by the ENGINEER'S REPRESENTATIVE of the CONTACTOR'S methods of dealing with water, the CONTRACTOR shall be responsible for and accept all the risks and liabilities of dealing with water from whatever source and of all effects thereof.

30) WORKS TO BE WATER-TIGHT

All WORKS, intended to retain or exclude water or through which water is to be passed shall be absolute water-tight, so as not only entirely to prevent loss of water from the WORKS, but also so as entirely to prevent the percolation of water into any part or parts of the WORKS.

31) NAME BOARDS / TEMPORARY SIGNAGE

The CONTRACTOR shall erect only such name boards as the ENGINEER may approve as per instructions by UAF. These must be of simple and becoming appearance. They shall display the name of the project, the CONTRACTOR, the main sub-SUB-Contractors, if any and duly approved by the ENGINEER, and such other information as the ENGINEER may direct or approve.

1. SITE CLEARANCE, CARRIAGE AND LOADING, UNLOADING

1.1. SCOPE

The clearing and grubbing shall consist of clearing the designated area of all trees, down timber, snags, bush, other vegetation, rubbish and all other material, and shall include grubbing stumps, roots, and matted roots, and disposal of all spoil material resulting from the clearing and grubbing. It shall also include the removal and disposal of structures that protrude, encroach upon, or otherwise obstruct the work, except when otherwise provided for on the plans or directed by the Engineer to be saved.

The carriage and stacking of materials shall be done as provided in the Contract Agreement. All tools and plants and means of transport shall be arranged by the SUB-Contractor. The carriage of materials includes loading unloading and stacking unless specifically provided otherwise in the Contract Agreement.

Scope of work shall include the loading into trucks from specified sites or stockpiles (or unloading as the case may be) as provided in the Contract Agreement and approved by the Engineer.

1.2. EXECUTION

1.2.1. LOCATION OF WORKS

The Engineer will define the limit of areas where clearing and grubbing is to be done. Normally it will include all land within the right of way and all other construction area including ditches, detours, minor road crossings and other areas shown on the plans or as specified or as directed by the Engineer. The Engineer will designate the fences, structures, debris, trees and bushes to be cleared where grubbing is not required. It shall not include clearing and grubbing of borrow or other pit areas from which material is secured. It shall include the leveling or removal of all bunds or mounds within the right of way unless otherwise directed by the Engineer.

All roots and stumps within the limits of the Site shall be grubbed and excavated unless otherwise specified or approved by the Engineer. Unless otherwise directed, holes from grubbing up tress, bushes and other holes from which obstructions are removed, shall be filled with suitable material and compacted in an approved manner.

1.2.2. DISPOSAL

The CONTRACTOR shall be responsible for disposal of any un-wanted material not to remain on Site within fourteen (14) days after cutting or felling unless otherwise approved. No tree trunks, stumps or other debris shall be left within Site unless approved in writing by the Engineer. The location of disposal areas shall be within or

outside the limits of the project or as approved in writing by the Engineer and shall be acquired by the CONTRACTOR at his own expense. Any useable material shall remain the property of the ENGINEER, and shall be stockpiled or stored safely by the SUB-Contractor. CONTRACTOR shall be responsible for obtaining permission from local authorities if & when required for disposal.

1.2.3. BURNING

There shall be no burning on or around the Site area whatever. The CONTRACTOR shall ensure that neither his Employees nor anyone whosoever burns anything on or within specified limits around the Site area.

1.2.4. PROTECTION AND RESTORATION

The CONTRACTOR shall prevent all damage to pipes, conduits, wires, cables or structures above or below ground. No land monuments, property markers, or official datum points shall be damaged or removed until the Engineer has witnessed or otherwise referred their location and approved their removal. The CONTRACTOR shall so control his operations as to prevent damage to trees and shrubs, which are to be preserved. Protection may include fences and boards lashed to trees to prevent damage from machine operations. The existing covered or open benchmarks should be relocated as directed by the Engineer. In the event that anything specified herein to be saved and protected is damaged by the CONTRACTOR; such damages shall immediately be repaired or replaced by the CONTRACTOR at his own cost to the satisfaction of the Engineer. All areas cleared and grubbed must be approved by the Engineer or Engineer's Representative before the start of cleaning operations.

The CONTRACTOR undertaking carriage of material shall be responsible for its safe loading, carriage, unloading, and delivery to the specified site within the specified time and stacking.

Depending upon the feasibility and economy, the CONTRACTOR shall propose the mode of carriage viz. whether by mechanical or animal transport and shall be as approved by the Engineer in accordance with corresponding item as provided in Contract Agreement.

1.2.5. REQUIREMENTS

1.2.5.1 The CONTRACTOR shall furnish, install, operate and maintain all necessary facilities for loading/unloading trucks.

1.2.5.2 The CONTRACTOR shall perform all loading/unloading operations in a systematic manner without breakages or segregation as determined by the Engineer. The CONTRACTOR shall load trucks in which materials are to be transported in such a

manner as to avoid loss in transit and shall be responsible for and make good any loss of materials lost in transit due to improper loading of mobile trucks and other handing operations. The materials carted shall be properly stacked as specified or directed by the Engineer.

2. DISMANTLING WORKS

2.1 SCOPE

The work covered by this section of the specifications pertains to the demolition and dismantling of the existing retaining walls and existing buildings. Foot prints of old buildings, Floors and stone masonry walls below plinth level and consists of furnishing all plant, labor, tools, equipment, appliances and performing all operations as required herein drawings and / or as directed by the Engineer at the proposed site.

2.2 EXECUTION AND MEASURES

The Demolition and Dismantling work of existing structures shall not proceed until the CONTRACTOR makes submittals and gets approved by the Engineer, the methodology of demolition and dismantling works and drawings of temporary shoring / lateral soil retaining system. Shoring shall be such as to protect workmen, adjacent paving, structures and utilities.

Demolitions and dismantling shall be performed in an orderly manner and the SUB-Contractor shall take all necessary precautions and expedients to prevent damages to the adjacent structures otherwise he will be responsible for the damages. Any existing utility lines which are not known to the CONTRACTOR in sufficient time to avoid damage, if inadvertently damaged during demolition, shall be repaired by the Contractor and adjustment in payment will be made as approved by the Engineer.

Explosives shall be used only to blast / excavate bedrock from the site and for no other work. The contractor is required to make a detailed submittal regarding rock blasting / excavation for review and approval by Engineer.

Seismic monitoring during blasting shall be done by the CONTRACTOR to avoid damage to adjoining and other nearby structures. A Pre-construction survey of adjoining structures must be carried out to evaluate their existing condition in order to protect the structures and disputes arising there from.

Where approval has been given to the CONTRACTOR for carrying out demolition operations at night or in places where day light is excluded, the CONTRACTOR shall provide adequate lighting at all points of demolition and transportation.

3. EARTHWORK

3.1. SCOPE

The work under this section of the specification consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with earthwork of all underground services and structural units, roads and temporary drainage, stock piling of suitable excavated material, disposal of unsuitable and surplus excavated material in accordance with this section of specifications, the applicable drawings and subject to terms and conditions of the Contract.

3.2. SUBMITTALS

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

a. Record of existing Site levels
b. Record of levels after completion of Site leveling and stripping
c. Record of existing trees

3.3. EXECUTION

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

All excavations, cuts and fills shall be constructed to the lines, levels, slopes and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Defects Liability Period the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Defects Liability Period any damage or defects in cuts and fills, in structures and other works or rolling of stones/boulders caused by blasting or otherwise, slips, falls of wash-ins or any other ground movement due to the CONTRACTOR's negligence shall be made good by the CONTRACTOR at his own cost.

3.3.1. EXCAVATION SUPPORT

3.3.1.1. Prior to Commencing any structural excavation work which is 5 feet or greater in depth the CONTRACTOR shall design an excavation support system.

3.3.1.2. Details of the excavation support system shall be submitted to the Engineer for review and approval at least one week before any excavation work commence. Details of the excavation support system shall be complete with, but not limited to the following:-

a. Drawings of the structural support members showing materials, sizes and spacing
b. Calculations showing the maximum theoretical deflection of the support member.

3.3.1.3. The CONTRACTOR shall make a detailed inspection of all adjoining structures and prepare a report on the pre-construction condition of all structures that may be affected during construction of the Works. The report will include photographs, drawings and sketches with levels and dimensions fully illustration the structure’s condition. In particular, it shall note any existing damage or structural inadequacy. Deficiencies and

damage are to suitably mark on the structure in a way that is not permanently defaced. This report shall be submitting along with excavation support system.

3.3.1.4. The system is to be designed so that no members extend through surfaces exposed in the finished construction, and no shoring or bracing is placed under permanent structures.

3.3.1.5. The CONTRACTOR shall submit to the engineer calculations of lateral earth pressure for the full excavation depths, surcharge loads of any description, equipment loads, and forces at various stages of support during excavation, the maximum design loads to be carried by various members of the support system and strut pre-load forces.

3.3.1.6. If the structure support system proposed includes tieback anchors, the CONTRACTOR's submitted details shall include drawings that show the profile of the soil in which each anchor is to be installed.

3.3.2. SITE PREPARATION

3.3.2.1. The CONTRACTOR shall set out the work 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 shall appear during the progress of the work, the CONTRACTOR shall at his own expense rectify such error, to the satisfaction of the Engineer/Engineer's Representative.

3.3.2.2. The CONTRACTOR shall construct and maintain accurate bench marks so that the Lines and Levels can be easily checked by the Engineer/Engineer's representative throughout the construction period.

3.4. EXCAVATIONS

3.4.1. Excavation shall include the removal of all material of every name and nature.

3.4.2. The major portion of excavations shall be carried out by mechanical excavators and excavated materials disposed off to stock on spoil as directed by the Engineer. The excavation may be done by normal means. Unless otherwise specified by the Engineer, leveling, trimming and finishing to the required levels and dimensions shall be done manually. The material suitable for fill and backfill if approved by the Engineer shall be stockpiled within the limits of whole of the Project Site at locations designated and approved by the Engineer.

3.4.3. Excavated material unsuitable for use as fill and backfill shall be disposed off by the CONTRACTOR at locations designated and approved by the Engineer outside the Project Site. CONTRACTOR shall be responsible for obtaining permission from local authorities if & when required for disposal.

3.4.4. The CONTRACTOR shall give reasonable notice that he intends to commence any excavation and shall submit to the Engineer full details of his proposals. The Engineer's approval shall not relieve the CONTRACTOR of his responsibility with respect to such work.

3.4.5. The CONTRACTOR shall preserve the completed excavation from damage due to slips and earth movements, ingress of water from any source whatsoever and deterioration by exposure to the sun and the effects of the weather. SUB-Contractor will install / fix safety barrier around the excavated pits and ditches to avoid any accident.

3.4.6. All excavations shall be kept free of water and shall be maintained dry to the satisfaction of the Engineer. Prevent surface water and sub-surface water from flowing into the excavation and flooding the project site and surroundings.

3.4.7. The CONTRACTOR shall not allow water to accumulate in excavations and shall remove water from excavations to prevent softening of foundation bottoms, under cutting footings and soil changes detrimental to the stability of sub-grades

and foundations. Provide discharge lines necessary to convey the water away from the excavations. Convey water, removed from excavation and rain water, to outside the limits in manner that no damages are caused to the surrounding services properties.

3.4.8. In blasting rock slopes, reasonably uniform faces shall be left, regardless of whether or not the excavation is carried beyond the specified slope. Any over breakage below the depth will not be paid for.

3.4.9. Excavation for pits, cable trenches, equipment-foundations and other structures shall be taken out to the levels and dimensions shown on Drawings or such other levels and dimensions as the Engineer may direct.

3.4.10. Excavation shall extend to adequate distance from walls and footings to allow for placing and removal of forms, installations of services and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces. Undercutting will not be permitted. The additional excavation for placing and removal of forms, installation of services, for inspection and generally for working area on slopes for stability shall not be measured for payment and shall be deemed to be included in the rates for excavation as measured net.

3.4.11. All excavations in foundations shall be taken to 6 inch above the final excavation elevations shown on the drawings and the last 6-inch 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 the drawings. All excavations for foundations which have been trimmed and disturbed shall be compacted.

3.4.12. No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the Engineer and his permission to proceed is given.

3.4.13. If excavation for sub-structures is carried below the required level, as shown on the Drawings or as directed by the Engineer, the surplus depth shall be filled in with concrete of same grade as of blinding concrete at the sole cost of the SUB-Contractor.

3.4.14. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry condition.

3.4.15. Shoring, where required during excavation, shall be installed to protect workmen and the bank, 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 the Engineer, for upholding the sides of excavation and also for planking and strutting to excavation against the side of roadways and adjoining properties in existing hardcore of any other material. The SUB-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.

3.4.16. Existing utility lines that are shown on the drawings or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, as well as utility lines constructed during excavation and backfilling, and if damaged, shall be re-done by the CONTRACTOR at his own cost. Any existing utility lines which are not known to the CONTRACTOR in sufficient

time to avoid damage, if inadvertently damaged during excavation, shall be re-done by the CONTRACTOR at this own cost as approved by the Engineer. 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.

3.4.17. Before starting the excavation for pipelines, the CONTRACTOR shall ensure the correct alignment of the pipeline on the ground the depth and width of excavation of the trench, all in accordance with the Drawings and instructions of the Engineer. The CONTRACTOR shall make profile with cement concrete pillars.

3.4.18. Excavation shall be carried out true to lines, levels, grades and widths as shown on the drawings or as directed by the Engineer ensuring proper laying of the pipe line, the bedding fill, construction of chambers for appurtenances and any other structures. The trench bottom shall be graded to provide even and substantial bearing over the specified bedding and of the structure.

3.4.19. Without the written permission of the Engineer, not more than 600 feet of the trench shall be opened in advance of the completed pipeline.

3.4.20. The Engineer may require the CONTRACTOR to excavate below the elevations shown on the drawings or may order him to stop above the elevations shown depending upon the suitable foundation material encountered.

3.4.21. If for any reason, the levels, grades or profiles of the excavations are changed adversely by the CONTRACTOR, the CONTRACTOR shall at his own cost, be liable to bring the excavations to the required levels and profiles as shown on the drawings or as directed by the Engineer.

3.5. BARRICADES, WARNING LIGHTS, SIGNS

All excavations made hereunder shall be properly maintained while they are open and exposed. Sufficient suitable barricades, warning lights, signs and similar items shall be provided by the CONTRACTOR. The CONTRACTOR shall be responsible for any personnel injury or property damage due to his negligence.

3.6. QUALITY ASSURANCE (EXCAVATION)

All slopes, lines and grades shall be true, correct and accurate to those shown in the plans or otherwise directed and approved by the Engineer. The sub-grade in cuts shall be accurate to the authorized profile grade for the sub-grade to + one inch (1”). Where discrepancies are found in the work the CONTRACTOR shall make the necessary corrections.

3.7. SAFETY MEASURES

Special measures shall be taken to handle dust / dirt control. During construction phase the ENGINEER may order, in writing, any or all shoring, sheeting and piling to be left in place for safety reasons, whether such sheeting was shown on drawings or not. If left in place, such sheeting shall be cut-off at the elevation approved by the ENGINEER, and shall be driven tight and its cost shall be considered included in the tendered rates.

3.8. FILL AND BACKFILL

3.8.1. The backfilling shall include filling under the floors, around the foundation trenches, pipes, conduits, ducts and channels.

3.8.2. The backfilling shall include loading, unloading, transporting, placing, stacking, spreading of earth, watering, rolling, ramming and compacting, etc., complete as specified herein.

3.8.3. Backfill shall be either using granular backfill material or common backfill as directed and approved by the Engineer. Granular backfill materials shall meet the following requirements.

Grading Requirements

Mm	Inch	A	B
25	1”	100	100
19	3/4"	60 – 100	75 – 100
4.75	No. 4	50 – 85	55 – 100
2.0	No. 10	40 – 70	40 – 100
0.425	No. 40	25 – 45	20 – 50
0.075	No. 200	0 – 15	5 – 15

3.8.4. Material satisfying the requirements of coarse sand falling under soil classification A–3 (AASHTO). In case coarse sand is utilized for granular fill it shall be ensured that the same is confined properly with approved material.

3.8.5. The material shall have a plasticity index of not more than six (6) as determined by AASHTO T – 89 and T – 90.

3.8.6. The excavated material if found suitable shall be stockpiled within the free haulage limit of the Project Boundary. This material shall be used for filling/back-filling if approved by the Engineer and shall be transported by the SUB-Contractor anywhere required for the purpose of filling/back-filling work in this Contract.

3.8.7. The CONTRACTOR shall provide the approved quality of backfill and fill material required to complete the fill and back- filling work from the places as designated by the Engineer.

3.8.8. Deep filling shall be predominantly granular material and free from slurry mud, organic or other unsuitable material and capable of compaction by ordinary means.

3.8.9. Material for backfilling shall be as approved by the Engineer and shall be placed in layers not exceeding six (06) inches measured as compacted material with optimum water and compacted to produce in-situ density shall not be less than 95% of the maximum dry density at optimum moisture content.

3.8.10. Depending on the depth of fill the Engineer may instruct increased thickness of successive layers to be placed.

3.8.11. The filling shall be compacted by mechanical means as approved by the Engineer.

3.8.12. Filling around pipes and cables shall be carefully placed with fine material to cover the pipe or cable completely before the normal fill is placed.

3.8.13. Backfilling of trenches/foundations shall be carried out only after the pipe line/structural works within the excavations have been inspected, tested and approved by the Engineer.

3.8.14. Fill shall not be placed against foundation walls prior to approval by the Engineer. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the top of footing.

3.8.15. Before the start of fill and backfill, the CONTRACTOR shall satisfy himself as to the levels and slopes of the fills and backfill shown on the Drawings, the requirements of compaction, the possibility of settlement & all other particulars whatsoever in connection with the filling works.

3.8.16. All filled areas shall be left neat, smooth and well compacted, the top surface consisting of the normal site surface soil, unless otherwise directed.

3.9. QUALITY ASSURANCE (BACKFILLING)

The stabilization of compacted backfill/fill surface shall be smooth and even and shall not vary more than 3/8 inch in 10 feet from true profile and shall not be more than 1/2 inch from true elevation.

3.10. DISPOSAL OF SURPLUS EXCAVATED MATERIAL

3.10.1. The rejected unsuitable material and surplus excavated material shall be disposed off outside the site and/ or as directed by the Engineer. No compensation of any lead/lift is admissible. The surplus excavated material shall be so placed that it

will present a neat appearance and not offer any danger to abutting properties.

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

3.10.3. The disposal of surplus/unsuitable excavated material shall include loading, unloading, transporting, stacking, spreading and leveling as directed by the Engineer.

3.11. WATERING FOR DUST CONTROL

3.11.1 Provide an adequate water supply and apply water needed at all hours (including nights, weekends, and periods of non-work) as necessary to control dust. Uniformly apply water using pressure-type distributors, pipelines equipped with spray systems, or hoses with nozzles.

3.11.2 Project dust control for public benefit. Control dust within the construction limits at all hours when the project is open to public traffic. When the project is not open to public traffic, control dust in areas of the project which neighbor inhabited residences or places of business. Control dust on approved, active detours established for the project. Apply water at the locations, rates, and frequencies ordered by the Engineer In-charge.

3.11.3 Control dust on active haul roads, in pits and staging areas, and on the project during all periods not covered in above.

3.11.4 The dust control must be completely in accordance with the approved EMMP Report as attached in the Tender Documents Volume-I “Exhibit M”.

4. TERMITE CONTROL TREATMENT

4.1. SCOPE

The scope of work for anti-termite treatment includes injection of insecticide in sides and bottom of foundation trenches, spraying on stockpiled backfill material and injections of the insecticide in floor sub-grade of the building. The insecticide used for anti-termite treatment should be from the approved list given in the UAF. The scope also covers treatment of all wood works with insecticides before installation in position.

4.2. APPLICABLE STANDARDS

All methods of termite protection used herein shall be in accordance with the standard practices as per manufacturers guide lines / recommendations. The anti-termite treatment should be executed in accordance with the approved EMMP Report.

4.3. SUBMITTALS

The CONTRACTOR shall supply samples of all the materials to be used for insecticide control for approval of the Engineer and testing in accordance with the specified standards. Rejected materials shall be removed from the site immediately.

4.4. QUALITY ASSURANCE

In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for the work, including preparation of substrata and application. A professional operator shall be engaged who shall have license in accordance with regulations of governing environmental authorities for application of soil treatment solution.

4.5. DELIVERY AND STORAGE

Store in closed original containers, in a cool, well ventilated area away from human being, food and feed stuffs. Do not store for prolonged periods in direct sunlight. In case of spillage, confine and absorb spilled product with absorbent material such as sand, clay or cat litter. Material should be stored at site as per manufacturer’s instructions. Do NOT allow spilled product to enter sewers, drains, creeks or any other waterways.

4.6. PROJECT CONDITIONS

Insecticide solution should not be applied during wet weather, or when the earth surface is excessively wet. Application should be made to all areas beneath concrete slabs-on-grade, including sidewalks and paving abutting buildings for distance of at least 6 feet beyond building line. Solution shall be applied in amounts of not less than 5 lit./ Sq.M or 5 lit./10.76

Sq.ft. of area. If applied over gravel or sand fill, application shall not be less than 7 lit./ Sq.M or 7 lit./10.76 Sq.ft. of area. Insecticide shall penetrate to a depth of 1-inch minimum in porous earth at bottom and 2 inch to 3 inch at sides of excavations.

4.7. MATERIAL/PRODUCT

An emulsible concentrate insecticide shall be used for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent. Provide a working solution of the following chemical elements and concentrations:

- **AGENDA** 25 EC Containing FIPRONIL
- **MIRAGE** 5% SC IMIDACLOPRID

All mixing shall be done at site and mixing proportion of insecticide with water shall be in accordance with the approved manufacturer's recommendations and shall be verified by the Engineer. The insecticide used for anti-termite treatment should be from the approved list given in the UAF. Pure turpentine shall be used for dilution of insecticide, in approved proportion for application to woodwork.

4.8. EXECUTION /APPLICATION

4.8.1 Insecticide solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150 psi to all applications to, on or in earth. Soil treatment shall begin after all work of preparation of earth prior to installation of concrete has been done. After application, no additional earth moving or work upon sub grade should be done. No covering of earth or concrete should be applied over soil treatment until at least 24 hours after treatment has been made.

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

4.8.3 In the areas of application signs shall be fixed to show that soil treatment has been applied. Such signs shall be removed when areas are covered by other construction. Care shall be exercised to insure that no marks or damage occurs to the finished structure as a result of the work under this section.

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

4.9. GUARANTEE

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

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

5. FORMWORK

5.1. SCOPE

This section of the Specification covers formwork and false work including removal and disposal thereof, for concrete work.

5.2. DEFINITIONS

"Formwork" means the surface against which concrete is placed to form a face, together with all the immediate supports to retain it in position while concrete is placed.

"False work" means the structural elements supporting both the formwork and the concrete until the concrete becomes self-supporting.

A "formed face" is one which has been cast against formwork.

An "exposed face" is one which will remain visible when construction has been completed.

5.3. SUBMITTALS

Before construction begins, submit to the Engineer drawings showing details of the proposed formwork and false-work if so required by the Engineer.

5.4. CONSTRUCTION OF FORMWORK AND FALSE WORK

5.4.1. Construct formwork and false work such that they will support the loads imposed on them by the fresh concrete together with additional stresses imposed by vibrating equipment and by construction traffic, so that after the concrete has hardened the formed faces shall be in the positions shown on the drawings within the tolerances set out hereinafter. No wooden props are allowed to be placed under from work. Only steel pipes are permitted.

5.4.2. Properly found ground supports on footings designed to prevent settlement. Do not found supports on frozen ground unless the Engineer has agreed to it.

5.4.3. Unless otherwise specified, evenly space horizontal and vertical joints in formwork for exposed faces; joints shall be continuous or form a regular patternas approved by Engineer.

5.4.4. Make all joints, in formwork including formwork for construction joints, tight against the escape of cement and fines. Where reinforcement projects through formwork, fit the form closely around the bars.

5.4.5. Design the formwork so that it may be easily removed from the work without damage to the faces of the concrete. Also incorporate provisions for making minor adjustments in position, if required, to ensure the correct location of concrete faces. Make due allowance in the position of all formwork for movement and settlement under the weight of fresh concrete.

5.4.6. Where overhangs in formwork occur, provide means to permit the escape of air and ensure that the space is filled completely with fully compacted concrete.

5.4.7. Provide formwork on both faces for concrete surfaces at slopes of 30 to the horizontal or steeper. Surface at slopes less than 20 may be formed by screeding. Surface at slopes between 20 and 30 shall generally be formed unless the SUB-Contractor can demonstrate to the satisfaction of the Engineer that such slopes can be screeded with the use of special screed boards to hold the concrete in place during vibration.

5.4.8. Adequately secure horizontal or inclined formwork, to the upper surface of concrete, against uplift due to the pressure of fresh concrete. Also tie down formwork to voids within the body of the concrete or otherwise secure against floating.

5.4.9. At the internal and external angles on concrete surfaces, provide forms with fillets and chamfers of the sizes shown on the drawings or of 2Omm x 2Omm if not shown on drawings.

5.4.10. Supports for formwork may be bolted to previously placed concrete provided the type of bolt used is acceptable to the Engineer. If metal ties through the concrete are used in conjunction with bolts, do not leave the metal closer than 5Omm to the face of the concrete.

5.4.11. Do not re-use formwork after it has suffered damage which is sufficient to impair the finished surfaces of the concrete.

5.4.12. Where circumstances prevent easy access within the form for cleaning and inspection, provide temporary openings for this purpose through the formwork.

5.4.13. Provide shear keys in all construction joints of the size and shape indicated on the drawings or as approved by the Engineer.

5.4.14. Where precast concrete elements are specified for use as permanent formwork or proposed by the CONTRACTOR and agreed by the Engineer, set such elements true to line and level within the tolerances.

5.5. PREPARATION OF FORMWORK

5.5.1. Before any reinforcement is placed into position within formwork, thoroughly clean the formwork and then dress with approved release agent. The agent shall be either suitable oil incorporating a wetting agent, an emulsion of water suspended in oil or low viscosity oil containing chemical agents. 'Do not use an emulsion of oil suspended in water nor any release agent which causes staining or discoloration of the concrete, air holes on the concrete surface, or retards the set of the concrete.

5.5.2. In order to avoid color differences on adjacent concrete surface, use only one type of release agent in anyone section of the Works.

5.5.3. In case where it is necessary to fix reinforcement before placing formwork, carry out all surface preparation of formwork before it is placed into position. Do not allow reinforcement or prestressing tendons to be contaminated with formwork release agent.

5.5.4. Before placing concrete remove all dirt, construction debris and other foreign matter completely from within the placing area.

5.5.5. Before concrete; placing commences, secure all wedges and other adjusting devices against movement during concrete placing and maintain a watch on the formwork during placing to ensure that no movement occurs.

5.6. REMOVAL OF FORMWORK

5.6.1. Carefully remove formwork without shock or disturbance to the concrete. Do not remove formwork until the concrete has gained sufficient strength to withstand safely any stresses to which it may thereby be subjected.

5.6.2. Allow the minimum periods to elapse between completion of placing concrete and removal of forms as given below, which apply to ambient temperatures higher than 10 C. At lower temperatures or if cement other than ordinary Portland is involved, the Engineer may instruct longer period.

Vertical formwork to columns, wall and beams	48 hours
Soffit formwork to slabs	15 days

Props to slabs	15 days
Soffit formwork to beams	15 days
Props to beams	15 days

Tolerances shall be as considered reasonable by the Engineer.

5.6.3. Alternatively, remove formwork when the concrete has attained the desired strength, provided that the attained strength is determined by making test cylinders and curing them under the same conditions as the concrete to which they refer.

5.6.4. Compliance with these requirements shall not relieve the CONTRACTOR of his obligation to delay removal of formwork until the removal can be completed without damage to the concrete.

5.6.5. If the CONTRACTOR wishes to strip formwork from the underside of arches beams and slabs before the expiry of the period for supports set out above, it shall be designed so that it can be removed without disturbing the supports Do not remove supports temporarily for the purpose of stripping formwork to subsequently replace them.

5.6.6. As soon as the formwork has been removed, completely fill bolt holes in concrete faces other than construction joints which are not required for subsequent operations, with mortar sufficiently dry to prevent any slumping at the face. Mix the mortar in the same proportions as the fine aggregate and cement in the surrounding concrete and with the same materials and finish flush with the face of the concrete.

5.7. SURFACE FINISHES FOR FORMED SURFACES

5.7.1 Classes of Finish for Formed Surface:

The surface finish to be achieved on formed concrete surfaces shall be as defined hereunder:

5.7.1.1 Class F1 Finish

This finish is for surfaces against which backfill or further concrete will be placed. Formwork may be sawn boards, sheet metal or any other suitable material which will prevent the loss of fine material from the concrete being placed.

5.7.1.2 Class F2 Finish

This finish is for surfaces which are permanently exposed to view but where the highest standard of finish is not required. Forms to provide a Class F2 finish shall be faced with wrought thicknesses tongued and grooved boards with square edges arranged in a uniform pattern and close jointed or with suitable sheet material. The thickness of boards or sheets shall be such that there shall be no visible deflection under the pressure exerted by the concrete placed against them. Joints between boards or panels shall be horizontal and vertical unless otherwise directed. This finish shall be such as to require no general filling of surface pitting, but fins, surface discoloration and other minor defects shall be remedied by methods agreed by the Engineer.

5.7.1.3 Class F3 Finish

This finish is for surfaces which will be in contact with water flowing at high velocity, and for surfaces prominently exposed to view where good appearance is of special importance. To achieve this finish, which shall be free of boards marks, the formwork shall be faced with plywood complying with BS 1088: 1966 with amendments 1 &2 or equivalent material in large sheets. The sheets shall be arranged in an approved uniform pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features or changes in direction of the surface. All joints between panels shall be vertical and horizontal unless otherwise directed. Suitable joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets. Unfazed wrought boarding or standard steel panels will not be permitted for Class F3 finish. Ensure that the surface is protected from rust marks, spillages and stains of all kinds.

5.7.1.4 Class F4 Finish

This finish is similar to that required for F3 but is used in places where a first class alignment and a dense surface free from air holes and other defects is required, suitable for the application of decorative finishes, in very high velocity water channels and in other similar circumstances.

The CONTRACTOR's attention is drawn to the fact that this finish requires careful selection of materials and the highest quality of workmanship and supervision at all stages.

5.7.2 Curved Surface

For curved surface where F2, F3 or F4 finishes are called for, the formwork face shall be built up of splices cut to make a tight surface which shall then be dressed to produce the required finish.

Alternatively, single curvature surfaces may be faced with plastic or plywood linings attached to the backing with adhesive or with escutcheon pins driven flush. Linings shall not bulge, wrinkle or otherwise deform when subjected to temperature and moisture changes.

5.7.3 Tolerances

All parts of formed concrete surfaces shall be in the position shown on the Drawings within the tolerances set out in Table.

In cases where the Drawings call for tolerances other than those given in Table the Drawings shall rule.

Where precast units have been set to a specified tolerance, make further adjustments as necessary to produce a satisfactory straight or curved line. When the Engineer has approved the alignment, fix the units so that there is no possibility of further movement.

Note-1:

The tolerance A, B and C given in the table are defined as follows:

Class of Finish	**Tolerances in mm (See Not 1)**		
	A	**B**	**C**
F1	10	10	+25 – 10
F2	05	10	+ or – 15
F3	02	05	+ or – 10
F4	Nil	02	+ or - 10

"A" is an abrupt irregularity in the surface due to misaligned formwork or defects in the face of the formwork.

"B" is a gradual deviation from a plane surface as indicated by a straightedge 3 m long. In the case of curved surface the straightedge shall be replaced by a correctly shaped template.

"C" is the amount by which the whole or part of a concrete face is displaced from the correct position shown on the Drawings.

Note-2:

Abrupt irregularities are not permitted in an F4 finish. Any residual irregularities which remain after removal of formwork shall be removed by grinding to achieve a transition of 1 in 50 between the surface adjacent to irregularity.

5.7.4 Remedial work to defective surfaces

If on stripping any formwork the concrete surface is found to be defective in any way, make no attempt to remedy such defects prior to the Engineer's inspection and the receipt of any instructions which the Engineer may give.

Defective surfaces shall not be made good by plastering. Cut back area of honeycombing, which the Engineer agrees may be repaired, to sound concrete or to 75 mm whichever is the greater distance. In the case of reinforced concrete, cut the area back to at least 25 mm clear distance behind the reinforcement or to 75 mm, whichever is the greater distance. The cavity shall have sides at right angles to the face of the concrete. After cleaning out with water and compressed air, apply bonding agent with brush, brush on a thin layer of bonding agent to the concrete surfaces in the cavity and then fill immediately with concrete of the same class as the main body but with aggregate larger than 20mm nominal size removed. Use a form against the cavity, provide with lip to enable concrete to be placed. Fill the form to a point above the top edge of the cavity.

After seven days, break off the lip of concrete, and grind the surface smooth.

Grind down the surface irregularities, which are outside the limits of tolerance set out in sub-clause (c) above, in the manner and to the extent instructed by the Engineer.

Deal with defects, other than those mentioned above, as instructed by the Engineer.

5.8. SURFACE FINISHES FOR UNFORMED SURFACE

5.8.1. Classes of finishes

5.8.1.1. Class U1 (Rough finish)

Pour the concrete to required elevation and top surface screeded true, even and level in both directions with a straight edge, after compacting, using a sawing motion. After the concrete has hardened sufficiently, float the surface by hand or machine to a uniform surface free from screed marks. Then sufficiently roughen floated surface with broom or stiff steel wire brushes. Class Ul finish shall be provided to all surfaces which will subsequently receive further flooring or plastering etc.

5.8.1.2. Class U2 (Smooth Finish)

After the surface has been floated as in Class Ul finish and when the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, steel trowel the surface under firm pressure to produce a dense, smooth uniform surface free from trowel marks in three operations; firstly to equalize surfaces as an initial finish, then secondly as a semi-final finish and allow to stand until trowel rings under impact with cement surface, and finally burnish with steel trowel to a smooth hard, un- blemished surface. In no instance use any dry cement or admixture of any kind (unless approved) during toweling process. Class U2 finish shall be provided where smooth finish is required.

5.8.2. Tolerances for sizes, levels alignment etc.

The CONTRACTOR shall be responsible for setting and maintaining concrete forms sufficiently within the tolerance limits so as to ensure completed work within the tolerances specified herein. Concrete work that exceeds the tolerance limits specified herein shall be remedied or removed and replaced at the expense of and by the CONTRACTOR. The tolerances are not cumulative.

6. REINFORCEMENT

6.1. SCOPE

The work under this section of specifications consists of furnishing, cutting, fabricating, bending and placing steel reinforcement and Welded wire fabric in any floor and at any height in concrete structures or elsewhere as shown on the drawings or as directed by the Engineer.

6.2. APPLICABLE STANDARDS

Latest editions of the following ASTM Standards are relevant to these specifications wherever applicable.

ASTM Standard

A 305	Minimum requirement for the deformations of deformed steel bars for concrete reinforcement.
A 615	Deformed billet steel bars for concrete reinforcement.
A 185	Welded steel wire fabric for concrete reinforcement.

All reinforcement shall be deformed hot rolled billet steel bars conforming to ASTM A-615M Grade 60 with specified Yield Strength neither less than 60,000 psi nor more than 78,000 psi and ratio of Ultimate Strength to yield Strength not less than 1.25. Bars shall be mild steel deformed bars Grade 40 with a minimum Yield Strength of 40,000 psi where required as per drawings.

6.3. SUBMITTALS

Reinforcement shall be obtained only from manufacturers approved list / Engineer. Each consignment of reinforcement steel shall be accompanied by the manufacturer's certificate or shall refer to a previous certificate, if the consignment is from the same batch, showing that the reinforcement steel complies with the specified requirement. If such certificate is not made available or if the Engineer considers that the manufacturer's tests are inadequate, test samples shall be taken for acceptance test from different consignments as the Engineer may direct and shall be tested at the SUB- Contractor's cost. Should the result of such tests show that the sample does not meet with the specifications the whole consignment shall be rejected and removed from the site at the CONTRACTOR's cost.

Submit (i) samples in triplicate, of each bar dia., from each consignment brought at Site,

(ii) samples of binding wire, (iii) test results, and (iv) samples of spacer blocks & steel chairs.

6.4. BAR BENDING SCHEDULES

The CONTRACTOR shall prepare bar bending schedules of all the reinforcing steel bars and these bar bending schedules shall be submitted to the Engineer for his approval.

All detailing shall be done as per ACI, standards ACI-315 & 318. The CONTRACTOR shall obtain approval of the bar bending schedules before starting actual bar bending works.

6.5. QUALITY ASSURANCE

Get the samples of bars (and wire if required by Engineer) tested at a Laboratory approved by the Engineer, and use in Works only the materials conforming to the Specification.

6.6. MATERIAL AND SIZE OF BARS

Reinforcement for concrete shall conform to the respective ASTM A615M Standards as specified in the Drawings / specified by the Engineer.

Standard weights of reinforcement bars shall be as tabulated below.

Bar Dia.	¼"	3/8"	½"	5/8"	¾"	7/8"	1"	1-¼"
	6mm	10mm	13mm	16mm	19mm	22mm	25mm	32mm
Wt. Lbs per ft	0.167	0.376	0.668	1.043	1.502	2.044	2.670	4.303
Wt. Kg per meter	0.249	0.560	0.994	1.552	2.235	3.041	3.973	6.403
Wt. Kg per rft	0.076	0.1706	0.303	0.473	0.681	0.927	1.211	1.952

6.7. DELIVERY AND STORAGE

6.7.1. DELIVERY

Steel reinforcement bars shall be kept in bundles firmly secured and tagged. Each bar or bundle of bars shall be identified by marks stamped on hot or cold or painted on or by any other means. The identifying marks shall contain the following information:

- Name of the producer or his trade.
- Standard to which the bars have been manufactured.
- The class type and strength.
- The diameter.
- The number of the test certificate.

6.7.2. STORAGE

The method of storage shall be approved by the Engineer. Reinforcing bars shall be stored in racks or platforms above the surface of ground and shall be protected free from scaling, pitting, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works. Bars of different diameters and grades of steel reinforcement shall be kept separately. CONTRACTOR will construct working platform where the cutting, bending process will be done.

6.8. EXECUTION / FABRICATING, BENDING & PLACING

6.8.1. Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the bar-bending schedule approved by the Engineer.

The cutting tolerance for all bars shall be + 1 inch.

6.8.2. Where an overall or an internal dimension of a bent bar is specified in the schedule, the bending tolerance, unless otherwise stated, shall be as follows:

- Splice length & Bent length as per drawings

6.8.3. Reinforcement shall not be bent or straightened in a manner that will damage the material.

6.8.4. No bars shall be bent twice in the same place, nor shall they be straightened after bending.

6.8.5. Unless permitted by the Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete.

6.8.6. Bars which depend for their strength on cold working shall not be heated for anyreason Welding shall be permitted for bars only under suitable conditions and withsuitable safeguards in accordance with BS 693, BS 1856, or AWS D12.1, provided

the type of reinforcing bar has the required welding properties. Tack welding may be used to fix in position bars that cross each other, only with prior approval of the Engineer. Welding shall be done as in lectum structural steel & metal works.

6.8.7. No splice of reinforcement shall be made except as shown on the working drawings.

6.8.8. Reinforcement is to be accurately placed as shown in the drawings, and secured against displacement by using 18-20 gauge 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 1 part of cement to 2 parts of sand & properly cured for a period of Seven days to achieve required strength.

6.8.9. 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.

6.8.10. Concrete clear cover for reinforcing steel shall be as follows:-

Structural Members		Minimum Cover (inches)
a.	Concrete cast against and Permanently exposed to earth	3
b.	Concrete exposed to earth or weather:	
	For reinforcing bars # 6 or larger	2
	For reinforcing bars less than # 6	1-1/2
c.	Concrete not exposed to weather or in contact with ground:	
	Slabs, Walls	3/4
	Beams, Columns (Primary Reinforcement)	1-1/2

6.8.11. Bars shall be placed to the following tolerances:-

a.	Concrete cover to formed surfaces	± 1/4 inch
b.	Minimum spacing between bars	- 1/4 inch
c.	Top bars in slabs and beams	
	i. Members 8 inch deep or less	± 1/4 inch
	ii. Members more than 8 inch but not over 2 feet deep	± 1/2 inch
	iii. Members more than 2 feet deep	± 1 inch
d.	Crosswise of members: spaced evenly within	2 inch
e.	Lengthwise of members	± 2 inch

6.8.12. 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, the resulting arrangement of bars shall be subject to approval of Engineer.

6.8.13. Vertical bars in columns shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all column dowels.

6.8.14. 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 where the exposed part is to be built into later concrete.

6.8.15. All reinforcement, at the time concrete is placed, shall be free of loose mile scale, loose rust mud, oil grease, or other materials that may adversely affect or reduce the bond.

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

7. PLAIN AND REINFORCED CONCRETE

7.1. SCOPE

The work under this section of the specification consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with the supply and installation of plain and reinforced concrete work complete in any floor and at any height as per drawings except where specifically stated in the relevant item of Schedule of values, in strict accordance with this section of the specifications and the applicable drawings, and subject to the terms and conditions of the Contract.

7.2. SUBMITTALS

7.2.1. Suitable templates or instructions or both shall be provided for setting out items not placed in the forms. Embedded items and other materials for mechanical and electrical operations shall have been completed, inspected, tested and approved before concrete is placed.

7.2.2. For special concrete finish 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 concrete finish shall be obtained before work is commenced.

7.2.3. The CONTRACTOR shall supply to the Engineer at fortnightly intervals, test certificates with the appropriate standard in respect of the samples of cement from the work-site. These tests shall be carried out in a laboratory approved by the Engineer. The grading of the coarse and fine aggregates shall be tested at least once for every 6000 cft, to ensure that the grading is uniform and same as that of the samples used in the preliminary tests. Where doubt exists as to the suitability of the water, it shall be tested in accordance with BS 3148.

7.2.4. 'Workability' of Concrete shall be determined by either the slump or compaction factor tests as directed by the Engineer and these shall be performed in accordance with the methods given in ASTM C 143.

7.2.5. The slump or compaction factor for each class of concrete shall be determined during the preliminary Test mixes and the value obtained shall not be modified without the written consent of the Engineer.

7.2.6. Manufacturer's recommendations and instructions along with the sample of material shall be submitted to the Engineer for his approval. The CONTRACTOR shall, at his own cost, make optimum mix design and testing for approval of the composition of Non Shrinking grout and Non Shrink second stage Concrete Grout, prior to Commencement of the work.

7.2.7. The CONTRACTOR shall be required to submit a sample of pre-cast unit for the approval of the Engineer; all pre-cast units shall strictly conform to the approved sample. The proposal for transporting and erecting pre-cast units in position shall also be submitted by the CONTRACTOR for the approval of the Engineer.

7.3. CONCRETE STRENGTH

The concrete shall develop the following minimum cylinder strengths as per ASTM C 192, ASTM C 172 and ASTM C 31.

Sr. No.	Strength at 28 days (Pounds per Sq.Inch)	Corresponding Strength at 07 days (Pounds Per Sq.Inch)
1	4000	2650
2	3000	2000
3	2000	1400

7.4. CONSISTENCY

Frequent consistency tests shall be made with a slump cone as directed by the ENGINEER in accordance with ASTM C 143 and the water in the mix shall be controlled and adjusted as necessary to maintain nearly the following consistencies throughout the parts of the works:

ASTM C – 192 and UBC 1997 Section 1905 will be followed for maintenance of quality of concrete.

Type of Construction	Slump - inches
Mass concrete	1" – 1-1/2"
Reinforced foundations	1-1/2" - 2"
Beams & Slabs	1-1/2" – 2-1/2"
Walls	2" - 3"

7.5. ADMIXTURES

No admixtures shall be used without the approval of the ENGINEER (unless already specified) and the following procedure shall be followed if admixtures are proposed:

Intention to use admixtures shall be submitted with reasons justifying its use supported by manufacturer's literature, past experience and applicable standards.

If approved, trial mixes shall be prepared to arrive at a control mix design with admixtures and with suitable characteristics for the job.

Control mix shall be used on the job only if and where approved by the ENGINEER.

The admixtures shall be sampled at the source of supply and tested by an approved laboratory. An admixture which has been in storage at the Site for longer than 6 months or which has been subjected to freezing shall not be used until retest proves it to be

satisfactory. Additional tests shall be made by the CONTRACTOR under the supervision of the ENGINEER.

7.6. MATERIALS

7.6.1. Aggregates

7.6.2. The sources of supply of all fine and coarse aggregates shall be subject to the approval of the Engineer. All fine and coarse aggregates shall be clean and free from clay, loam, silt and other deleterious matter. If required, the Engineer reserves the right to have them washed by the CONTRACTOR at no additional expense. 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. Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings and shall conform to requirements of PS 243 and/or BS 882 and/or ASTM C 33. Only fine aggregate of grading zones 1 to 3 (BS 882) shall be used.

7.6.3. Coarse aggregate shall be crush stone of hard, durable material free from laminated structure and conforming to PS 243 and/or BS 882 and/or ASTM C 33 graded as follows for use in mass concrete as in foundations:

Total Passing B.S. Sieve			Percent by weight
3 in.	(76.20 mm)	:	100
1.5 in.	(38.10 mm)	:	95-100
0.75 in.	(19.05 mm)	:	30-70
0.38 in.	(9.52 mm)	:	10-35
0.19 in.	(4.76 mm)	:	0-5

Coarse aggregate for all cast-in-place concrete other than mass concrete as for foundations shall be graded with the following limits:

Total Passing B.S. Sieve			Percent by weight
1.5 in.	(38.10 mm)	:	100
0.75 in.	(19.05 mm)	:	95-100
0.38 in.	(9.52 mm)	:	25-55
0.19 in	(4.76 mm)	:	0-10

7.6.4. Wherever feasible, the nominal maximum size of aggregate for cast- in- place reinforced concrete slabs and other members shall be 3/4 inch. If there are difficulties in placing such concrete the maximum size may be restricted to 1/2 inch provided the requirements for strength are satisfied. The grading requirements of 1/2 inch or 3/8 inch

down aggregate shall be agreed to with the Engineer as per relevant ASTM/BS standards. The nominal maximum size of the aggregate for precast concrete shall not be larger than one fifth of the narrowest dimension between sides of forms, or one-third of the depth of slabs or three-fourths of the minimum clear distance between reinforcing bars or between bars and forms, whichever is least. In Precast columns the nominal maximum size of the aggregate shall be limited as above but shall not be larger than two-thirds of the minimum clear distance between bars.

7.6.5. Coarse aggregates in precast concrete of normal weight may be of one maximum size for all concrete placed in 1 day when quantities to be placed are too small to permit economical use of more than one mix design. When a single mix design is so used, the maximum nominal size shall be as required for the most critical condition of concreting, in accordance with the requirements of clause (4.1.6) above.

7.6.6. Except where it can be shown to the satisfaction of the Engineer that a supply of properly graded aggregate of uniform quality can be maintained over the period of the work, the grading of the aggregates shall be controlled by obtaining the 19.05 mm maximum nominal size, the different size being stocked in separate stock piles and recombined in the correct proportion for each batch at the mixing plant. The materials shall be stock-piled 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 aggregates shall be tested at least once for every 6000 cft supplied to ensure that the grading is uniform and the same as that of the samples used

in the preliminary tests. For use in fireproof concrete, the aggregates shall be fire clay and semi-acidic fine ground. The use of broken fire clay bricks as coarse aggregate and waste of semi-acidic refractory particles as fine aggregate can be allowed.

7.7. CEMENT

7.7.1. The cement shall be fresh and of approved origin and manufacture. It shall be one of the following as may be specified by the Engineer. Ordinary or Rapid Hardening Portland cement complying with the requirements of PS 232 or BS 12 /EN 196-197 or ASTM C-150. For all fair faced concrete it will be necessary to use approved cement with a view to obtain light shade concrete as approved by the Engineer.

7.7.2. Only one brand of each type of cement shall be used for concrete in any individual member of the structure. 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. Cement reclaimed from cleaning of bags or from leaky containers shall not be used. The CONTRACTOR shall provide and erect (at his own cost) in a suitable plane, dry, well ventilated, weather- proof and water proof shed of sufficient capacity to store the cement.

7.7.3. Cement shall be used as soon as possible after delivery and cement which the 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 the CONTRACTOR's expense. Any cement in containers damaged so as to allow the contents to spill or permitting access of the atmosphere prior to opening of the container at the time of concrete mixing shall be rejected and removed immediately from the site at the CONTRACTOR's expense. The mixing together of different types of cement will not be permitted.

7.8. WATER

7.8.1. Only clean water from the city supply, tube well installed at the site or from other sources approved by the Engineer shall be used. The CONTRACTOR shall supply sufficient water for all purposes, including mixing the concrete, curing and cleaning plant and tools. Where water can be shown to contain any sugar or an excess of acid, alkali or salt, the Engineer may refuse to permit its use. In case of doubt, the Engineer may require that concrete mixed with water proposed to be used should not have a compressive strength lower than 90 percent of the strength of concrete mixed with distilled water.

7.8.2. Testing of Water

7.8.3. Tests on the purity, soluble sulphate, chloride or other chemical content, sediment and pH value shall be carried out as the ENGINEER may direct. The SUB-

CONTRACTOR shall supply all apparatus, labor and other facilities required for routine testing on Site and shall make available to the ENGINEER the results of all testing within 24 hours. In the event that the ENGINEER requires further independent testing of any water source or supply the CONTRACTOR shall arrange for the dispatch of samples of water to an approved analytical laboratory and shall pay all expenses incurred during such further testing. In addition to the above, the CONTRACTOR shall regularly carry out tests on the water used for concreting in accordance with ASTM D-596 and shall pay all expenses connected with such testing.

7.9. ADDITIVE

7.9.1. All additives such as foaming and water proofing agents shall be from a manufacturer approved by the Engineer. Air Entraining Admixtures shall conform to ASTM C 260. Other Admixtures shall conform to ASTM C 494.

7.10. MIXING CONCRETE

7.10.1. Mix all concrete in machine except that, in emergencies, the mixing may be by hand as approved by the Engineer but with 10% extra cement at the CONTRACTOR's cost. Produce homogeneous concrete mixtures of uniform colour, and discharge it without segregation. Accurately proportion and control all materials including water entering the drum. Discharge the entire batch before re-charging'; the volume of the mixed material per batch not to exceed the manufacturer's rated capacity of the mixer and each batch to remain in the mixer for a mixing period of not less than 2 minutes measured from the time when all the solid material is in the mixing drum. Introduce all the mixing water before one-fourth of the mixing period elapses.

7.10.2. Measure aggregate by approved gauge boxes made to dimensions suitable for measuring quantities by whole numbers of cement measures for a batch based on one bag cement. Do not remix concrete which has partially hardened, with or without additional cement, aggregate or water.

7.11. CONCRETING IN EXTREME WEATHER

Avoid concreting when weather is windy or resulting concrete temperature is above 100^{o}F in hot weather or below 40^{o}F in cold weather. If concreting is allowed by Engineer to be continued for the safety of the structure take all additional measures instructed by him.

7.12. PLACING CONCRETE

Get Engineer's approval to formwork, false work and reinforcement before concrete is place. During conveyance of concrete avoid segregation or separation or loss of ingredients, and place in its final position before initial setting of the cement has taken

place and within 30 minutes of the addition of water in the mix. When placed from a height of more than two meters, a employ chutes etc; to ensure that no segregation takes place. The concrete shall be efficiently sworded and worked around reinforcement steel work and embedded fixtures and into the corners of tile forms so that no voids or honeycombing occurs and no reinforcement or embedded fixtures are displaced. In forms for columns or walls and thin sections of considerable height, provide openings and other devices that will prevent segregation and accumulation of hardened concrete on the forms or reinforcement above the level of concrete. Clean steel before next pour of concrete. Keep record of the date of placing concrete in each part and section of the Works. No person shall walk on the steel reinforcement; walk on boards placed for the purpose.

7.13. COMPACTING CONCRETE

Compact all concrete by means of internal vibrators, but surface and external vibrators may be used either in conjunction with them or alone. Employ trained personnel to operate them. Continue vibration till the concrete is fully compacted and air bubbles cease to break the surface. Do not touch forms with internal vibrators and do not push the concrete along the forms. Avoid excessive vibration or tamping. Concrete members

100 mm or less thick shall not be vibrated with internal vibrators; compact such members by other approved means.

7.14. CONSTRUCTION JOINTS

Construction joints shall be as few as possible only at places shown on the Drawings or approved by the Engineer. Where concreting is stopped on a vertical plane as in beams, provide lap joint with approved stop board. Make provision to allow the reinforcement to pass through the joints without being temporarily bent or otherwise displaced. In the case of slabs or walls, nail a 50mm x25mm fillet slightly splayed (to permit easy removal) on the stop board to form a joggle running throughout the length of the joint. Remove any concrete flowing past the joint as soon as initial set occurs. When concreting against a hardened surface is resumed, well roughen, wet, clean the surface and apply cement sand slurry of same ratio as the mortar used in concrete and application of bonding agent. Provide approved water proofer in lieu of mortar at joints in basement and water retaining structures. In case of continuous retaining walls more than 10m long, carry out concreting such that vertical gaps of about one meter width with vertical joggled ends at both sides are left out at about 10m distances to be filled in after 14 days of concreting adjacent sections.

7.15. EXPANSION JOINTS

Expansion joints shall be provided wherever indicated on the Drawings or as directed by the Engineer. In no case shall the reinforcement, corner protection angles, or other embedded items be permitted to extend continuously through any expansion joint. All

expansion joints shall be carefully placed so as not to be displaced during concreting. The method of placing the expansion joints shall be strictly in accordance with the Drawings and/or as directed by the Engineer.

7.16. PROTECTION AND CURING OF CONCRETE

Protect concrete, after it is placed and during the early stages of hardening, from the harmful effects of sunshine, rain, wind, cold, heat, running water and shock. Prevent concrete from drying out for at least ten days. Do wet curing or employ other approved means. For columns, vertical wall surfaces and wherever water may not stand are as shall be covered with Hessian cloth and kept moist all the- time.

7.17. CONCRETING POUR LIFTS

Do not pour concrete in lifts of more than 2 m height. Pour concrete in one continuous operation in horizontal layers of uniform thickness not exceeding 300mm in depth and in walls at such rate of rise that adequate vibration can be ensured to avoid honeycombing and deformations of the formwork.

7.18. INSERTS AND OPENINGS IN CONCRETE

Start concreting after all types of inserts, conduits; pipes etc. and block out of openings have been placed as per drawings.

7.19. ALTERNATE BAY CONSTRUCTION OF NON-SUSPENDED FLOORS

Construct large areas of non-suspended floors in alternate bays; the area of the bay not to exceed 30 square meters for reinforced floors. Stop reinforcement 40 mm from the edges of the slabs. Use approved separators between panels if floors are required to be laid in independent panels.

7.20. NON-STRUCTURAL CONCRETE 1:2:4

7.20.1. DEFINITION

Non-structural concrete is the concrete for which no strength requirement is specified.

7.20.2. WATER/CEMENT RATIO

The quantity of water used shall be just sufficient to produce dense concrete of adequate strength and workability for its purpose. For all external work and foundations the water/cement ratio should not exceed 0.40 for concrete Class A, B and C.

7.20.3. PVC WATER STOP/HYDROFOIL

All PVC water stops/hydrofoil shall be central bulb type from a manufacturer approved by the 'Engineer'. The specific gravity of PVC water stop/hydrofoil shall not be less than

1.37 and full stretch Break cut intensity when tested at normal temperature shall not be less than 1875 psi. The material shall have a modulus of rigidity of 850 psi at $+10^{o}$ C and 10,500 psi. at 20^{o} C.

7.21. DELIVERY, STORAGE AND HANDLING

Except where it can be shown to the satisfaction of the Engineer that a supply of properly graded aggregate of uniform quality can be maintained over the period of the work, the grading of the aggregates shall be controlled by obtaining 3/4" maximum nominal size, the different sizes being stocked in separate stock piles and recombined in the correct proportion for each batch at the batching plant. The material 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 SUB- Contractor shall provide and erect (at his cost) a suitable plain, dry, well ventilated, weatherproof and water proof shed of sufficient capacity to store the cement.

7.22. TRANSPORTING

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 of ingredients. All skip vehicles, or containers used for transporting the concrete shall be thoroughly cleaned. During hot or cold weather, concrete shall be transported in deep containers, on account of their lower ratios of surface area to mass, which reduces the rate of loss of water, by evaporation during hot weather and loss of heat during cold weather.

7.23. PLACING

7.23.1. The CONTRACTOR shall note that placing of concrete will be done with appropriate manner. Before placing of concrete, formwork shall have been completed; water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors and other embedded items shall have been kept in position; and the entire preparation shall have been approved by the Engineer.

7.23.2. No concrete is to be placed into the foundation trenches until the ground to receive the same has been examined and approved by the Engineer for this purpose. The actual sequence of construction proposed by the CONTRACTOR shall be subject to the Engineer's approval before construction starts on any part of the structure, and this sequence shall not be varied without the Engineer's approval. The concrete after it has been mixed shall be placed as soon as it 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 concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means available.

7.23.3. 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, or 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. The CONTRACTOR shall ensure that the delay between mixing and placing including consolidation does not exceed 15 minutes under any circumstances. Any concrete which does not satisfy this requirement shall be rejected. Concrete shall be deposited as nearly as possible in its final position to avoid segregation due to rehandling or flowing. In no circumstances may concrete be railed or made to flow along the forms by the use of vibrators.

7.23.4. The free fall of concrete shall not be allowed to exceed 6 feet. Where it is necessary for the concrete to be lowered more than this depth, it is not to be dropped into its final position, but shall be placed through pipes fed by a hopper. When a pipe is used for placing concrete the lower end shall be kept inside or close to the freshly deposited concrete. The size of the pipe shall be not less than 9 inch in diameter. The workmen carrying concrete to the site, and all other workmen moving about on the reinforcement before the concrete is placed, shall move only along runways or planks placed for the purpose and no person shall be allowed to walk on the reinforcement itself. Prior to the laying of concrete on load bearing masonry walls, bearing plates and at other points, as may be directed by the Engineer, the surface will be brought to a true, hard and smooth level surface using cement sand mortar in the ratio of 1 volume of cement to 3 volumes of sand. Two layers of building paper weighing .082 lb./ft2 will then be laid flat to separate the concrete from the surface on which it is to be laid.

7.23.5. 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 Contract Documents or as approved by the 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 shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained. Every CONTRACTOR whose work is related to the concrete or services 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.

7.24. CONSTRUCTION JOINTS

7.24.1. Construction 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 the Engineer. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset a distance equal to twice the width of the secondary beam. Joints in walls and columns shall be at the underside of floors, slabs or beams and at the top of footings or floor slabs. 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. All reinforcing steel shall be continued across joints. Keys and inclined dowels shall be provided as directed by the Engineer. Longitudinal keys at least 1-1/2 inches deep shall be provided in all joints in walls and between walls and slabs or footings.

7.24.2. When the work has 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 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 herein shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

7.24.3. 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 similar in proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2 inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained initial set. Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle, and brushed, care being taken to avoid dislodgment 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 6 inch in thickness, and shall be well rammed against old work, particular attention being paid to corners and closed spots.

7.24.4. Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement passing through them, so that each portion can be positioned and removed separately without disturbance or shock to the 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 the 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.

7.25. PLACING AND CONNECTION OF WATER-STOPS

The water-stops and expansion joint material shall be positioned accurately and supported against displacement as shown on the drawings.

7.26. ELECTRIC CONDUITS AND PIPES

7.26.1. 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 on which stress is calculated or which is required for fire protection. Sleeves, conduits, or other pipes passing through floors, walls, or beams shall be of such size or in such location as not to impair unduly the strength of the construction; such sleeves, conduits, or pipes may be considered as replacing structurally in compression the displaced concrete, provided that they are not exposed to rusting or other deterioration, are of uncoated or galvanized iron or steel not thinner than standard steel pipe, have a nominal inside diameter not over 2 inch and are spaced not less than three diameters on centres. Except when plans of conduits and pipes are approved by the Engineer, embedded pipes and conduits other than those merely passing through, shall not be larger in outside diameter than one third the thickness of the slab, wall, or beams in which they are embedded nor so located as to impair unduly the strength of the construction. Sleeve pipes, or conduits of any material not harmful to concrete and within the limitations of this section may be embedded in concrete with the approval of the Engineer provided they are not considered to replace the displaced concrete.

7.26.2. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. 'Mass-concrete' shall be placed in layers approximately 18 inch thick. Vibrator heads shall extend into the previously placed layer.

CONSOLIDATION

7.26.3. All concrete shall be consolidated by vibration, spading, rodding or forking 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 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. They shall be operated by competent workmen. Use of vibrators to transport within forms shall not be allowed. Vibrators shall be inserted and withdrawn at points approximately 18 inch apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not excessive so as to cause segregation, generally from 5 to 15 sec. A spare Vibrator shall be kept on the job site during all concrete placing operations.

7.26.4. 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, supplemented, if necessary, by spading to work the coarse aggregate back from the formed surface. 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 effect an improvement in the quality of the concrete to the satisfaction of the Engineer and in conformity with the provisions of Clause 5.

7.26.5. Vibrator shall not be allowed to contact the formwork for exposed concrete surfaces. Mechanical vibrators shall be of a type suited in the opinion of the Engineer to the particular conditions. Over-vibration or vibration of very wet mixes is harmful and should be avoided.

7.27. APPLICATION OF NON-SHRINK GROUT

7.27.1. Concrete surfaces to receive non-shrinking grout shall be roughened, cleaned and dampened. Form shall be provided to retain the grout until sufficiently hard to support itself. Grout shall be poured in place and thoroughly rodded or washed to prevent the formation of voids. After non-shrink grout has received its initial set, it shall be kept damp for 24 hours.

7.27.2. Placing of Vapour Barrier

Vapour barrier shall be laid in position wherever shown on the Drawings. The material shall be supplied in rolls and laid by rolling over the prepared surface at the levels and position in the areas shown on the Drawings. Where joint is necessary at the side or end of a sheet, this shall be a double weld folded joint made by placing the edges together and folding over twice continuously taking the top edge prior to concreting. The CONTRACTOR shall protect the film sheets from damages during laying and subsequent operations and shall replace at his own cost all damaged film sheets to the satisfaction of the Engineer.

7.28. CEMENT CONCRETE PAVEMENTS

7.28.1. Full co-operation shall be given to trades like electrical, mechanical and other services. For all concrete work relevant specifications of this section shall apply. Side Forms and Construction. Side forms shall be of steel or any other suitable material and of a design as approved by the Engineer. In general, only materials and methods that have proved their acceptability by past performance will be considered. All form shall be constructed so that they can be removed without hammering or prying against the concrete.

7.28.2. Horizontal joints in the forms will not be permitted. Forms shall be thoroughly cleaned and oiled with linseed/mineral oil shall be given two coats of niter-cellulose lacquer each time they are used.

7.28.3. The forms shall be set on a thoroughly compacted base true to line and level and firmly secured in position by appropriate methods. Conformity with the alignment and levels shown on the Drawings shall be checked as and when required by the Engineer. Where necessary corrections shall be made immediately before placing the concrete; where any form has been disturbed it shall be reset and rechecked.

7.28.4. Pavements shall be constructed in panels of sizes as shown on the Drawings. The panels shall be laid alternately, the adjoining panels being concreted when the side forms are struck and the jointing materials placed, inspected and approved by the Engineer. Each panel is to be concreted in one operation and no interruptions shall be permitted during the operation. The concrete shall be tipped from the trolley slightly in advance of the working place and then shoveled into position. The spreading shall be carried out very carefully. Compaction shall be done by means of vibro-compactors of approved surface vibrators. If a vibro-compactor is used, if shall be operated on the concrete and will not be allowed to strike or displace the forms. The spreading and compacting of the successive layers shall proceed without interruptions and as quickly as practicable so as to ensure that the slab is monolithic throughout its depth.

7.28.5. The wearing surface shall be laid while the base concrete is still wet and screeded to line and level. When the initial set takes place the surface shall be troweled smooth with a steel trowel to provide a dense closed surface.

7.28.6. All the joints shall be carefully formed as shown on the Drawings or as directed by the Engineer. The joint filler together with performed groove shall provide complete separation of adjacent slabs. The joints shall all be sealed with bitumen as shown on the Drawings and as directed by the Engineer.

7.29. PROTECTION AND CURING

7.29.1. General Requirements:

Concrete shall be protected adequately from injurious action by sun, rain, flowing water and mechanical injury, and shall not be allowed to dry form the time it is placed until the expiry of the minimum curing periods specified hereinafter. Water curing shall be accomplished by keeping the surface of the concrete continuously wet by covering with water or with approved water saturated covering. Where wood forms are left in place for curing, they shall be kept sufficiently damp at all times to prevent openings at the joints and drying out of the concrete. All portions of the structure shall be kept moist for the full curing periods, specified hereinafter.

When liquid membrane curing compound is used the surface of the concrete shall be protected from traffic or other abrasive action, which may break the membrane, for the full period of curing. The membrane curing compound shall be colorless or light colored and shall be approved by the Engineer and shall comply with ASTM Designation C 309.

7.29.2. Curing Periods

The curing period shall be at least 10 days, or as directed by the Engineer.

7.29.3. Removal of Forms

The CONTRACTOR shall exercise great care in avoiding damage to joints, arises, dowel bars etc., while removing the forms. Under no circumstances will the use of pry bars between the forms and pavement be permitted. Side forms shall not be removed until at least 40 hours have elapsed from the time of completing the concreting of the slab, which they contain. In no case shall forms be removed until the concrete has hardened sufficiently to permit removal without damage to the concrete. Concrete work shall be protected from injury resulting from the storage or movement of material during construction.

7.29.4. Finishing

All unformed surfaces shall be finished with a wood float except as otherwise specified. Visible vertical surfaces shall have all projections and irregularities removed. The entire surface shall be rubbed if required by the Engineer, with a No. 16 carborundum brick, or other abrasive until even, smooth and of uniform appearance, and shall be shed clean. Plastering of surface, application of cement or other coating will not be permitted. All exposed corners shall be chamfered, 1"x 1" (2.5 cms x 2.5 cms) unless otherwise mentioned or shown on the plans or directed by the Engineer. Concrete surfaces which will be covered with other materials shall be screeded without floating. Spreading, finishing and floating of concrete in pavements

7.30. GENERAL REQUIREMENTS

The striking off, compacting and floating of concrete shall be done by mechanical methods, if approved by the Engineer. Where the Engineer determines that it is impracticable to use mechanical methods, manual methods of spreading, finishing and floating may be used on pavement lines as indicated on the Drawings.

7.31. MANUAL METHODS

When striking-off and compacting by manual methods is permitted, the concrete shall be leveled and then struck-off to such an elevation that, when properly compacted, the surface will conform to the required grade and cross-section. The strike board shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither ends is raised from the side forms during the process. While striking off, a slight excess of concrete shall be kept in front of the cutting edge at all times. Prior to tamping, the concrete along the forms shall be thoroughly spaded or vibrated. The entire area of pavement shall be tamped or vibrated a manner that will ensure maximum compaction. The concrete shall be brought to the required grade and shape by the use of a tamper consisting of a heavy plank whose length exceeds the width of the pavement by 1 foot or by the use of a mechanical vibrating unit spanning the full width of the spread. The tamper shall be constructed with properly trussed roads to stiffen it and prevent sag and shall be shod with a heavy strip or metal for a tamping surface. The tamper shall be moved with a combined tamping and longitudinal motion, raising it form side form and dropping it so that the concrete will be thoroughly compacted and rammed into place. A small surplus material is compacted and rammed into front of the tamper or vibrating unit and tamping or vibrating shall continue until the true cross-section is obtained and the mortar flushes slightly to the surface.

7.31.1. On grades in excess of 5 percent where hand methods are permitted, a little strike board shall follow at a speed of 25 ft to 50 ft per hour back of the heavy strike board, and shall be used in the same way, so as to remove waves caused by flow of concrete.

7.31.2. Where hand tamping is permitted, not less than two strike boards or tampers shall be used for production in excess of 350 Cu.ft. After the concrete has been compacted, it shall be smoothed with a wooden float where necessary, as directed by the Engineer.

7.32. LONGITUDINAL FLOATING

Manual floats shall be at least 12 ft. in length not less than 6 inches in width and shall be properly stiffened to prevent bending or warping. In using the float, it shall be held parallel to centre line of the pavement at all time and shall be moved laterally across the pavement from one side or edge to the other until all high areas are cut down and floated into depressions, leaving a surface that is smooth and true to grade. Batch transverse passage of the longitudinal manual float shall lap the proceeding passage by half.

7.33. FIRST STRAIGHT EDGE TESTING

7.33.1. Immediately following final floating the entire area of the pavement shall be tested with a 10-ft. (approx. 3. meters) straight edge. Any depressions found shall be immediately filled with fresh concrete which shall be struck off compacted and finished. High areas shall be worked down and refinished. The straight edge testing and refloating shall continue until the pavement has the required surface contour.

7.33.2. Burlap (Coarse Canvas) Dragging

After the first straight edge testing and when most of the water sheet has disappeared from the surface and just before the concrete becomes non-plastic, the surface shall be dragged with a strip of burlap (coarse canvas) 3 ft. to 10 ft. wide and having a length 4 ft. more than the width of the slab. The burl of shall be dragged along the surface of the pavement in a longitudinal direction. Burlap shall be clean and kept free from coatings of hardened concrete. It shall be moist at the time of use.

7.33.3. Second Straight Edge Testing

After the concrete has hardened sufficiently to permit walking on it, the surface of the pavement shall again be tested with a 10-ft. straight edge. Any portion of the pavement which shows a variation from the testing edge of more than 1/8 inch shall be corrected by cutting, or shall be removed and replaced at the expense of the CONTRACTOR.

7.34. EXPANSION AND CONTRACTION JOINTS

7.34.1. All the expansion and contraction joints shall be carefully formed as shown on the Drawings or as directed by the Engineer. As regards dowel bars and joint assemblies, such stakes, brackets or other devices shall be used, as necessary to keep the entire joint assembly in true vertical and horizontal position. The joint filler together with the preformed groove shall provide complete separation of adjacent slabs. The joints shall all be sealed with the specified non-extruding sealing compound set in a 3/4 inch wide preformed chase as shown on the Drawings. The preformed chase shall be thoroughly cleaned of all dust, debris, stones or other hard material prior to its sealing. The riser of all joints shall be rounded to a radius as shown on the Drawings before the concrete hardens.

7.34.2. The joints sealing compound shall be hot poured bitumen or approved sealing compound for concrete pavements complying with BS-2499 for hot tropical climates and heavy duty industrial site subject to severe exposure. All joints are to be filled with flexell expansion joint filler, or an approved elastic, compressible, durable and rot-proof equivalent of sufficient rigidity to enable it to be satisfactorily installed in the joint and resist deformation during the passage of the concreting equipment. The filler is to be of the same thickness as the joint width. Holes to accommodate the dowel bars shall

accurately be drilled or punched out. Where shown on the Drawings, dowel bars of required diameter shall be placed at the specified spacing. The bars shall be lubricated with an approved lubricant. One end of the dowel bar at expansion joints shall be provided with a closely fitting sleeve 3 inch long, consisting of bitumen coated plastic or other approved material to permit expansion. A loose plug 1 inch deep of approved compressible filling material shall be inserted into the sleeve as shown on the Drawings at the end of the bar. All the dowel bars shall be mild steel bars of the size shown on the Drawings and shall conform to the requirements as specified in the section 'Concrete.

7.34.3. Contraction joints shall be provided as shown on the Drawings. The assembly and method of constructing the expansion joints/contraction joints shall be subject to the approval of the Engineer.

7.34.4. In general all PVC water stops/hydrofoil shall be placed in the centre of the structural member. Each piece of the water stop-hydrofoil shall be of maximum practicable length. An ordinary sharp knife saw or any other sharp tool can be used to cut the water stop. Joints at inter sections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective water tightness fully equal to that of the continuous water stop material and shall permanently retain their flexibility. For straight line connection-melting method of connection can be used by passing two water stops intended for connection against a heated iron or copper sheet. When they are melted, the two are combined.

7.34.5. After joining, the water stop should be allowed to cool. For all other connections such as T-type or L-type, the welding method of joining should be used. Welding rod of same material as the water stop shall be used. The welding rod & the water stop shall be heated & melt at the same time, by means of heated air jetting from the hot jet gun.

7.35. CONCRETE COVER

The minimum concrete cover to reinforcement excluding stirrups and binders, shall be as indicated on the Drawings unless otherwise directed.

The minimum cover will normally comply with the following requirements:

For Normal Construction

On all external faces: 2”~3”

On all other faces: 3/4”

Notwithstanding the above provision the cover to any bar shall be not less than the diameter of that bar.

For Water Retaining Structures
Faces exposed to fresh (Potable) water: 1-1/2" OR 40mm

Faces exposed to effluent and other impure water: 2” OR 50mm

For unscreeded ground-bearing, ground floor slabs: 2” OR 50mm

Provided always that the required minimum cover is maintained, the actual cover to any bar shall be that indicated on the Drawings with the following tolerances:

Plus or minus 5 mm or 1/4" on bars up to and including 12 mm or 1/2" diameter.

Plus 10 mm or 3/8" or minus 5 mm or 1/4" on bars over 12 mm or 1/2" up to and including 25 mm or 1" diameter.

Plus 16 mm or 5/8" or minus 5 mm or 1/4" on bars over 25 mm or 1" diameter.

7.36. TEST OF CONCRETE QUALITY

7.36.1. The CONTRACTOR shall provide samples of concrete for testing at the ENGINEER's direction. Proper facilities shall be provided for making and curing „the test specimens. A competent person shall be employed by the CONTRACTOR whose first duty shall be to supervise all stages in the preparation and placing of the concrete. All test specimens shall be made and site tests carried out under his direct supervision. All tests shall be carried out at laboratories approved by the ENGINEER. The ENGINEER may be present during testing.
7.36.2. Preliminary cylinder tests and works cylinder test shall be performed in accordance with the discretion of the ENGINEER. The standard of acceptance for preliminary and works tests shall be as given below.
7.36.3. Strength Tests During the Work: Strength tests of the concrete placed during the course of the work shall be made by the CONTRACTOR. The CONTRACTOR shall test, for control purposes, such number of cylinders as the ENGINEER may direct.
7.36.4. In general three sets of three cylinders each shall be taken from each 250 cubic feet or fraction thereof or from each day's pour, whichever is less, of each class of concrete placed. Test specimens shall be made and cured in accordance with the applicable requirements of ASTM C-31. Specimens shall be cured in the manner and environments as the pertinent structure.

7.36.5. Cylinders shall be tested in accordance with the applicable requirements of ASTM C-39 and ASTM C-78. The test result shall be based on the average of the strength of the test specimens except that if one specimen in a set of three shows manifestevidence of improper sampling, moulding or testing, the test result shall be based on the average of the remaining two specimens. If two specimens in a 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.

7.36.6. The standard age of test shall be 28 days, but 7-day tests may be used at the discretion of the ENGINEER, based on the relation between the 7-day and 28-day strengths of the concrete as established by tests for the materials and proportions used. If the average of the strength tests of the specimens for any portion of the work falls below the minimum allowable compressive strength at 28-days required for the class of concrete used in that portion, the CONTRACTOR may change the proportions of the constituents of the concrete, as necessary to secure the required strength for the remaining portions of the work. Tests of Hardened Concrete in or Removed from the Structure:

7.36.7. Where the results of the strength tests of the control specimens indicate that the concrete as placed does not meet Specification requirements, or where there is other evidence that the quality of the concrete is below Specification requirements, core-boring tests will be made by the ENGINEER in accordance with the applicable requirements of ASTM C- 42 entirely on the expense of the CONTRACTOR. 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.

7.36.8. 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. If a strength deficiency is found and is in the opinion of the ENGINEER due to the SUB-CONTRACTOR's fault or negligence, the entire cost of replacing faulty concrete or carrying out prescribed corrective measures shall be borne by the CONTRACTOR.

7.37. ARCHITECTURAL FINISH CONCRETE:

Architectural finish to concrete formed surfaces as shown on the Drawings is required by the Engineer where the architectural appearance of surfaces of structures exposed to public view is of special consideration and importance. The CONTRACTOR shall use approved special material for formwork and design the forms in conformity with the specified architectural patterns, textures and finishes in order to obtain first class architectural finish on formed concrete surface without any defect, irregularities, blemishes, imperfections and encrustation's.

7.38. SAMPLES:

7.38.1. Submit to the Engineer a minimum of two units or portions of units of each precast item required. Each pair of samples when accepted will describe the allowable limits between which variations can be acceptable. Similar samples of in-situ concrete for approval by the Engineer submit two samples, 2 Sq. ft. of each type of exposed in-situ concrete. All in-situ samples will remain at the construction site.

7.38.2. Sample approvals of precast & in-situ concrete:

These samples will be reviewed and approved on the basis of colour, dimensional accuracy, and finish of surfaces and general appearance. The same requirements for sample approval will be required for both pre-cast and in-situ concrete exposed surfaces.

7.39. FORMS

7.39.1. The CONTRACTOR must maintain the forms unusually tight and braces to prevent movement, mal-alignment and bleeding that will result in sand streaks, honeycomb, fins, stain or unsightly appearance.

7.39.2. If wood forms are chosen to be used by the CONTRACTOR they shall be constructed of 3/4 inch minimum thickness plywood constructed in a fashion to allow many re-uses with all surfaces sealed with a polyurethane varnish.

7.39.3. Edges, surfaces and corners of forms shall be sealed to prevent loss of any matrix or unequal absorption of water. Corners of wood forms shall be filled with suitable compound and all contact surfaces sealed with a polyurethane varnish. Re-use of forms shall be subject to approval by the Engineer.

8. FLOORING

8.1. SCOPE

The work under this section of the Specification consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in any floor and at any height in connection with the installation of cement concrete floors and floor finishes including bases, skirting and surface treatments, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

8.2. SUBMITTALS

CONTRACTOR shall submit at least 3 range samples of all the items/each type of stone/tile to be provided under this section showing color, grade, finishing and texture to the Engineer for approval. CONTRACTOR shall provide samples from each specified manufacturer and in sufficient variation for each type of item. The Engineer shall make his selection only when all related samples have been submitted and he is satisfied that the samples submitted are the maximum range available against any item.

8.3. MATERIAL

8.3.1. STONOLITHIC/GRANOLITHIC FLOORING

8.3.1.1. CEMENT

Cement shall be ordinary Portland confirming ASTM C-150 PS232-2008 (R-OPC-43)

8.3.1.2. SAND

Sand shall be obtained from sources approved by the Engineer. The grading shall confirm to B.S 882 Grading which the gradation limits are as follows:-

Percentage (by weight) passing

B.S. Sieve	Grading
3/8" (9.53 mm)	100
3/16" (4.765 mm)	90-100
No. 7	75-100
No. 14	55-90
No. 25	35-59
No. 52	8-30
No. 100	0-10

8.3.1.3. COARSE AGGREGATE

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone, angular or rounded in shape and shall have granular, crystalline or smooth surface free from friable, flaky and laminated pieces, mica and shale. It shall not contain matters injurious to concrete. All coarse aggregate shall conform to BS 882 and shall be graded as follows:

B.S. Sieve	% Passing by weight
1" (25.40 mm)	100
3/4" (19.05 mm)	90-100
3/8" (9.53 mm)	20-55
3/16"(4.765 mm)	0-10

The aggregate shall be stored on properly constructed paving or as directed by the Engineer.

There shall be a physical partition between the stockpiles of coarse and fine aggregate. If required aggregates shall be washed and screened to the satisfaction of the Engineer. Sieve analysis of all the aggregates to be used in the works shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer.

Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall be removed from site without delay.

Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuilt at the expense of the CONTRACTOR.

8.3.1.4. BRICK BALLAST

Brick ballast to be used as soling shall conform to specifications of "Brick Masonry" or using crush as per direction of Engineer.

8.3.1.5. WATER

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solutions or in suspension. Only water of the approved quality shall be used for all constructional purposes.

8.4. INSTALLATION OF FLOORING

Earth / structural fill be leveled, watered and compacted at optimum moisture content either by hand rammers or mechanical compactors to achieve 95% modified dry density as per AASHTO standards.

6” thick layer of crushed stone aggregate with screening will be placed on top of compacted earth / structural fill and then leveled, watered and compacted manually or mechanically to achieve in situ dry density of 95% when tested as per AASHTO standards.

4” thick P.C.C. 1:4:8 will be placed on top of crushed stone layer as per specifications specified for cement concrete under “concrete”. Water will be sprinkled to wet minimize absorption of cement slurry from the PCC 1:4:8.

The surface will be kept damp for at least seven days and then allowed to dry for at least seven days to ensure that the surface is absolutely dry.

Two coats of bituflex will be applied on top of PCC 1:4:8 after cleaning the surface with wire brushes and blowing out of all the dust from the upper surface of PCC 1:4:8. The bitulfex will be applied at the rate of 20 pounds per 100 square feet per coat.

Method of mixing and laying of reinforced cement concrete floors shall be as specified for cement concrete under "Concrete". Cement concrete shall be laid as per ACI 304 and specified in the "Concrete". Unless otherwise specified cement concrete used for topping shall be P.C.C. 1:2:4. Before laying concrete the base surface shall be cleaned and wetted so that it is well bounded. The concrete after laying shall be finished by tamping the concrete with straight edges to bring the surface to the required smooth, even, impervious finish level with no coarse aggregate visible and free from trowel or other such marks. While the concrete is still green it shall be roughened where topping is to be laid directly on concrete. When the concrete is sufficiently hardened to bear a man's weight without deep imprint, it shall be wood floated to a true even plane with no coarse aggregate visible. Just so much pressure shall be used on the wood floats as to bring moisture to the surface.

Concrete shall be left undisturbed for 24 hours after laying. During laying and 14 days thereafter the concrete shall be kept wet and protected from weather and extreme temperatures. In no case shall hammering be allowed on a finished surface.

Method of laying and finishing tile floor shall be as specified under "Tile Work". The floor shall be laid truly level at top in one plane horizontal or sloping as directed by the ENGINEER and as shown in the drawings and specified for tile work.

9. TILE, GRANITE AND FLOOR FINISHES

9.1. SCOPE

The work covered by this section of the Specifications, consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with the installation of tiles including bases, skirting and wainscots, complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the Contract. The scope of this section of Specification is covered with detailed specifications as laid down herein.

9.2. SUBMITTALS

CONTRACTOR shall submit at least 3 range samples of all the items/each type of stone/tile/granite/marble/corian/rubber/carpet to be provided under this section showing color, grade, finishing and texture to the Engineer for approval. CONTRACTOR shall provide samples from each specified manufacturer and in sufficient variation for each type of item. The Engineer shall make his selection only when all related samples have been submitted and he is satisfied that the samples submitted are the maximum range available against any item.

9.3. APPLICABLE STANDARDS

Latest editions of following standards are relevant to these specifications wherever applicable.

ASTM (American Society for Testing and

Materials): C 482 Bond strength of Tile to Portland

cement.

C 648 Breaking Strength of Tile.

C 650 Resistance of tile to Chemical substances.

C 798 Color Performance of glazed tile.

BSI (British Standard Institution):
1281 Glazed tiles and tile fittings for internal walls.

5442 Classification of Adhesives for construction.

203 Sheet and Tile Flooring.

209 Care and Maintenance of Floor Surface.

9.4. MATERIAL

9.4.1. CEMENT

Cement shall be ordinary Portland confirming ASTM C-150 PS232-2008 (R-OPC-43)

9.4.2. SAND

Sand shall be obtained from sources approved by the Engineer. The grading shall confirm to B.S 882 Grading which the gradation limits are as follows:-

Percentage (by weight) passing

B.S. Sieve	Grading
3/8" (9.53 mm)	100
3/16" (4.765 mm)	90-100
No. 7	75-100
No. 14	55-90
No. 25	35-59
No. 52	8-30
No. 100	0-10

9.4.3. COARSE AGGREGATE

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone, angular or rounded in shape and shall have granular, crystalline or smooth surface free from friable, flaky and laminated pieces, mica and shale. It shall not contain matters injurious to concrete. All coarse aggregate shall conform to BS 882 and shall be graded as follows:

B.S. Sieve	% Passing by weight
1" (25.40 mm)	100
3/4" (19.05 mm)	90-100
3/8" (9.53 mm)	20-55
3/16"(4.765 mm)	0-10

The aggregate shall be stored on properly constructed paving or as directed by the Engineer.

There shall be a physical partition between the stockpiles of coarse and fine aggregate. If required aggregates shall be washed and screened to the satisfaction of the Engineer.

Sieve analysis of all the aggregates to be used in the works shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer.

Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall be removed from site without delay.

Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuilt at the expense of the CONTRACTOR.

9.4.4. WATER

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solutions or in suspension. Only water of the approved quality shall be used for all constructional purposes.

9.4.5. GLAZED / UNGLAZED TILES

Glazed tiles shall comply with BS 1281 or the requirements ASTM C609, C648, C650, C798. Tiles shall be of standard grade. Unglazed tiles shall comply with BS 1286.

The tiles shall be free from cracks or crazing, free from twisting and uniform in color. Tiles shall be obtained to the size and thickness indicated on the drawings.

All tiles shall be in colors selected by the Engineer from the manufacturers' range of standard colors in the standard grade of products.

Prior to commencement of work the CONTRACTOR shall submits to the Engineer three samples of each type of tiles of all available color and patterns for his approval.
Manufacturers published literature containing instructions and recommendations shall also be submitted.

The glazed/unglazed tiles shall be laid on cement concrete base of specified grade and the joints filled with neat white or gray cement including vertical and horizontal covers.

9.4.6. GRANITE/MARBLE/CORIAN SLABS

Corian® surfaces from the DuPont Company having thickness ranging from ½" to ¾".

Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.

Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.

Granite / Marble Slabs conforming to following standards.

Hard Granite / Marble free of veins, blemishes will be obtained from quarry and cut to sizes as required and shown on drawings.

Granite will be pre-polished

Marble will be polished and grinded

Slabs will be hard enough to with stand chemicals attack.

Slabs will be detergent resistant

Slabs will be non-absorbent

Slabs will not absorb blood and will resist staining by blood.

Slabs will be cut to desired thickness and size prior to installation.

Cement, sand, aggregate and water shall be in conformity with the specifications laid down under the Section "FLOORING".

9.4.7. RUBBER FLOORING

Rubber Flooring with PVC coating shall comply with the requirements of ASTM F1344-15. Thickness of rubber tile will be 4mm and be laid as per standards mentioned above.

9.4.8. CARPET FLOORING

Carpet shall be tufted textured loop modular with fire retardant specifications,

Nylon Fiber Type 6.6, 100 % solution dyed nylon,

Machine Gauge: 1/12th gauge,

Pile Weight: 407 g/m2,

Pile Height: 3.0 mm ± 0.5 mm,

Total Thickness: 6.5 mm ± 0.5 mm,

Tile Size: 500 mm x 500 mm,

Dimensional Stability: Less than 0.2% variation.

9.4.9. TERRACOTTA TILES

9.4.9.1. Terra Cotta units shall conform to the physical requirements listed below as performed in accordance with ASTM Specifications.

a. Compressive Strength – ASTM C 67

b. Absorption (5 hour boil) – ASTM C 67

c. Saturation Coefficient – ASTM C 67

d. Crazing – ASTM C 126

9.4.9.2. Face Dimension Tolerances for sized/cut units: The face dimensions (length and width) shall not vary more than 1/16 inch plus or minus the dimensions specified on the setting drawings.

9.4.9.3. Face Dimension Tolerances for uncut/net units: The face dimensions (length and width) shall not vary more than 1/8 inch plus or minus per linear foot.

Tolerances for handmade units: The exposed face shall not vary from a true plane more than the existing original Terra Cotta units. Tolerances for machine-extruded units: The exposed face shall not vary from a true plane by more than 0.005 inch per inch of length.

9.4.9.4. Finished faces that will be exposed when installed shall be free from chips, blisters or other imperfections detracting from the appearance of the finished wall when viewed from a distance of no less than 15 feet.

9.5. LAYING/INSTALLATION

9.5.1. LAYING OF TILES/SLABS

The curing period of the setting bed shall be as directed by the Engineer. As large an area of setting bed shall be spread at one time as can be covered with tiles/slabs before the base has set. Surplus base material shall be removed. The thickness of setting bed shall not be less than the thickness specified in the Drawings.

Floor and other surfaces to receive the tiles/slabs shall be thoroughly cleaned of all dirt, dust oil and other objectionable matters. Tiles/Slabs shall be laid out from the center line of each space in an outward direction and the pattern should be made symmetrical with a minimum number of cut tiles.

Joints between the tiles/slabs shall be of uniform width. Tiles/Slabs shall be cut with an approved cutting tool and rough edges shall be rubbed smooth. Tiles/Slabs shall be laid to straight edges.

The floor and other finished surfaces should be kept wet for at least 72 hours and man traffic should not be allowed on the tiles during the period.

Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

9.5.2. LAYING OF RUBBER FLOORING

Clean your sub floor so that it is free of all dust, dirt, grease or other foreign material.

Also when gluing your flooring down, it is recommended that the sub floor is free of any moisture.

Loose lay out the rolls in the room as you would like them to look after a complete installation. (The rolls can be directional so make sure the color matches on each rolls. If the colors do not appear to match, flip them or turn them 180 degrees to ensure color matches.
Make any necessary cuts to the rolls to fit them into the room using a straight edge and a Utility knife with a fresh blade.

Roll up the rolls at one end of the room. Put down a 10 foot long light layer of adhesive and unroll 10 feet of the flooring into the adhesive at a time. Repeat this step for every 10 feet of roll length until the entire roll has been unrolled into its desired position.

After all rolls have been glued down, it is often recommended to use a 100 pound roller on the floor in order to guarantee good adherence to the sub floor. If a roller is not available, walking on the flooring in small choppy steps to ensure every spot of flooring has been walked on can also work.

9.5.3. LAYING OF CARPET FLOORING

9.5.3.1. Carpet is to be laid from the centre of rooms and parallel to walls. Where alignment with walls is not possible, the contractor is to submit for approval a shop drawing showing a proposed layout, taking into account appearance.

9.5.3.2. Carpets are to be fixed with a contact adhesive as specified or approved by the carpet manufacturer and care taken to avoid spreading of adhesive on the carpet surface. Any stained carpets to be removed and replaced.

9.5.3.3. Where carpet covers stepped areas an anodized aluminum angle strip specifically manufactured for the purpose is to be fixed to the edge of the step and secured to ensure that it cannot be dislodged. Samples are to be submitted for approval and the color of anodizing will be approved at the time of carpet color selection.

9.5.3.4. Where carpet meets walls it is to be trimmed to a neat line against skirting rails or other wall trim and securely fixed with adhesive.

9.5.3.5. Where carpet meets door openings, it is to finish with a specifically designed aluminum threshold strip securely fixed to the floor with stainless steel screws. Strips will be positioned so that the carpet surface is maintained up to the near-side face of the door and layout of carpet carpets will take this into account.

9.5.3.6. After lying, all trimmings are to be collected and removed and the whole surface carefully vacuum-cleaned.

10. BRICK MASONRY

10.1. SCOPE

The work under this section of the specifications consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in any floor and at any height in connection with furnishing and installing brick masonry in position including Portland cement and sand for mortar & masonry, complete in strict accordance with this section of the specifications and applicable drawings.

10.2. SUBMITTALS

Samples of first class bricks shall be submitted to the Engineer with test reports for his approval. Bricks of approved samples shall only be used in the works. If at any time, during the progress of the work, the Engineer finds use of sub-standard material, such work shall be rejected and the CONTRACTOR shall replace the rejected work at his cost.

10.3. QUALITY ASSURANCE

Portland cement for mortar shall conform to the applicable requirements specified in the section "Plain and Reinforced Concrete". Sand for mortar shall be furnished by the CONTRACTOR and shall conform to the applicable requirements for sand specified in the section "Plain and Reinforced Concrete". Water used in the manufacture of bricks and in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities, and will be tested and approved by the Engineer.

10.4. DELIVERY AND STORAGE

The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the bricks nor delay the use of mixed mortar. Masonry materials shall be so stored that at the time of use the materials are clean and structurally suitable for use.

10.5. STACKING, SAMPLING AND TESTING

Sort out and arrange the bricks in stacks of one or two thousands or as directed by the Engineer. Each stack shall be 10 courses high and two bricks thick so that at least 0.6 meter space between the stacks shall be left for the purpose of inspection. Stack each size or class of brick separately. For purposes of inspection and tests, the sample bricks shall be selected by the Engineer.

10.6. BRICK

10.6.1. All brickwork shall be erected plumb and true to line and level with maximum variation in any story height or any length of wall being one mm in one meter.

10.6.2. All bricks shall be of first class quality made from good brick earth, free from saline deposit and shall be hand moulded as per approved manufacturer list. They shall be thoroughly burnt without being vitrified, shall be regular, uniform in shape and size with sharp and square edges, parallel faces and of deep red or copper colour. First class bricks shall be homogeneous in texture and shall 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 at 21 to 27 degrees centigrade and shall show no signs of efflorescence on subsequent drying. The average compressive strength of five representative first class bricks shall be not less than 1800 psi and not less than 1500 psi for any individual brick.

10.6.3. 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.

10.6.4. The moulds used in the manufacture of bricks shall be thoroughly sanded before each use and shall be sufficiently larger 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 9" by 4-1/2" by 3" in size and shall weigh between 7 lb. to 9 lb. All bricks shall have a "frog" 1/4" deep on one face.

10.6.5. Cavity Wall is a wall comprising of two leaves, each leaf being built of masonry units and separated by a cavity so as to provide an air space within the wall and tied together with metal ties or bonding units to ensure that two leaves act as one structural unit. The width of the cavity shall not be less than 30 mm and not more than 115 mm. The space between the leaves being either left as cavity or filled with non-load bearing insulating and water proofing material.

10.6.6. Metal Ties may be of galvanized iron, wrought iron, gun metal, brass, copper, stainless steel or any such corrosion resistant metal, made of flats 20 x 5 mm cranked or twisted at their mid-point with ends split and fish tailed. The ties shall be built into horizontal bed joints during erection, placed sloping towards the exterior side to prevent water from flowing along it from outer to inner leaf side.

10.6.7. Bonding Units length will be sum of thickness of both leaves plus width of cavity if the leaves are 75 mm or 115 mm. If the leaves are more than 115 mm thick, then the length of a unit will be [(2 ×115) + width of cavity].

Cement concrete used in the bonding units shall not be leaner than 1:3:6 (1 cement: 3 sand : 6 aggregate 20 mm nominal size).

10.6.8. Metal ties/bonding units shall be spaced not more than 90 cm apart horizontally and 45 cm vertically and staggered in each course. Additional ties shall be used near openings.

10.6.9. Cavity walls shall not normally be built more than 7.5 meters in height and 9 meters in length. Where large lengths and heights are desired, the wall shall be divided into panels with strengthening measures such as pillars etc. Cavity shall be covered at the top with at least two courses of masonry unit and/or a coping over it. Adoption of cavity walls is not recommended when heavy concentrated load from beam etc. are to be supported by walls.

10.7. MORTAR

10.7.1. Mortar for first class brick masonry, except where otherwise directed by the Engineer, shall consist of one part Portland cement to five parts of damp loose mortar sand by volume and sufficient water to produce proper consistency for the intended use. Where directed by the Engineer for increased workability, hydrated lime putty, approved by the Engineer, shall be added to the mortar but shall not exceed 25 percent, by volume of the dry cement.

10.7.2. Methods and equipment used for mixing mortar be such as will accurately determine and control the amount of each separate ingredient entering into the mortar and shall be subject to the approval of the Engineer. Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of water to the mix shall be rejected. Re-tempering of mortar shall not be allowed.

10.8. EXECUTION

10.8.1. Soaking and washing bricks

Before use, soak bricks in clean water for at least 4 hours. If bricks contain soluble salts liable to cause efflorescence, wash bricks thoroughly to satisfaction of the Engineer using diluted HCL (1:40 litre)

10.9. PLACING / FIXING

10.9.1. The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the brick nor delay the use of mixed mortar. Brick 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 kept wet by soaking in water for 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.

10.9.2. Bricks shall be laid "frog" upward with mortar joints and in English and Flemish bond as shown on the Drawings or as directed by the Engineer. Both bed and vertical joints shall be 3/8" in thickness completely filled with cement mortar as specified herein, and each brick shall be bedded by 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 repainted. Care shall be taken during construction of cavity walls so as to avoid the filling up of cavity with mortar. G.I. flashing and weep holes shall be provided where ever specified on the drawings or as per the instructions of the Engineer. Weep- holes will be formed by oiled rods, removed after the mortar is set, at specified locations.

10.9.3. The external face of brick masonry surface of the exterior walls (where ever shown or as directed by the Engineer) shall be finished by English/ Flemish bond and by deep struck pointing as the work proceeds. The joints shall be struck by the help of a pointing tool to provide a notch in the green mortar after the brick work has been laid. 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.

10.10. ANCHORING

All brick masonry shall be bonded to concrete columns/walls/beams with steel anchors as per details provided in drawing. Anchors/wall ties as specified or as instructed by the Engineer shall be provided in cavity walls.

10.11. CURING AND REPAIR

10.11.1. All brick masonry shall be water 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 the Specifications for water used in the manufacture of bricks.

10.11.2. If, after the completion of any brick masonry work, the brick is not in alignment or level, or does not conform to the lines and levels 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.

10.12. SCAFFOLDING

10.12.1. 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 SUB-Contractor in the unit rate for masonry items.

10.12.2. Damage to masonry from scaffolding or from any other cause shall be repaired by the CONTRACTOR at his own cost.

10.13. TESTING

All brick work shall be erected plumb and true to line and level with maximum variation in any storey height or any length of wall being 1/8" in 10 feet. The maximum tolerance in the length, height or width of any single masonry unit shall be ± 1/8".

10.14. DAMP PROOF COURSE

All damp proof course unless otherwise specified shall consist of class 'C' cement concrete 2" thick, mixed with approved quality water proofing compound (SIKA/ MBT/ Approved equivalent) as per manufacturer's specifications and shall be laid at required levels 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 the relevant drawings including finishing and curing complete. All damp proof courses shall be laid over approved water proofing materials as specified on the Drawings.

11. WOOD WORK

11.1. SCOPE

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

11.2. SUBMITTALS

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

11.2.1. Provide manufacturer's literature completely describing products.
11.2.2. Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.
11.2.3. Provide certificates stating that doors were constructed with timber of the species specified having moisture content and meeting equilibrium and relative humidity requirements.
11.2.4. Submit samples of MDF, Wood, Plywood, Formica, etc. for selection of texture/colour, quality and grain.
11.2.5. Procurement of materials shall be made only after the submittal of shop drawings and samples and their approval by the Engineer.

11.2.6. MOCK-UP SAMPLE

After approval of shop drawings and tests etc., the CONTRACTOR shall submit one mock-up sample of each type of wood work complete with all fixing, fixtures accessories prior to the actual fabrication of the bulk. No extra payment shall be admissible to the SUB-Contractor on this account.
The samples shall be returned to the CONTRACTOR for incorporation in the works after installation of at least 80% of the works.

11.3. MATERIAL

11.3.1. HARD WOOD

Hard wood shall comprise of Ash, beech, Walnut Mahogany, Teak, Iroko and Sheesham.

11.3.2. SOFT WOOD

All soft wood shall consist of pines, spruce, hemlock and douglas fir or cedrous deodar (referred in the document as deodar), wood locally known as Deodar Wood.

11.3.3. PLY WOOD

The plywood of any type mentioned on drawings and Schedule of values (softwood plywood, hardwood plywood, marine plywood, etc) shall comply in all respects with BSI No. 1455:1963 approved by the Engineer. All plywood shall be manufactured with phenol pharamaldihide or any other approved waterproof adhesive but not with urea pharamaldihide.

Plywood used for doors, and other similar works shall be to the thickness and size as shown on the Drawings or as directed by the Engineer. The grade shall be first quality and the face and back shall be free from end joints, dead knots, overlaps, patches and other similar defects. The surfaces shall be free, smooth for painting or polishing.

11.3.4. LAMINATED VENEERED BOARD

It shall be built-up board, with narrow strip 3 to 7 mm wide, faced both sides with either one or two veneers from 1.2 mm to 3.7 mm thick. Where single or double face veneers are used, the grain shall usually run at right angles to the grain of the core strip. This type of board, conforming to B.S. 3444 and of a thickness between 13 mm to 25 mm, shall be the base for the highest class of veneered wood.

11.3.5. CHIP BOARDS (PARTICLE BOARD)

Chip boards shall be made of wood particles in the form of chips or shavings of a controlled size combined with a thermo setting synthetic resin glue binder and formed into panels under the influence of mechanical pressure and heat. The process of adhesion shall be controlled resulting in a variety of boards with different but predictable physical properties. Chip Board, if specified, shall be used in sheathing, flooring and sub-flooring, wall paneling, partitions, shelves, furniture and veneered boards. It should not be affected dimensionally by changes in atmospheric humidity, though in wet conditions it shall have a limited resistance to moisture.

The surface finish of standard boards shall be comparatively rough and to support a good quality paint or varnish finish it shall require sanding and filling. Special grade of the board which has a paper surface permanently bonded to the board during manufacture shall be used for painting.

Chip boards shall be classified in grades of high, medium and low density mainly in thickness of 13 mm and 19 mm. The density range of this board is from 480 to 800 Kg per cubic meter as under:

High Density (HDF)	**Above 800 kg/m3**
Might (MDF)	**Below 650 kg/m3**
Ultra-Light (ULDF)	**Below 550 kg/m3**

Due to variation between brands, the weight of chipboard is not constantly proportional to thickness. Typical weights, based on standard chipboard with average density 750 kg/m3, are:

Thickness	**Mass Per Unit Area**
13.0mm	9 kg/m2
16.0mm	11.0 kg/m2
19.0 mm	14.0 kg/m2

Chipboard is available in an extensive range of thicknesses, i.e. 1.8mm to 60mm. The most common sheet sizes are: widths 1220mm, 1525mm and 1850mm and in lengths upto 3660mm.

Medium density fiberboard to be used on the project shall be imported of Malaysian origin of thickness as specified in the drawings. Board shall be manufactured with waterproof resinous glues and shall be guaranteed by the manufacturer. All boards required for the exterior surfaces of cabinets shall be laminated with Formica in approved colour and texture in factory as specified elsewhere.

11.3.6. GENERAL CHARACTERISTICS

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

The whole of the timber shall be from the heart of sound and fully grown tree, uniform in substance, straight in fibre, first class quality properly seasoned, free from large or loose dead-knots, open shakes and excessive sapwood. The scantlings of all timbers shall be bright, sound and square edged. The moisture content of timber shall not be more than 10 (ten) percent in case of soft wood and 7 (seven) percent in case of hard wood.

11.3.7. PRESERVATION OF WOOD

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

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

11.3.8. ADHESIVE

The adhesives shall conform to the requirements of BSI No. 745 manufactured approved for this Project or as directed and approved by the Engineer.

11.3.9. NAILS AND SCREWS

All nails and screws shall comply with requirements of BSI NO. 1202 and BSI NO. 1210 respectively.

11.4. DELIVERY, STORAGE AND HANDLING

Deliver and store products in waterproof, protective containers with seals unbroken and labels intact until time to use.

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

11.5. EXECUTION /FABRICATION

`Unwrought' timber shall be used. Sawing shall be done with sufficient oversize margin to finally meet the requirements of specified sizes and dimensions of the finished work.

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

11.6. PROTECTION OF MATERIALS

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

11.7. WOODEN DOORS

11.7.1. MATERIALS

First class Deodar wood as approved by the Engineer shall be used for doorframes and frames of shutters as specified and shown on drawings. Deodar wood planks/MDF boards shall be used in paneled shutters. Deodar wood shall be used as inner core for flush doors with Ash Ply facing.

Architraves, beads, lippings shall be of Deodar /Ash Wood of specified sizes and fixed as per details shown on Drawings.

11.7.2. GROUND, BLOCKING & NAILING STRIPS

Ground, blocking and nailing strips shall be provided as necessary to receive the work included herein and as required for the work of other trades.

Except as otherwise shown or specified, ground blocking and nailing strips shall be secured in place as follows: To steel--- by means of 3/8" diameter bolts spaced not over 3 feet.

To brick wall by the use of cut nails spaced not more than 1.5 feet apart and driven directly into the block.

To poured concrete by means of 1/4" diameter galvanized expansion bolts spaced not more than 1.5 feet part or by any approved method.

11.7.3. EXTERIOR AND INTERIOR DOOR FRAMES

All exposed surfaces of frames and architraves/beads shall be lacquer polished/painted with synthetic matt finished enamel paint of approved shade as per the instructions of the Engineer.

The doorframes shall be secured in place by means of corrugated anchors of non ferrous metal or galvanized ferrous metal bent up against the back and welded in place and built into masonry as it is being constructed. There shall be minimum of three anchors per side, with a maximum distance of three feet between the anchors. Additional steel plates for reinforcement shall be provided in the frame at the locations of hinges / locking arrangements.

11.7.4. DOOR SHUTTERS

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

All doors, shutters shall be fabricated in a workman like manner strictly to the correct sizes and shapes as shown on the Drawings or as directed by the Engineer. Flush shutters shall be hydraulically hot pressed and the frame of the shutter shall have tongue and grove joint.

The door shutters shall be built in sections, properly jointed and glued together. The surfaces shall be prepared for painting or polishing.

All door shutters shall be flush as per the schedule and details, fabricated from first class deodar wood as shown on drawings. Flush shutters wherever specified shall have Deodar / hard wood solid core with Polished Ash Ply of required thickness, color and approved quality on both sides.

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

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

All exposed surfaces of wooden frames and wooden shutters shall be lacquer polished/painted with synthetic matt finished enamel paint of approved shade as per the instructions of the Engineer.

Chamfers shall be made as shown on the drawings or as directed by the Engineer.

11.7.5. FITTING, HANGING AND TRIMMING

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

Doors shall have a clearance of 1/8" at sides and top unless otherwise directed by the Engineer and shall have 3/16" clearance at bottom. Doors shall be hung and trimmed with

hardware as specified. All the locks shall be installed at the same height and shall be located at height as directed by the Engineer. Where directed by the Engineer margin for carpet shall be incorporated in the door shutter.

11.7.6. HARDWARE

Hardware shall be of best quality local make extra heavy duty and first class finished material except door locks and door closures which shall be imported of European origin as per attached hardware schedule. The CONTRACTOR shall obtain prior approval from the Engineer for quality, shape, pattern, and brand of all the hardware materials by providing samples and catalogues, etc., and shall provide and fix only the approved hardware materials.

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

11.8. QUALITY ASSURANCE

Tolerances: Doors shall be fabricated to following tolerances

Length of diagonal measured on face of door from upper right corner to lower left corner and length of diagonal measured from upper left corner to lower right corner).

Manufacturer's Qualifications: The manufacturer of doors herein specified shall have been in business of manufacturing doors of type specified for minimum period of five years.

11.9. INSTALLATION

Install doors at correct openings and assure smooth swing and proper closer with frames.

Install finish hardware in accordance with manufacturer directions.

PARTITIONS

Partitions wherever shown on the drawings will be fabricated from deodar wood inner frames, MDF boards, glazing, hollow flush shutters (at least 70 % solid with deodar wood frame and Deodar wood core). CONTRACTOR shall submit detailed shop drawing for the approval of the Engineer. The surface of partitions shall be prepared for painting.

11.10. DEFECTIVE WORK

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

11.11. SURFACE PREPARATION

The surfaces of all wood works shall be prepared in the manner as directed by the Engineer for polishing or painting. Lacquer Polish, French polish must be used for the finishing of the Wood Work.

12. SURFACE RENDERING AND CLADDING

12.1. SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in any floor and at any height connection with providing and installation of cement plaster, and specified external rendering complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the Contract.

12.2. MATERIAL

12.2.1. Cement for plaster shall be Ordinary Portland Cement (B.S 12 or P.S 232) or ASTM C144-C631 CP 211 & CP 211 ASTM-D 596, C-40 C-87 C-109.
12.2.2. Sand for plaster shall comply with the requirements of BS 1199, BS 1200 or the draft Pakistan Standard "Sand for Plaster" as directed by the Engineer.
12.2.3. Water for plaster shall conform to requirements specified in the section for "plain and reinforced concrete".
12.2.4. Granite Slabs shall comply with ASTM C 615, “Standard Specification for Granite Dimension Stone” for material characteristics, physical requirements, and sampling for selection of granite and should be mechanically fixed as shown on the Drawings.
12.2.5. Sand Stone should be conforming to the drawings and manufacturer’s data.
12.2.6. SKINROCK is a wall covering made of real natural stone and it should conform to ASTM C-121 standard. Stone is drawn onto a solid carrier film in thin layers. Even larger stone veneers in the sizes 120 x 60 cm and 250 x 120 cm are extremely lightweight and can be installed on almost any surface.
12.2.7. Color Crete includes Karachi Sand in any color with binding and water proofing chemicals. Consists of silica sand, white cement, binding chemical of pegal German color and yellow color from China.

12.2.8. All materials and workmanship for plaster, not explained in these Specifications, shall comply with the requirements of relevant BS CP 211 and CP 221 as directed by the Engineer. The material used for plastering and pointing shall be got tested by the ENGINEER at the expense of the CONTRACTOR before giving approval thereof and the same approved type of material shall be used throughout the work. Waterproofing agent of proper standard shall be used where specified or indicated.

12.3. SUBMITTALS

The material used for plastering and pointing shall be got tested by the ENGINEER at the expense of the CONTRACTOR before giving approval thereof and the same approved type of material shall be used throughout the work. Waterproofing agent of proper standard shall be used where specified or indicated.

12.4. EXECUTION

12.4.1. Except as may be otherwise shown on surfaces specified, all plaster work, both internal and external shall be ordinary Portland cement plaster of the required thickness as shown on the drawings.
12.4.2. Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, doors and window frames and all sorts of inserts and embedded items are fixed in position. It shall be the responsibility of the SUB-Contractor to make sure that all such work is carried out by other CONTRACTORs before starting of plaster work. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer. Sample of materials shall be submitted to the Engineer for his approval prior to use in the works.

12.5. PROPORTIONING AND MIXING

12.5.1. Measurement of materials by volume shall be by containers of known capacity to maintain consistent proportions. No lumpy or caked material shall be used. Mixing equipment boxes and tools shall be clean. Materials shall be proportioned as specified on the Drawings, in the Schedule of values or as directed by the Engineer. Mixing shall be continuous until all ingredients are evenly distributed and thoroughly mixed.

12.5.2. Only limited water shall be added for proper workability and such quantity of mortar shall be prepared which can be consumed in thirty minutes after preparation. Preparation of mortar in bulk quantity for use during the entire day or for any other time more than that stipulated above is expressly prohibited. Retempering shall not be permitted and all mortar which has begun to stiffen shall be discarded.
12.5.3. Plaster ingredients shall be thoroughly mixed either by hand on a clean cement concrete platform or by a mechanical mixer, as directed by the Engineer.

12.6. PREPARATION OF SURFACE TO BE PLASTERED

12.6.1. Concrete surface to be plastered shall be cleaned to remove all grease, form oil and other surface impurities, which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface of all-concrete ceilings, beams and

columns shall be lightly hacked by approved means to give the required key for plastering.

12.6.2. All masonry surfaces to be plastered shall be cleaned to remove all matter, which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface shall be washed with clean water and kept damp for 24 hours before further treatment. The surface thus prepared shall be treated uniformly with cement and sand slurry. The slurry to be used shall be one part cement to one part sand by volume with water added to make a stiff creamy mix. The slurry shall be applied with a stiff brush on surface, which has previously been well wetted. The surface so treated shall be left to cure for 3 days.

12.7. APPLICATION OF PLASTER

12.7.1. The plaster of thickness less than the specified thickness shall be rejected. If the plaster is to be more than 3/4" thick, it shall be done in two coats. The surface of first coat shall be made rough before the second coat is applied. Smooth surface of concrete cost-in-situ shall be made rough by chiseling gently.
12.7.2. The plaster shall not have wavy surface and shall be perfectly in plumb. The edges and corners shall represent a straight line. The plaster shall be kept wet continuously for at least ten (10) days. No extra payment shall be allowed for jambs, junctions, corners, edges, round surfaces or for more than one layer of plaster required due to any unevenness in the work done by the CONTRACTOR. The plasterwork is to cover all conduits, pipes etc. fixed in the walls and ceiling. Wherever specified, metal lath shall be nailed firmly before plastering is commenced. The plaster surface shall be tested frequently with a 10 feet straight edge and plumb bob.
12.7.3. Plaster containing cracks, blisters, pits, discoloration or any defects shall not be acceptable. Any such plaster or loose plaster shall be removed & replaced with plaster in conformity with these specifications and as additionally directed by the Engineer. CONTRACTOR shall cut out and patch all defective work at his own cost. All damaged plaster shall be patched as directed by the Engineer. Patching plaster shall match appearance of and shall be finished level with adjoining plaster.

12.8. METAL LATH

12.8.1. Metal lathing shall be fabricated from sheet steel and shall be of uniform quality and free from flaws broken strands, cracks and corrosive pitting, shall be rectangular and true to shape and shall comply with BS-1369.
12.8.2. All lathing shall be galvanized. Where plastering material depends entirely on the lathing for its key, these shall be not less than two complete mesh openings per 1-1/8"in one direction and the width of the aperture shall not be less than 3/16".

12.8.3. Sheets shall not be less than 1.6 kg/sq.m when fabricated, using 0.7 mm thick steel sheet. Where used on smooth surfaces to form a key it shall be not less than 1.2 kg/sq.mm when fabricated, using 0.5 mm thick steel sheet. Tying wire shall be 1.2 mm diameter galvanized annealed iron wire. Sheets shall be welded to angle iron frame as shown on drawings or as per direction of incharge.

12.9. ANGLE AND BEADS

12.9.1. Angle beads, stop beads, depth gauge beads, edging profiles, plaster dividing profiles, interior angle profiles, plaster borders and the like shall all be manufactured from sheet steel and galvanized after fabrication, all beads shall be perforated at edges to ensure good adhesion of the plaster work. Thickness and dimensions shall suit particular locations and plaster thickness.

12.9.2. All angle beads, stop beads, depth gauge beads and the like are to be fixed in accordance with the manufacturer's instructions, at all corners, stops, joints, etc. as per directions of Engineer In-charge.

12.10. INTERNAL/EXTERNAL PLASTER

Where specified in the Drawings external surface shall have an average 3/4" thick plaster finish, consisting of a base coat of 1:4 cement sand mortar in Grey cement and the finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer. Where specified in the Drawings all internal plaster shall have an average 1/2" thick consisting of base coat of 1:3/1:4 cement sand mortar in grey cement and finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer.

12.11. STUCCO PLASTER

Wherever specified in the drawings external stucco plaster shall consist of 1:2, one part white cement & 2 parts approved shade of marble chips zero size mixed with approved pigment to achieve desired shade. Wherever shown on drawings, groves shall be provided with aluminum U/Y channels. The CONTRACTOR shall prepare mockup samples of stucco plaster for the approval of Engineer. The plaster shall be applied with machines and the final rough surface/texture/shade shall be as per the approved sample, direction and approval of the Engineer-Incharge.

12.12. CURING

Curing of base coats and finish coats of walls shall be by covering with burlap, kept wet at all times, shall commence as soon as plaster has set and shall continue for 8 days or as noted otherwise. Curing of ceilings: Shall be by direct application of water so as to keep plaster damp at all times for 8 days.

12.13. CLEANING AND PROTECTION

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

12.13.2. Remove protective materials and any plaster materials from adjacent surfaces. Prior to plastering all aluminum windows, finished metals should be covered by sheet of plastic or tarpaulin to protect it from damage.

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

13. WATER PROOFING

13.1. SCOPE

The work under this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in any floor and at any height in connection with installation of insulation, water-proofing and built-up roofing, including water proof treatment to foundations and basement structures complete in strict accordance with the specifications and the applicable drawings.

13.2. SUBMITTAL

13.2.1. Shop drawings shall be submitted showing all the details for construction.

13.2.2. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

13.2.3. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements as specified.

13.2.4. Submit 2 samples of insulation and any other samples requested as per direction of Engineer

13.2.5. Product Data: Submit copies of manufacturer's product data sheets, installation instructions, use limitations and recommendations. Include certification of data indicating Volatile Organic Compound [VOC] content of all components of waterproofing system.

13.2.6. Installer Qualifications: Copies of verification of waterproofing capabilities, facilities, personnel and a list of completed projects comparable to scope of this project.

13.2.7. Samples of all materials proposed for use under this section, shall be submitted to the Engineer for approval.

13.3. MATERIALS

13.3.1. Bitumen shall be specified grade as per drawing and Special Industrial bitumen (SIB) National / Refinery. A priming coat of suitable thinned bitumen shall be applied before the application of bitumen coating.

13.3.2. Polyethylene building film visqueen standard or approved equal. The film shall be 150 (minimum) micron thick.

13.3.3. For thermal insulation closed cell polyethylene foam bonded sheets manufactured by JUMBOLON shall be used. The thickness of bonded sheets shall be 1-½" minimum.

13.3.4. Sealant to be used in expansion joints and flashings shall be 2 parts polysulphide or approved equivalent.

13.3.5. Sika Seal-105 N as per International Standards comprising of cementitious powder and polymer dispersion should be used for water proofing of exposed as well as retaining structures such as tanks, manholes and retaining walls etc.

13.3.6. Puddled earth shall be composed of stiff clay to which an equal amount of chopped rice husk/ bhoosa shall be added.

13.3.7. 3-½" thick average (2" thick min) puddle earth (mud plaster) mixed with rice husk/ bhoosa, laid in slope.

13.3.8. PVC Geo-membrane as per ASTM standards of approved membrane shall be 4 mm thick.

13.3.9. WATER PROOFING & BUILT UP ROOFING

Size of roll	1.0 M wide X 10.0 M long	
Nominal Thickness	4 mm	ASTM D75I,UEAtc
Upper Surface	Polyethylene film See 'Other Finishes' also	
Lower Surface	Polyethylene film	
Type of coating	APP modified bitumen	
Reinforcement	Non-woven Polyester	UEAtc
Tensile strength	Longitudinal 1000 N/5 cm Transversal 1000 N/5 cm	ASTM D146,UEAtc

Elongation at break	Longitudinal 5 0% Transversal 50%	ASTM D I 46,UEAtc
Softening point of the coating	> 150 °C	ASTM D36,UEAtc
Cold flexibility	- 10 °C (No cracks)	ASTM DI46,UEAtc
Heat Resistance Method A, 2 hours	I 30 °C (No flow)	UEAtc
Chemical Resistance	Resistance to water, salt solutions, dilute acidsand alkalis	

13.3.10. STORAGE: Rolls should be stored vertically in dry covered areas, protected from frost and heat during storage.

13.3.11. GUARANTEE: Should be warranted against manufacturing defects for a

period of ten years.

13.4. DELIVERY STORAGE AND HANDLING

13.4.1. Materials shall be protected from damage during loading shipment delivery and storage. Non-staining materials shall be used for blocking and packing.

13.4.2. Water proof membrane shall be stored at a temperature recommended by the manufacturer. Deliver materials to job site in labelled packages

13.4.3. Store and handle materials in strict compliance with manufacturer's instructions, recommendations, and material safety data sheets.

13.4.4. Protect materials from damage from sunlight, weather, excessive temperatures, and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

13.4.5. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

13.4.6. Protect mastic and adhesive from moisture and potential source of ignition.

13.4.7. Store protection board flat and off ground. Provide cover on top and all sides.

13.4.8. Store aluminium materials clear of ground in a dry place. Protect from distortion, damage to surfaces & edges and from contact with alkaline materials.

13.5. EXECUTION

Inspect all surfaces to receive roofing materials, waterproofing, insulation & sheet metal and ascertain that they are sound, clean, smooth, dry and free of debris, loose material or defects which would have an adverse effect on the roofing application or performance. All vents and any other projections through the roofs shall be properly flashed and secured in position.

13.6. PREPARATORY WORK

All scuppers and roof drains shall be placed and metal flashing flanges etc. shall be provided in time to be installed along with the roofing assembly.

All surfaces, to be treated shall be dust free and dry. Application of roof finishes shall not start unless the preparatory work has been inspected and approved by the Engineer.

13.7. APPLICATION

13.7.1. Roofing shall not be applied during rain or while surfaces are damp, it shall be applied only to surfaces that are clean and dry.

13.7.2. PVC Geo-membrane sheet shall be laid on primer coat in position wherever shown in drawings. The application of the membrane is by using a suitable propane gas torch. The membrane roll is lined up and positioned over the area to be fixed. The membrane should be rolled up again and progressively unrolled without changing its orientation and heated at the lower surface with a propane gas torch to cause slight surface melting and adhesion to the substrate. The next roll of membrane is positioned with the membrane already fixed by overlapping at least 8 cm at the side and end laps. Overlaps should be heated from the top and sealed with a trowel to ensure total adhesion of joint. Exposed application provided with a selvedge strip 8 cm wide along the length of roll. At the end of roll, joint is made by scraping off 8 cm of slate granules or marble chips.

13.7.3. The CONTRACTOR shall protect the sheets from damages during laying and subsequent operation and shall replace at his own cost all damaged sheets to the satisfaction of the Engineer.

13.7.4. For thermal insulation closed cell polyethylene foam bonded sheets manufactured by JUMBOLON shall be laid in places as designated on drawings or as directed by the Engineer. Joints between the sheets/overlaps shall be treated as per Manufacturer's recommendation.
13.7.5. Polyethylene sheet shall be laid in position wherever shown in drawings or specified herein. Where joint is necessary at the side or end of the sheet, this shall be a double weld folded joint made by placing the edges together and folding over twice continuously taking the top edge prior to the application of mud plaster. The SUB-Contractor shall protect the sheets from damages during laying and subsequent operation and shall replace at his own cost all damaged sheets to the satisfaction of the Engineer.
13.7.6. The clay containing sand not less than 5% shall be reduced to fine powder and mixed with water in a pit adding fibrous material such as chopped rice husk/bhusa in the proportion of 60 to 70 lb/ 20 Cft. of clay. The mixture will be allowed to mature for 7 days during which period it will be worked up from time to time so as to make it into a homogeneous mass. 3-½" thick average (2" thick min) puddle earth (mud plaster) mixed with rice husk/ bhoosa, laid in slope. It will then be thoroughly mixed to the required consistency of mortar and applied to the required slopes.
13.7.7. Brick tile of approved size shall be laid in 1:2, grouted and pointed flush in cement mortar. The top surface shall be smooth and accurately leveled in accordance with the specified slope. No broken or cracked tiles shall be used.
13.7.8. SETTING OUT: the area to receive tiles shall be set out to correct alignment, gradients and crossfall using optical instruments.
13.7.9. LAYING: each tile or paver shall be laid as indicated in drawings, depths as specified or detailed. All adjacent vertical edges shall be mortared. Before each tile is fixed to a slight concave bevel, check to insure correct alignment with adjacent tiles or pavers and that there is a no evidence of rocking or movement. Fill joints as soon as possible after tile or paver installation.
13.7.10. CUTTING OF TILES: make all cuts square to the face of the flag. A tolerance of 1/8" shall be permitted where such cuts abut other tiles or pavers or fittings in the area of work. Cut tiles occurring on curves to radius lines.
13.7.11. SURFACE ACCURACY: a tolerance of 1/8" over 10 feet shall be permitted, alignment of tiles with adjacent edging, curbs, etc. shall be as detailed. Chipped, broken and cracked tiles will be rejected.
13.7.12. CURING: Tiles after laying, grouting and flush pointing shall be kept wet throughout for at least 7 days.

14. FALSE CEILING

14.1. SCOPE

The work under this section of the specifications, consists of furnishing all plant, labour, equipment, appliances and materials in any floor and at any height and in performing all operations in connection with providing and installing different types of false ceiling including suspension system complete, in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

14.2. SUBMITTALS

14.2.1. Shop drawings shall be submitted showing reflected ceiling plan, locations of built in products and access facilities, dimensions, layout arrangements, hanger locations, structural connection, details of level changes, direction of pattern and panel joint details: The shop drawings shall be got approved by the CONTRACTOR from the Engineer in advance of under taking this item of works.

14.2.2. No materials shall be procured prior to approval of shop drawings and details.

14.2.3. The CONTRACTOR shall incorporate the required access panels of false ceiling as per approved shop drawings.

14.3. MATERIALS

14.3.1. WATER RESISTANT GYPSUM BOARD CEILING

- ASTM C1396 (Section 7), regular type except where Type X fire-resistant type is indicated or required to meet UL assembly types.
- Thickness: 1/2 inch, unless otherwise indicated.
- Acceptable products: Equivalent to Sheetrock Brand Water-resistant, Water-resistant Firecode "C" or Water-resistant Firecode Type X Gypsum Panels by USG.

14.3.2. GYPSUM BOARD CEILING

- ASTM C1396 (Section 5), regular type [except where Type X fire-resistant type is indicated or required to meet UL assembly types.
- Thickness: 1/2 inch, unless otherwise indicated

14.3.3. GYPSUM BOARD ECHO BLOC CEILING

- This type of ceiling must be sound absorption gypsum board having sound absorption with NRC 0.65-0.8.
- Modern design with graphic pattern.
- Rate of perforation 13.4%

14.3.4. PLYWOOD CEILING

For materials and standards in plywood ceiling refer to section “WOOD WORK”.

14.3.5. SUSPENSION SYSTEM

The suspension system for all types of false ceiling shall be in accordance with the recommendations of the approved false ceiling manufacturer and approved shop drawings, galvanized steel universal U-channels/ main T/Cross-T Bars, wail moldings/ edge trims, hold down/adjustment clips, galvanized, hanger strips with adjustment mechanism, etc. Main-T/Cross-T bars shall have the exposed surface finished in the desired colour as per the instructions of the Engineer.

14.4. DELIVERY, STORAGE AND HANDLING

14.4.1. Material shall be delivered in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating.

14.4.2. Material shall be stored in original protective packaging to prevent soiling, physical damage or wetting.

14.4.3. Cartons shall be stored in the installation area, opened at each end to stabilize moisture content and temperature, for 48 hours prior to installation.

14.5. EXECUTION

False ceiling shall be installed wherever indicated on the drawings by skilled technicians experienced in this type of work. Installation shall not commence in any room or space before completion of plaster work on structural roofing/internal wailing/external surfaces.

14.5.1. JOB SITE CONDITIONS

14.5.1.1. Work, which will be concealed by false ceilings, shall be completed, tested, inspected and accepted before ceiling work is started.
False ceiling installation shall not begin until the area has been closed in, 'and temperature and humidity approximate occupancy conditions. Wet work shall be cured and dry before ceiling work is started.

14.5.1.2. Surface which will support the ceilings, and those to which the ceiling abut, shall be inspected and accepted for completeness and adequacy to receive the ceilings before the work begins.

14.5.2. INSTALLATION AND WORKMANSHIP

False ceiling suspension system and panels shall be installed in accordance with the manufacturer's recommendations and as approved by the Engineer.

14.5.2.1. Suspension System
The hangers as specified shall be evenly disposed as per drawings, details and place and position as indicated. The suspension system should be installed by making holes directly in the roof and shall be made good as directed by the Engineer. Their lengths clear of roofing slab shall be as per shop drawing details.

The framing of the specified sections, jointing of runners to hangers, extra framing where required shall be provided for light receptacles as per approved shop drawing details.

Wall hangers shall be positively and rigidly connected to the structure and to cross runners.

14.5.2.2. Gypsum Board Tiles/Moisture-Resistant Gypsum Board/Echo Bloc Gypsum Board false ceiling.
Panels shall be installed in the grid system after completion of installation of the suspension of lighting and air conditioning fixtures.

Forming ceiling panels shall be laid out in pattern including border of uniform width around all sides of each ceiling area. The pattern shall be as per shop drawings approved by the Engineer.

All panels shall be furnished and installed in an approved manner and as per approved types, sizes and surface design.

14.5.3. INSTALLATION OF FIXTURES

Light fixtures shall be installed as per approved pattern and supported in accordance with manufacturer's recommendations.

14.5.4. FINISHING

After installation, dirty, oiled or discolored surfaces shall be cleaned and left free from defects and ready to receive any painted finish if required.

The panels, which are damaged or improperly installed, shall be removed and replaced by the CONTRACTOR at his cost.

15. PAINTING & VARNISHING

15.1. SCOPE

The work under this section of the Specifications consists of furnishing all materials, plant, labor, equipment, appliances and performing all operations in any floor and at any height in connection with surface preparation, mixing, painting concrete works, gates, frames, walls, ceilings and all such surfaces, architectural textured coatings, as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

15.2. SUBMITTALS

Samples of all colors/textures and finishes shall be prepared in advance of requirement so as not to delay work and shall be submitted to the Engineer for approval before any work is commenced. Any work done without such approval shall be redone to the Engineer's satisfaction, without additional expense to the ENGINEER. Samples of each type of paint/textured coating shall be on separate 12" x 12" x 1/8" tempered hard board panels. Manufacturer's chart showing all the variety of paint/textures shall be submitted for color/texture selection.

The Engineer will furnish a schedule of colors/textures for each area and surface. All colors shall be mixed in accordance with the manufacturer's instructions.

15.3. MATERIALS

15.3.1. Except as otherwise specified, all painting shall be applied in conformity with BS CP 231 "Painting of Building" as applicable to the work. All materials shall be acceptable, proven, first grade products and shall meet or exceed the minimum standards of reputable manufacturers as approved by the Engineer.

15.3.2. 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. All materials shall be subject to the Engineer's approval.

15.3.3. All synthetic enamel paints and primers for structural steel works, metal work and wood works will be the best available of its type and shall be approved by the Engineer prior to its procurement.

15.3.4. Approved quality Weather Shield/Weather Coat paint shall be used for painting the exteriors of the structures or other surfaces where specified on the drawings as directed by the Engineer.

15.3.5. The plastic emulsion paint/vinyl emulsion paint or similar as approved by the Engineer shall be used for interior surfaces.

15.3.6. Texture coating wherever specified shall be acrylic resin based coating composed of acrylic copolymers, natural quartz, natural marble chips, metallic oxides, antibacterial and antifungal additives, and expanders, foaming and setting agents and shall be applied in-accordance with approved manufacturer’s recommendations.

15.3.7. All material for Bitumen painting shall consist of Bitumen grade as mentioned on drawings. It shall be used for foundations or wherever recommended by the Engineer. The rate of application in foundations shall not be less than 20 lb/100 Sft. each coat.

15.4. DELIVERY, STORAGE AND HANDLING

Paints/coatings shall be delivered to the site in sealed containers, which plainly show the type of paint, colour (formula or specifications number) batch number, texture, quantity, date of manufacture, name of manufacturer and instructions for use. Pigmented paints shall be supplied in containers not larger than 20 liters. All materials shall be stored under cover in a clean storage space, which should be accessible at all times to the Engineer. If storage is allowed inside the building, floors shall be kept clean and free from paint

spillage.

15.5. EXECUTION

Except as otherwise specified all concrete and plastered surfaces are to be painted/coated.

SURFACE PREPARATION

15.5.1. All oil, grease, dirt, dust, loose mill scale and any other foreign substance shall be removed from the surface to be painted/coated, polished and white washed by the use of a solvent and clean wiping material. Following the solvent cleaning, the surfaces shall be cleaned by scrapping, chipping, blasting, wire brushing or other effective means as approved by the Engineer.

15.5.2. In the event the surfaces become otherwise contaminated in the interval between cleaning and painting/coating, re-cleaning will be done by the CONTRACTOR at no additional cost.

15.5.3. Surfaces of stainless steel, aluminum, bronze, and machined surfaces adjacent to metal work being cleaned or painted shall be protected by effective masking or other suitable means, during the cleaning and painting operations.

15.5.4. All the surfaces to be painted/coated with approved quality paint/coat shall be free from dust, dirt, fungus, lichen, algae etc. Oil paint, varnish and lime wash should always be removed by scraping and washing.

15.5.5. All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire-brushing or as directed by the Engineer. The surface shall be primed with a coat of asphalt oil used at the rate of not less than 1 gallon per 100 square foot of area. No work in this section shall be allowed until all surfaces or conditions have been inspected and approved by the Engineer.

15.6. APPLICATION

15.6.1. All paint and coating materials shall be in a thoroughly mixed condition at the time of application. All work shall be done in a workman like manner, leaving the finished surface free from drips, ridges, waves, laps, and brush marks. All paints shall be applied under dry and dust free conditions. Unless approved by the Engineer paint shall not be applied when the temperature of the metal or of the surrounding air is below 7 degrees centigrade. Surfaces shall be free from moisture at the time of painting.

15.6.2. All primary paint shall be applied by brushing. The first coat of paint shall be applied immediately after cleaning. When paint is applied by spraying, suitable measures shall be taken to prevent segregation of the paint in the container during painting operation.

15.6.3. Effective means shall be adopted for removing all free oil and moisture from the air supply lines of the spraying equipment. Each coat of paint shall be allowed to dry or harden thoroughly before the succeeding coat is applied. Surfaces to be painted that will be inaccessible after installation shall be completely painted prior to installation.

15.6.4. Coats of Weather Shield/Weather Coat paint and textured coatings shall be applied in accordance with the manufacturer's instructions or as directed by the Engineer.

15.6.5. For painting only as much material should be mixed as can be used up in one hour. Over-thinning will not be permitted. After the first coat the surfaces will be soaked evenly four or five times and the second coat shall be applied after leaving for at least overnight.

15.6.6. Where shown on Drawings all exterior finishes shall be painted/coated with Weather Shield/weather coat paint or texture coated in approved colours/textures as per manufacturer's specifications. The number of coats shall be as shown on the drawings or as directed by the Engineer.

15.6.7. All wooden doors shall be painted with approved synthetic enamel paint or lacquer polished as per manufacturer's recommendation and instructions or after approval of the Engineer.
15.6.8. Plastic emulsion paint, vinyl emulsion paint or matt enamel paint of the approved make and shade shall be applied to surfaces as shown on Drawings as per manufacturer's instructions. The number of coat shall be as indicated on the Drawings or as directed by the Engineer.
15.6.9. Two coats of hot bitumen paint shall be applied to exposed concrete surfaces in contact with earth. The first coat shall be allowed to dry for about six hours before applying the second coat. During the operation of painting great care should be taken to avoid air bubbles. The manufacturer's instructions and Engineer's directions shall be complied with.
15.6.10. The CONTRACTOR shall repair at his own expense all damaged or defective areas of shop-painted metal work and structural steel work. Metal surfaces against which concrete is to be placed will be shop-painted and shall be cleaned prior to being embedded in concrete.

15.7. JOB CONDITIONS

15.7.1. Observe manufacturer's recommended minimum and maximum temperature but do not apply paint or finish to any surface unless ambient temperature is 10 degree C or above and less than 43 degree C. No painting shall be done above 90% relative humidity.
15.7.2. Place drop cloths to adequately protect all finished work.
15.7.3. Remove and replace all items of finish hardware, device plates, accessories, lighting fixtures or other removable items.
15.7.4. In no case shall any finish hardware or other finished item that is already fitted into place be painted, unless otherwise specified.

15.8. QUALITY ASSURANCE

All paint/coat for any one surface shall be top quality, of one manufacturer and approved by the Engineer. Deep tone accent colours shall be used and the unavailability of final coat colours may be the basis for rejecting materials for any one surface.

16. STEEL AND METAL WORKS

16.1. SCOPE

The work covered by this section, consists of supply of all material, labour, plant, equipment and appliances including welding, bolts, nuts, washers, anchor bolts, embedded parts etc, fabrication, erection and painting in accordance with the specifications and as per drawings and as directed by the Engineer.

16.2. APPLICABLE STANDARDS

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

AISC Code of standard practice

AISC Specifications for Design, Fabrication and Erection of Structural Steel for buildings.

AISC Specifications for structural joints using ASTM A325 or A490

Bolts. ASTM Specifications for materials

AISC/ Guide to shop painting of structural steel

AWS Specifications for welding of steel structures

BS 449 Use of structural steel in Buildings

16.3. SUBMITTALS

Shop drawings shall be prepared by the CONTRACTOR. These shall contain main dimensions, sizes of members, typical details of joints and submitted to the Engineer for approval.

16.4. MATERIAL

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

16.4.1. MILD STEEL

Structural Mild steel for structures shall conform to the requirements of ASTM A-36 or equivalent

16.4.2. STEEL FORGING

Steel forging shall conform to the requirements of ASTM A235.

16.4.3. STAINLESS STEEL

Stainless Steel shall conform to the requirements of AISI 304 or 316.

16.4.4. PIPE FOR HANDRAILS

Pipe for hand rails: unless shown otherwise on drawings, it shall conform to Stainless Steel standards mentioned above.

16.4.5. CORRUGATED GI SHEETS

Pipe for hand rails: unless shown otherwise on drawings, it shall be medium grade complying with the requirements of ASTM A-123, A-153, A-767.

16.4.6. STEEL CASTING

Steel casting shall conform to the requirements of ASTM A27.

16.4.7. WELDING

Welding Electrodes for manual shielded metal arc welding shall conform to AWS A 5.1 latest edition or the A 5.5 latest edition. Equivalent locally manufactured electrodes may be used subject to the approval of the Engineer.

16.4.8. COMMON BOLTS, ANCHOR BOLTS, NUTS AND WASHERS

Common Bolts, Anchor Bolts, Nuts and Washers Bolts and Nuts shall conform to the requirements of ASTM A 307.

16.4.9. HIGH STRENGTH BOLTS

High strength carbon steel bolts including nuts and washers shall conform to the requirements of ASTM A325 latest editions and of AISI B18.2

16.4.10. WASHERS

Cut Washers: Shall be of structural grade steel and shall conform to the dimension of the manufacturer's regular standard for plain washers for the size of bolts used.

16.4.11. CAST IRON

Shall conform to the requirements of latest edition of ASTM A 48.

16.5. CONNECTIONS

16.5.1. DESIGN OF CONNECTION

All connections shall be designed and detailed for forces shown on the drawings, if any or 50% of the effective capacity of the member, whichever is greater.

Shop connections may be welded or bolted. Field connections shall be bolted unless noted otherwise on design drawings.

16.5.2. INSTALLATION OF BOLTS

High strength bolts shall be installed in accordance with AISC “Specifications for Structural Joints using ASTM A 325 or A 490 bolts”.

16.5.3. MINIMUM SPACING OF BOLTS

The distance between centers of boltholes shall not be less than 3d, where d is the diameter of the bolt in inches.

16.5.4. MINIMUM EDGE DISTANCE

The minimum edge distance i.e. center of standard hole to edge of connected part shall be as given in the table below:

NOMONAL BOLT DIAMETER (INCHES)	AT SHEARED EDGES (INCHES)	AT ROLLED EDGES OR PLATES, SHAPES OR GAS CUT EDGES (INCHES)
1 / 2	1.5 TIMES THE DIAMETER OF BOLTS	3 / 4
5 / 8		7 / 8
3 / 4		1
7 / 8		1 – 1 / 8
1		1 – 1 / 4

16.5.5. ALLOWABLE STRESSES

Allowable design stresses for structural steel members and their connections, including temporary bracings and shorings shall be in accordance with AISC Specifications.

16.6. EXECUTION

16.6.1. FABRICATION

The CONTRACTOR shall notify the Engineer about any problems or doubts/errors discovered in the drawings for clarification/rectification well in time to prevent any fabrication errors. Fabrication shall not be commenced until approval has been obtained from the Engineer.

16.6.1.A. Straightening of Material

Rolled material, before being worked upon must be straightened within tolerances by ASTM specifications A6 Straightening, necessarily shall be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 1100°F for A 514 steel or 1200°F for other steels.

16.6.1.B. Cutting

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

16.6.1.C. Holes Punching Drilling.

Holes shall be punched where thickness of the material is not greater than the diameter of bolt + 1/8". Where the thickness of the material is greater the holes shall either be drilled or sub-punched and reamed to size. The die for all sub-punched holes and the drill to all sub-drilled holes shall be at least 1/16" smaller than the nominal diameter of the rivet or bolt. Holes for A514 steel plates over 1/2" thick shall be drilled.

16.6.1.D. Welding

a) General:

The execution and inspection of welding will be done in accordance with the provisions of the American welding society code for welding in Building construction, D1.0. No welding for piping/electrical supports shall be made transversely to any tension flanges of trusses, beams or columns.

b) Automatic sub-merged Arc Welding:

For all built-up members, i.e. sections fabricated from plates and flat bars or compound rolled sections, plate and box girders, where long continuous, welding is to be done, should be executed by Automatic submerged Arc Welding process in accordance with relevant AWS specifications.

c) Maximum and minimum size and lengths of fillet welds shall be in accordance with AISC specifications.

Surface to be welded shall be free from loose scale, slag, rust, grease, paint or any other foreign matter except mill scale, which withstands vigorous wire brushing.

d) Tolerances

i. A variation of l mm is permissible in the overall length of members with both ends finished for Contact bearing. The bearing surfaces prepared to a common plane by milling.

ii. Members without end finished for contact bearing which are to be framed to other steel parts of the structure shall have a variation from detailed length not greater than 1/8" for length over 30 feet and not greater than 1/16" for length.

iii. Members with ends finished for contact bearing shall have a variation 1/32" in the overall length.

16.6.2. TEST ASSEMBLY

16.6.2.A. After fabrication and before galvanization or painting, test assembly of complete Structural Components shall be done on the shop floor as directed by the Engineer.

16.6.2.B. Each test assembly will be inspected by the Engineer and will be dismantled only after his approval in writing

16.6.3. SURFACE PREPARATION/PAINTING

16.6.3.A. Surface Preparation

All structural steel material i.e. rolled steel sections, plates, pipes, flat bars, chequered plates shall be cleaned free from loose scale, rust, burrs slag, etc. by means of sand blasting.

16.6.3.B. Painting

a. Immediately after surface preparation all material shall be given one prime coat of rust preventive paint.

b. After fabrication one shop coat of prime paint and then one coat of enamel paint shall be applied.

c. One final coat of enamel paint shall be applied after erection of all components.

d. The type of primer and enamel paints to be applied shall be as specified on the drawings and the thickness of the paint shall be in accordance with the specifications of the paint manufacturer.
e. All other requirements for the specified paint system shall be in accordance with the paint manufacturer's specification / recommendations.
f. The CONTRACTOR shall use the best quality of the type of paint specified and shall get the same approved by the Engineer.
g. Steel work/Surfaces not to be painted
h. Steel work to be encased / embedded in concrete or surface in contact with concrete or grout shall not be painted, but shall be given a cement wash after sand blasting.
Machined finished surfaces shall not be painted but shall be coated with rust preventive compound, (approved by the Engineer) immediately after finishing. Such surfaces shall also be protected with wooden pads or other suitable means for transportation. Unassembled pins, keys, and bolt thread shall be greased and wrapped with moisture resistant paper.

Contact surfaces of connections using high strength bolts in friction type connections shall not be painted. Such surfaces of all components after fabrication shall be cleaned free of all paints, grease, burrs slag by means of sand blasting. No coating whatsoever shall be applied to these surfaces. The surface roughness for high strength friction grip bolts is a very important factor and the components therefore will not be erected unless approved by the Engineer.

16.6.4. ERECTION

16.6.4.A. Bracing

The structure shall be carried up true and plumb within the limits defined in the AISC code of standard practice. Temporary bracing shall be introduced wherever necessary to take care of all loads of which the structure may be subjected including the equipment and the operation of the same. Such bracings shall be left in place as long as required for safety.

16.6.4.B. Alignment

Bolts tightening as specified by ASTM A 325 shall not be done at site during erection until the structure has been fully aligned and leveled.

16.6.4.C. Joints using High Strength Bolts

All structural joints using high strength bolts shall be executed and inspected in accordance with "AISC Specification for structural joints using ASTN A 325 or A 490 bolts".

16.6.4.D. Stubs

Stubbs of trusses before being embedded in concrete shall be erected in position timely aligned using stub setting templates.

16.7. INSPECTION AND TESTS

16.7.1.A. Manufacturer's Work Test Certificate for all material used shall be furnished by the CONTRACTOR for Engineer's scrutiny and approval.

16.7.1.B. Rolling tolerance of all shapes and profile according to AISC shall be in accordance with the provisions of the American Society for Testing and Materials

Designation A.6. The CONTRACTOR shall check these before being worked upon and these shall be rejected if found not within limits.

16.7.1.C. The CONTRACTOR shall arrange for analysis and test of all material rolled locally at a testing laboratory selected by the Engineer.

16.7.1.D. Inspection of Welding.

The inspection of welding shall be performed in accordance with the American Welding Society specifications, as directed by the Engineer.

16.7.1.E. Rejection

Materials or workmanship not in reasonable conformance with the provisions of these specifications shall be rejected at any time during the progress of the work or the completion and erection at site.

16.8. MISCELLANEOUS STEEL WORKS

16.8.1.A. General

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

a. Steel gates

b. Steel grills

c. Steel embedded plates anchor bolts and other miscellaneous items

The CONTRACTOR shall submit shop drawings for each item showing in sufficient detail the material, its fabrication, surface preparation and other relevant information so as to conform to the applicable requirements of relevant clauses of these specifications for Engineers Approval. After the approval of drawing the CONTRACTOR shall erect a mock-up sample showing exactly the finished item as it will be fabricated/erected. Only after the approval of the mock-up sample the CONTRACTOR shall start the fabrication of items to be installed in place. Any proposed deviation due to field conditions and availability of local material shall be submitted to the Engineer for approval.

17. ALUMINIUM WORKS

17.1. SCOPE

The work covered under this section of the specifications consists of providing all material, labor, equipment, performing all operations required for providing and installation of aluminum doors, windows, ventilators & louvers including all related items such as sealants, gasket, netting, rollers, hinges, latches, fastenings, anchor bolts, door locks, locking devices and glass complete in strict accordance with this section of specifications, the applicable drawings and as scheduled.

17.2. APPLICABLE STANDARDS

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

17.2.1. ISO (International Organization for Standardization)

1804 Doors - Terminology

6442 Door Leaves - Measurement of defects of General flatness.

6443 Door Leaves - Measurement of dimensions and Defects of squareness.

6444 Door Leaves - Test of behavior under humidity variations (successive uniform climates)

6612 Windows & Doors - wind resistance tests.

6613 Windows & Door - Air permeability test.

BSI (British Standard

Institution) 1227 Hinges

4873 Aluminum alloy windows.

17.3. GENERAL

17.3.1. Door, Windows, ventilators, louvers and other items to be provided shall be aluminum, of profile pattern and design shown on drawings and shop drawings manufactured by reputable manufacturer approved by the Engineer. The contractor shall provide manufacture literature completely describing the product instructions for installation and maintenance.

17.3.2. All the sections used for doors, windows, ventilators & louvers fly screens shall be of best quality aluminum products such as equal and unequal angles, channels, tubes, corrugated strips, moldings etc., in accordance with International standards conforming to ASTM B 308 & B 221.

17.3.3. All doors, windows. Ventilators and louvers shall be of type and size indicated on drawings and shall conform to the requirements shown and specified herein.

17.3.4. Contractor shall arrange tests and analysis if directed by the Engineer of scaled models of each door, window, ventilator and louvers type at the maker's works or any laboratory specified by the Engineer for the material supplied by him to be tested in the presence of the Engineer's Inspector, to whom test certificates, proof sheets, etc. shall be furnished. The models shall be submitted to the Engineer for approval prior to testing. Nevertheless, neither the fact that the materials have been tested in the presence of the inspector nor that the Engineer may have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer to reject, after delivery of materials found not in accordance with these specifications.

17.3.5. The contractor shall submit shop drawings conforming to design concept which shall show full construction details, quantities and locations, fastenings, stiffening members and attachments to adjacent construction and materials. Shop drawings and calculations shall be submitted at the proper time to allow for checking, revisions, and agreement and to permit manufacturer's product delivery and start of site work to suit the building programme. The Contractor shall submit representative samples of finished doors, windows, anchoring mechanism, embedded parts, fastenings, glass panes, accessories and other materials for the Engineer's approval.

After approval of shop drawings and tests etc., the Contractor shall submit at his own cost one mock-up sample of each type of aluminum works complete with glazing, all components assembly method and required fittings and accessories prior to the actual

fabrication of the bulk. The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

Fabricate and assemble all work in the shop of the approved manufacturer to reduce field fabrication to a minimum unless otherwise directed by the Engineer.

17.3.6. The glass shall conform to specification laid down under chapter 'Glazing' and shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in window members. Double glazed windows/ curtain wall shall have a gap of 12mm and sealed with European butyl and Argon gas filled by imported plant.

The tempering of glass should be done on European, USA or Japan origin plant. Tempered glass delivered at site should fulfill the requirements of International standards including ASTM, ANSI, BS, EN, JIS R 3206. It should have minimum 50 fragments in 50 mm x 50mm size when broken.Maximum tolerance for roller wave is 0.13 mm and roller circumference should not be less than 300 mm. Glass bow/ bend should be less than 0.003mm/mm at long side & diagonal of glass.

17.3.7. The structural shape of the Aluminum members shall be of uniform quality, color and temper, clean, round, commercially straight and free from injurious defects.

17.3.8. All doors, windows, ventilators and louvers shall be fabricated as a complete unit, fully airtight and watertight, including rubber gasket for glazing, hinges, stays, rollers, latch, locking arrangement, handles, etc anodized/ powder coated in specified color, inclusive of glass sheet, necessary holes for fixing, door locks, door closures and window locking requirements, all as approved by the engineer.

17.3.9. Contractor shall, provide certificate signed by the manufacturer stating that each lot has been sampled, tested and inspected and has met the requirements in accordance with these specifications and the same shall be furnished to the Engineer.

17.3.10. The shop drawings shall clearly show that there shall be no penetration of rainwater from the exterior to the interior in case of severe wind and rainstorm. This has to be specially ensured in cill section.

17.4. MATERIAL

17.4.1. Frames/shutters

The frames of aluminum door, windows and ventilator shall be formed from rolled, strip or extruded aluminum. The thickness of sectional members shall be maximum 2.0 mm. All outer / frame sections of openable / fixed windows. Ventilators and louvers shall be 4” (100 mm) minimum in width. The Frames for doors and door/windows shall be at least 4” (100 mm) in width.

17.4.2. As shown on the drawings, aluminum frames shall be provided as per international standard approved by the engineer.

17.4.3. Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.

17.4.4. Gaskets shall be vinyl glazing channel gasket to commercial standard CS-230-60.

17.4.5. Hardware shall be manufacturer's standard hardware. Flush to match doors, windows, ventilators and louvers finish. Floor mounted concealed type double action/swing imported door closures shall be provided to all doors. Heavy duty in-matching finish stays shall be provided to all openable windows, ventilators and louvers. Stays shall be attached to the window frame so as could be replaced easily.

17.4.6. Joint sealant shall be approved elastomer.

17.4.7. Aluminum sections shall be powder coated (where required) in accordance with the standards of Aluminum Association of USA where ever. The thickness of powder coating surface shall be of not less than 70-90 microns. The surface shall be properly sealed.

17.4.8. For powder coated finish aluminum sections to be coated shall be mill finish. The sections shall be firstly degreased with a degreasing chemical to remove all/any stains. The sections will then be given a chromating coating and electro static powder coating in the desired color with a powder-coating machine. After color coating the sections will be baked at baking temperature of 220 degree Centigrade for 25 minutes.

17.4.9. All sliding/openable windows shall have sliding/openable wire/fly screen shutters in window matching finish with wire/fly screen of size so as not to permit the entry of flies and mosquitoes. The wire mesh shall be 30 SWG. 14 mesh (14 x 14 openings per square inch).

17.5. DESIGN REQUIREMENT

The Contractor shall design the installation to meet or excell the following requirements.

17.5.1. Tolerances

The Contractor shall be responsible for agreeing to all dimensions with the Engineer before proceeding with the manufacture and for making provision to allow for building tolerances required by the Engineer. Contractor shall also take site measurements of the structure completed before manufacturing.

17.5.2. Thermal & Seismic Movements

The window and glazing assemblies are to be constructed and installed in the openings with sufficient tolerance and, where necessary, to provide for joints incorporated in couplings, to provide for expansion and contraction as will be caused by the local seismic and climatic conditions and temperature changes, winter to summer - day to night without buckling, distortion of joints, or other harmful effects.

17.6. WORKMANSHIP

The Contractor shall be responsible for the protection and installation of all items furnished. All items shall be installed plumb and square and shall be solidly anchored in a good workman like manner in accordance with the manufacturer's instruction and as specified herein. The Contractor shall be responsible for the protection of installed items from damage by other trades. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, etc. The Contractor shall be responsible for final cleaning before the final acceptance.

The glass panes shall firmly be secured in the rebates with the rubber gasket. Ensure that the beads and grooves are clean, dry and unobstructed at the time of glazing. The complete unit shall be airtight and watertight on completion. No doors, windows and ventilator shall be considered complete until and unless the fingerprints and other stains and marks have been removed from the surface of glass and aluminum.

17.7. PRODUCT DELIVERY AND STORAGE

17.7.1. Deliver doors, windows, ventilator and louvers in a manner preventing damage to units. Store materials off the ground under cover in a manner preventing deterioration or damage.

17.7.2. All embedded parts and anchor bolts shall be delivered to the site carefully and keeping the fabricated shape and configuration. All these parts shall be suitably marked for identification.

17.8. ERECTION

Rawal plugs and anchoring bolts shall be embedded into the concrete or block masonry for holding the doors windows, ventilators and louvers in their correct positions.

Care shall be taken to install the doors, windows, ventilators and louvers in line and plumb & solidly anchored in a good workman like manner in accordance with the drawings. Should any scale or scratch appears on the surface of doors, windows and ventilators the contractor shall at his own expense and at the Engineer's direction have all exposed surfaces cleaned to bare bright specified color.

All works shall be installed in strict accordance with the manufacturer's printed instructions.

17.9. SCAFFOLDING

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate of items.Damage to existing works from scaffolding or from any other object shall be repaired by the Contractor at his own cost.

17.10. PROTECTION AND CLEANING

17.10.1. Temporary protection shall be achieved by applying water-soluble protective coating capable of withstanding the action of lime mortar.

17.10.2. Apply coating in the manufacturer's plant to the exposed surfaces of all components.

17.10.3. Before application of coating, remove all fabrication compounds, moisture and dirt accumulations.

17.11. DEFECTIVE WORK

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

17.12. GUARANTEE

17.12.1. The manufacturer shall furnish his standard written guarantee against leakage of rain, excessive infiltration of dust and air and all defects in materials and workmanship covering all work under this section. No payment shall be made for any arrangement required to be provided in the sections for complete protection against water leakage any damages caused to the furniture & furnishings, plant and equipment due to leakage of water shall be fully recovered from the Contractor.

17.12.2. Such guarantee shall be in addition to and not in lieu of all other liabilitieswhich manufacturers and the Contractor may have by law or by other provisions of the Contract Documents.

18. TUFF PAVERS

18.1. SCOPE

The work under this section of the specifications consists of furnishing all plant, labor, equipment, all materials and performing all operations such as compaction of made up ground level (MUGL) in conformity with lines, grade, spreading, watering and compaction of sand and laying of Tuff Pavers, curing etc including supply from manufacturer and transportation to the site of works.

18.2. MATERIAL

Concrete Pavers: Solid, interlocking paving units, ASTM C 936, made from normal-weight aggregates in sizes and shapes indicated.

18.2.1. Coarse Aggregate: Clean, hard, un-weathered stone crushed into angular particles varying in size up to 3/8 inch (9.5 mm).
18.2.2. Filler: Dust produced from limestone or other material as standard with manufacturer.
18.2.3. Dimensional Tolerances: Manufacture unit to standard dimensions indicated with deviations in any dimension not exceeding plus or minus 1/16 inch (1.6 mm) by Owner with ground tudor finish.
18.2.4. 50mm thick concrete pavers must have minimum 28 days compressive strength of 5000 Psi whereas 60mm thick concrete pavers must have minimum 28 days compressive strength of 7000 Psi.

18.3. ACCESSORIES

Steel Edge Restraints: Painted commercial steel edging with loops pressed from or welded to face of sections at 36 inches (900 mm) o.c. to receive stakes, and steel stakes 15 inches (380 mm) long for each loop. Size of edging as follows:

- 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high.
- 1/4” inch (6.4 mm) thick by 5 inches (125 mm) high.

Joint Filler Materials: Portland cement, ASTM C 150, Type I; and sand, ASTM C 144.

18.4. EXECUTION

Examine surfaces indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit pavers. Do not proceed with installation until unsatisfactory conditions have been corrected.

18.5. PREPARATION

Clean surface free of dirt, dust, debris, and loose particles.

18.6. INSTALLATION, GENERAL

Do not use unit pavers with chips, cracks, voids, discolorations, and other defects which are visible to the eye 6 feet away from the surface or could cause staining in finished work. Mix pavers from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, Un-chipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable. Cut pavers are to be no smaller than 3 inches in any dimension where field cutting would result in pavers below these minimum sizes, use larger pavers adjacent to fill space.

- Joint Pattern: Match field-constructed mockup.
- Joint Pattern: As indicated on drawings.

18.6.1. Tolerances: Do not exceed 1/32-inch (0.8mm) unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

18.6.2. Tolerances: Do not exceed 1/16-inch (1.5-mm) unit-to-unit offset from flush (lippage) or 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

19. LANDSCAPE WORK

19.1. GENERAL

19.1.1. DESCRIPTION

These general requirements apply to all landscape operations. Refer to specification sections for specific general, product, and execution requirements.

19.1.2. QUALITY ASSURANCE

A. Comply with all applicable local and state requirements regarding materials, methods of work, and disposal of excess and waste materials.

B. Obtain and pay for all required inspections, permits, and fees. Provide notices required by governmental authorities.

C. Owner shall appoint a qualified representative to oversee the work and assure its adherence to the plans and these specifications. Henceforth, this person shall be designated as Owner's Representative.

19.1.3. PROJECT CONDITIONS

A. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations at Contractor's expense.

B. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.

C. Locate, protect, and maintain benchmarks, monuments, control points and project engineering reference points. Re-establish disturbed or destroyed items at Contractor's expense.

D. Obtain governing authorities written permission when required to close or obstruct street, walks and adjacent facilities. Provide alternate routes around closed or obstructed traffic ways when required by governing authorities.

E. Control dust caused by the work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.

F. Protect existing buildings, paving, and other services or facilities on site and adjacent to the site from damage caused by work operations. Cost of repair and restoration of damaged items at Contractor's expense.

G. Protect and maintain streetlights, utility poles and services, traffic signal control boxes, curb boxes, valves and other services, except items designated for removal. Remove or coordinate the removal of traffic signs, parking meters and postal mailboxes with the applicable governmental agency.

19.2. MATERIALS AND EQUIPMENT

A. Materials and equipment: As selected by Contractor, except as indicated.

19.3. EXECUTION

19.3.1. PREPARATION

A. Examine the areas and conditions under which work is to be performed. Do not proceed with the work until unsatisfactory conditions are corrected.

B. Consult the available records and drawings of adjacent work and of existing services and utilities which may affect work operations, as provided by owner.

19.4. TREES, PLANTS, AND GROUND COVERS

19.4.1. DESCRIPTION

A. Provide trees, plants, and ground covers as shown and specified. The work includes:

1. Soil preparation.
2. Trees, plants, and ground covers.
3. Planting mixes.
4. Mulch and planting accessories.
5. Existing plant relocation.

B. Related work:

1. Section 02200: Earthwork.
2. Section 02485: Seeding.
3. Section 02487: Sodding.

19.4.2. QUALITY ASSURANCE

A. Comply with GENERAL requirements.

B. Plant names indicated, should comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature or local recognized authority. Provide stock true to botanical name. Do not substitute without permission of owner or owners representative.

C. Comply with sizing and grading standards of the latest edition of "American Standard for Nursery Stock" or local recognized authority. A plant shall be dimensioned as it stands in its natural position.

For plant material grown in fabric-ground containers, the following chart shall determine root mass size in relation to caliper:

Fabric-ground Suggested Container Diameter	Caliper of Size
Plant 10"	1"
12"	1"
14" - 16"	1 ½" -2"
18" - 20"	2" - 3"
22" - 24"	3" - 4"

D. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project.

E. Stock furnished shall be at least the minimum size indicated. Larger stock is acceptable, at no additional cost to owner. Root systems must meet AAN standards as specified. Plants should not be altered by pruning or other means to meet specifications.

F. Provide "specimen" plants with a special height, shape or character of growth. Specimen trees or shrubs may be tagged at the source of supply. The Owner's Representative may inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, provide sufficient photographs of the proposed specimen plants for approval.

G. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size and variety.

19.4.3. SUBMITTALS

A. Submit the following material samples, if requested:

1. Mulch -Bulk or Bagged.

2. Decorative Stone or Gravel -Bag or Bulk

B. Submit the following materials certification, if requested:

1. Topsoil source and pH value.

2. Peat moss, compost, or other organic soil amendments

3. Plant fertilizer.

19.4.4. DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer materials in original, unopened and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.

B. Take all precautions customary in good nursery practice to prepare plants for transport. Workmanship, which fails to meet the highest standards, will be rejected. Spray deciduous plants in foliage with an approved Anti- Desiccant immediately before digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury.

C. Cover plants transported on open vehicles with a protective covering to prevent wind or sunburn.

19.4.5. PROJECT CONDITIONS

A. Work notification: Notify Owner's Representative at least five (5) working days prior to installation of plant material.

B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations. Call Miss Utility to mark underground utilities a minimum of 48 hours before digging.

C. A complete list of plants, including a schedule of sizes, quantities, and other requirements is shown on the drawings. In the event that quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall govern. Payment shall be based on actual installed plant count.

19.4.6. WARRANTY

A. Warrant plant material to remain alive and be in a healthy, vigorous condition for a period of one (1) year after acceptance, provided plants are given proper care during this period.

1. Contractor to call for final inspection of plants.

B. Remove and immediately replace all plants, as determined by the Owner's Representative, to be unsatisfactory during the initial planting installation.
C. Replace once, in accordance with the drawings and specifications, all plants that are dead or, as determined by Owner's Representative, are in a severely unhealthy condition within warranty period. Replacements to be installed at next best planting season.
D. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, drought, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting areas; acts of vandalism or negligence on the part of the Owner. Any replacement attributed to these causes must be in addition to the contract amount.

19.5. PRODUCTS

19.5.1. MATERIALS

A. Plants: Provide plants typical of their species or variety; with normally developed branches and vigorous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation.

1. Dig balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth as necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock" or local recognized authority. Cracked or mushroomed balls are not acceptable.
2. Container-grown stock shall have grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.

a. No plants shall be loose in the container.
b. Container stock shall not be pot bound.
3. If the use of larger than specified plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.
4. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size and variety designated in the plant list and according to the AAN Standards for Nursery Stock.
5. Shrubs and small plants shall meet the requirements for spread and/or height indicated in the plant list and be in accordance with AAN standards.

19.5.2. ACCESSORIES

A. Topsoil for planting beds: Fertile, friable, natural topsoil without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH 5.5 to 6.0 and be typical of the area.
1. Identify source location of topsoil proposed for use on the project.
2. Provide topsoil free of substances harmful to the plants which will be grown in the soil.

B. Peat moss: Brown to black in color, weed and seed free granulated raw peat or baled peat, containing not more than 9% mineral on a dry basis.
C. Organic Matter- Organic matter can be from peat moss, compost, or locally available organic waste. Organic matter should be free from debris, weed seeds, and insects or diseases which may be harmful to the intended planting.
D. Fertilizer:
1. Plant fertilizer: Commercial type approved by the Owner's Representative, containing 10% nitrogen, 10% phosphoric acid and 10% potash by weight.

E. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces;; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.

F. Water: Hoses or other methods of transportation furnished by Contractor. Water to be provided by the Owner at the site.

G. Stakes for staking: Hardwood, 2" x 2" (6-8')long (2x4 pine is permissible).

H. Stakes for guying: Hardwood, 2" x 2" x 24" long.

I. Guying/staking wire: 12- or 14-gauge galvanized wire.

1. Turnbuckles: Galvanized steel of size and gauge required to provide tensile strength equal to that of the wire. Turnbuckle openings shall be at least 3".

J. Staking and guying hose: Two-ply, reinforced garden hose not less than ½" inside diameter. Shall be uniform in color.

K. Plastic guy material no less than ¼". Shall be uniform in color and level as applied.

L. Twine: Two-ply jute material.

M. Weed control barrier: Rot resistant polypropylene fabric or equivalent, water and air permeable.

19.5. EXECUTION

19.5.1. *INSPECTION*

A. Examine proposed planting areas and conditions before installation. Do not start planting work until unsatisfactory conditions are corrected.

19.6. PREPARATION

A. Time of planting:

1. Evergreen material: Plant evergreen materials between September 1 and December 1 or in spring before new growth begins. If Owner requires planting at other times, plants shall be sprayed with anti-desiccant prior to digging operations, weather dependent.

2. Deciduous material: Plant deciduous materials in a dormant condition. If deciduous trees are planted in- leaf, they shall be sprayed with an anti-desiccant prior to digging operation.

B. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.

C. Locate plants as indicated on drawings. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until Owner's Representative has selected alternate plant locations.

D. Excavate circular plant pits with vertical sides, except for plants specifically indicated to be planted in beds. Provide shrub pits at least twice as wide as the root system and 24" greater for trees. Depth of pit shall be no greater than the root ball depth. Scarify bottom of the pit. Remove excess excavated materials from the site.

E. Provide pre-mixed ground cover bed planting mixture for use around the balls and roots of the plants consisting of five (5) parts existing soil to one (l) part peat moss and 1 lb. plant fertilizer for each cubic yard of mixture or equivalent. Bagged bark professional mixes or an equivalent substitute for peat moss.

F. Provide pre-mixed ground cover bed planting mixture consisting of three (3) parts existing soil to one (l) part peat moss and 1lb. plant fertilizer per cubic yard. Provide beds a minimum of 6" deep. Bagged bark professional mixes or an equivalent substitute for peat moss.

19.6.1. *INSTALLATION*

A. Set plant material in the planting pit to proper grade and alignment. If Fabric In-ground container material is used, remove fabric bag first. Set plants upright, plum and faced to give the best appearance or relationship to each other or adjacent structure. Set plant material no lower than the finish grade or 2" - 3" above finished grade. No filling

will be permitted around trunks or stems. Back fill the pit with existing soil or approved top soil or mix. Form a ring of soil around the edge of each planting pit to retain water.

B. After plants are set, muddle planting soil mixture around bases of balls and fill all voids.

1. Remove all burlap, ropes, and wires from the collar of balls.

C. Space ground cover plants in accordance with indicated dimensions.

D. Watering: Water planting thoroughly to pull soils against root ball and settle air pockets. Additional soil may be needed, water again to ensure complete compaction.

E. Mulching:

1. Mulch tree and shrub planting pits and shrub beds with required mulching material 2" - 3" deep immediately after planting. After watering, rake mulch to provide a uniform finished surface.

2. Mulch ground cover beds with mulch 2" deep before planting.

F. Wrapping, guying, staking:

1. Wrapping should be done only on an as need basis.

2. Staking/Guying

a. Stake/guy should only be used when trees are loose or weak stemmed.

(See Staking details on the drawings)

G. Pruning:

1. Remove or cut back broken, damaged and asymmetrical growth of new wood.

2. Unless otherwise directed, prune evergreens only to remove broken or damaged branches.

H. Existing plant relocation:

1. Transplant trees and shrubs designated for relocation to locations shown on the drawings. Prune, dig, ball and burlap, move and plant in accordance with specified tree planting requirements.

2. Prune, dig, ball and burlap, and move designated trees for relocation to the designated plant storage area for heeling-in of materials until final planting areas are prepared, if required.

a. Maintain plants in storage areas by bracing plants in vertical position and setting balls in an enclosed berm of topsoil or bark. Water as required to maintain adequate root moisture.

b. Re-burlap plant balls if required before final transplanting operations.

c. Move to final locations shown on the drawings and plant in accordance with specified tree planting requirements.

3. Transplants are not under warranty.

19.6.2. ***SUBMITTALS***

A. Submit the following material samples, if requested:

1. Mulch -Bulk or Bagged.

2. Decorative Stone or Gravel -Bag or Bulk

B. Submit the following materials certification, if requested:

1. Topsoil source and pH value.

2. Peat moss, compost, or other organic soil amendments

3. Plant fertilizer.

19.6.3. ***DELIVERY, STORAGE, AND HANDLING***

A. Deliver fertilizer materials in original, unopened and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.

B. Take all precautions customary in good nursery practice to prepare plants for transport. Workmanship, which fails to meet the highest standards, will be rejected. Spray deciduous plants in foliage with an approved Anti- Desiccant immediately before digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury.

C. Cover plants transported on open vehicles with a protective covering to prevent wind and sunburn.

19.6.4. PROJECT CONDITIONS

A. Work notification: Notify Owner's Representative at least five (5) working days prior to installation of plant material.

B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations. Call Miss Utility to mark underground utilities a minimum of 48 hours before digging.

C. A complete list of plants, including a schedule of sizes, quantities, and other requirements is shown on the drawings. In the event that quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall govern. Payment shall be based on actual installed plant count.

19.6.5. MAINTENANCE

A. Maintenance of installed and accepted plantings will be performed by the Owner.

B. Contractor's maintenance shall include pruning, cultivating, weeding, watering, and application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease until acceptance.

1. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.
2. Tighten and repair guy wires and stakes as required, only if originally needed.
3. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.
4. Water trees, plants and ground cover beds.

19.6.6. ACCEPTANCE

A. Planted areas will be inspected at completion of installation and accepted subject to compliance with specified materials and installation requirements.

B. Inspection upon contractors request to determine acceptance of planted areas will be made by the Owner's Representative.

1. Planted areas will be accepted provided all requirements have been complied with and plant materials are alive and in a healthy, vigorous condition.

C. Sections of the work may be accepted when complete upon agreement of the Owner's Representative and the Contractor.

D. Upon acceptance, the Owner will assume plant maintenance.

19.6.7. CLEANING

A. Perform cleaning during installation and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from planting operations.

19.7. SODDING

19.7.1. DESCRIPTION

A. Provide sodded lawns as shown and specified. The work includes:

1. Soil preparation.
2. Sodding lawns.

B. Related work:

1. Earthwork.

2. Seeding.

3. Trees, Plants, and Ground Covers.

19.7.2. QUALITY ASSURANCE

A. Comply with LANDSCAPE GENERAL requirements (3.1 – 3.4).

B. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials or recognized local authority.

19.7.3. SUBMITTALS

A. Submit sod grower's certification of grass species. Identify source location.

19.7.4. DELIVERY, STORAGE, AND HANDLING

A. Cut, deliver and install sod within a 48-hour period.

1. Do not harvest or transport sod when moisture content may adversely affect sod survival.

2. Protect sod from dehydration prior to installation.

19.7.5. PROJECT CONDITIONS

A. Work notification: Notify Owner's Representative at least five (5) working days prior to start of sodding operations.

B. Protect existing utilities, paving, and other facilities from damage caused by sodding operations.

C. Provide hose and lawn watering equipment as required. Owner to provide water on site.

19.7.6. WARRANTY

A. Disclaimer - Acts of God and other conditions beyond the landscape contractor's control such as vandalism shall not be the responsibility of the landscape contractor. Any re-sodding or re-grading contributed to this must be an addition to the contract amount.

19.8. PRODUCTS

19.8.1. MATERIALS

A. Sod: As recommended by VPI and SU for the area or local Extension Service.

B. Provide well-rooted, healthy sod. Provide sod uniform in color, leaf texture, density and development when planted.

1. Furnish sod uniformly machine-stripped from ¾" - 1 ½" thick with clean cut edges.

C. Fertilizer:

1. Granular, non-burning product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer.
2. Starter fertilizer containing 5% nitrogen, 10% phosphoric acid and 10% potash by weight, or according to special provisions.

D. Ground limestone: Containing not less than 85% of total carbonates and ground to such fineness that 50% will pass through a 100 mesh sieve and 90% will pass through a 20 mesh sieve.

E. Water: Free of substance harmful to sod growth. Hoses or other methods of transportation furnished by Contractor. Water will be provided by the Owner on site.

19.9. EXECUTION

19.9.1. INSPECTION

A. Examine finish surfaces, grades, topsoil quality, and depth. Do not start sodding work until unsatisfactory conditions are corrected.

19.9.2. PREPARATION

A. Limit preparation to areas which will be immediately sodded.

B. Loosen topsoil of lawn areas to minimum depth of 3", if compacted. Remove stones over 1" in any dimension, sticks, roots, rubbish, and extraneous matter.

C. Apply limestone as required to adjust pH of topsoil to not less than 5.5 nor more than 6.8. Distribute evenly by machine and incorporate thoroughly into topsoil.

D. Apply fertilizer at the rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. (220 lbs./acre). Apply fertilizer by mechanical rotary or drop type distributor: thoroughly and evenly incorporate it into the soil to a depth of 3" by disking or other approved methods. Fertilize areas inaccessible to power equipment with hand tools and incorporate it into

soil.

E. Grade lawn areas to smooth, free-draining and even surface with a loose, uniformly fine texture.

F. Restore prepared areas to specify condition if eroded, settled, or other-wise disturbed after fine grading and prior to sodding.

19.9.3. *INSTALLATION*

A. Sodding:

1. Lay sod to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger strips to offset joints in adjacent courses. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.

2. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and lightly against previously installed row.

3. Tamp or roll with roller to ensure contact with sub- grade soil.

4. Water sod thoroughly one time immediately after laying.

5. Stake sod on slopes over 2:1 to anchor.

B. Sod indicated areas within contract limits. Areas outside contract limits disturbed as a result of construction operations are to be charged according to size of area.

19.9.4. *MAINTENANCE*

A. Maintenance of installed and accepted sodded lawns will be performed by the Owner.

19.9.5. *ACCEPTANCE*

A. Sodded areas will be inspected at completion of installation and accepted subject to compliance with specified materials and installation requirements.

B. Inspection to determine acceptance of sodded lawns will be made by the Owner's Representative, upon Contractor's request.

1. Sodded areas will be acceptable provided all requirements have been complied with, and a healthy, even-colored viable lawn is provided.

C. Sections of the work may be accepted when complete upon agreement of the Owner's Representative and the Contractor.

D. Upon acceptance, the Owner will assume lawn maintenance.

19.9.6. *CLEANING*

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from sodding operations.

END OF SECTION

CONSTRUCTION OF SEED BUIILDING

AT UNIVERSITY OF AGRICULTURE, FAISALABAD

TENDER DOCUMENTS (VOLUME-III)

TECHNICAL SPECIFICATIONS (ELECTRICAL WORKS)

FOR
SEED BUILDING
AT
UNIVERSITY OF AGRICULTURE FAISALABAD

(JUNE, 2023)

ONSULTING SERVICES (Pvt.) Ltd.
34-A, Main Gulberg, Lahore

TECHNICAL SPECIFICATIONSELECTRICAL WORKS

CONTENTS **PAGE NO.**

SECTION - 1 TECHNICAL PROVISIONS

TP.1 GENERAL.

The general instructions are given to the tenderers elsewhere in this contract document. The additional instructions in the following paragraphs are given in order to invite the tenderer's attention towards some major points pertaining to electrical work only and to assist them in preparing tenders. These instructions shall be deemed as Technical provisions of the Contract.

TP.2 SCOPE OF WORK.

The work consists of furnishing all tools, plants, labor, materials and equipment and performing the internal and external electrical works comprising of the following or as specified in Schedule of Values.

SECTION - A H.T. Switchgear & Transformer.

SECTION - B L.T. Switchgear Main Panel Board and DB's.

SECTION - C Internal Wiring Concealed with PVC

Conduit.SECTION - D Fitting & Fixtures.

SECTION - E Cables, Conduits, Cable Trays & Rising

Mains.SECTION - F Emergency Diesel Generating Set.

SECTION - G Voice Data

Systems.SECTION - HFire Alarm

System. SECTION - I M.A.T.V

System.
SECTION - J Music & Paging System.

SECTION - K Lightning Protection

System.SECTION - L Earthing System

SECTION - M Closed Circuit Television

System.SECTION - N Miscellaneous

Items.

The work shall be carried out in strict accordance with the conditions of contract, special conditions, Drawings, Technical Specifications, in coordination with other sub-contractors on this project and as per items of Schedule of values and including the responsibility of all related works necessary for their proper functioning, testing, commissioning and satisfactory operation and performance including maintenance for the period specified elsewhere. The sub-contractor shall provide for all required technical non-technical personnel, skilled and non-skilled labour, construction equipment, transportation etc., as required for the completion of works in strict accordance with the Technical specifications laid here-in after.

TP.3 SUB-CONTRACTOR'S QUALIFICATION.

The Electrification work shall be carried out only by a licensed Sub-contractor authorized to undertake such work under the provisions of the Electricity Act, 1910, and the Electricity Rules, 1937, as adopted and modified by the Government of Pakistan.

TP.4 This licensed Electrical Sub-contractor shall have the following qualifications.

a. Must have in his employment a competent graduate Electrical Engineer registered with Pakistan Engineering Council, Islamabad.
b. Must possess a valid Electrical licence issued by the Electrical Inspectorof Islamabad region.
c. Must have in its employment an Electrical Supervisor having certificate of competency who will exclusively look after this work.
Must have necessary tools, plant and instruments.
d. Must have adequate experience of similar works.

TP.5 RULES AND REGULATIONS

The installation in general shall be carried out in conformity with the Electricity Rules, 1937, and the latest edition of the Regulations for the electrical equipment of buildings issued by the Institution of Electrical Engineers London (I.E.E.) However, in case of conflict between these specifications and the I.E.E. Regulations, these specifications supercede IEE regulation.

TP.6 STANDARDS

The latest relevant British specifications and codes, Pakistan Standard Specifications, VDE, I.E.C. and I.E.E. recommendations shall be applicable and be followed for the equipment specified herein.

TP.7 CLIMATIC CONDITIONS

All equipment supplied shall withstand, without developing any defect, the following climatic conditions.

Maximum Ambient Temperature = 120^{o}F or

49^{o}C Minimum Ambient Temperature = 28^{o}F or -

2.2^{o}CMaximum Humidity = 90 %

SPECIFICATIONS

TP.8

The sub-contractor shall furnish all material and equipment at site, conforming fully to the specifications given herein and to the accepted standards as laid down by British Standards, the Institution of Electrical Engineers, London, and the Pakistan Standard Institution. It is not the intent of these specifications to include all details of design and construction of various material and equipment to be supplied under this contract. The Sub-contractor shall supply and install all material and equipment specified herein and also all installation and small material such as nuts, bolts, washers, shims, angles, leveling material, installation as covered by the specifications.

All material and equipment supplied by the Sub-contractor shall be new and in all respects conform to the high standard of engineering design and workmanship, perform and function as herein specified and fully meet the quality level and ruggedness requirement of the specifications. All material and equipment which have to be supplied and installed by the Sub-contractor shall be passed / approved by the Engineer; even if the same is exactly in accordance with the Schedule of values and drawings.

TP.9 **SUBMITTAL**

The sub-contractor, after the award of work, shall submit for approval of the Engineer all drawings and Catalogues of equipment, appliances, fixtures and accessories that are to be furnished under the contract. After final approval of a sufficient number of copies as desired shall be furnished for distribution. Catalogues

and drawings shall be clearly marked to indicate, the items furnished. Catalogues of all fixtures, and not a few, shall be submitted.

TP.10 **APPROVAL OF DRAWINGS AND DATA**

The Sub-contractor shall provide detailed electrical drawings, wiring diagrams, foundation details, etc., for all electrical switchgear, fuse-gear and all other systems etc., for the Engineer's review for obtaining approval.

The manufacturing of electrical equipment shall be started only after the above mentioned drawings and data are approved.

The time required for review and approval shall be considered included in the totaltime of completion of job.

TP.11 **DRAWINGS AND DATA**

Three sets of drawings and data for each equipment shall be furnished by the Sub-contractor for the Engineer's approval before commencement of fabrication and manufacture which would start only after that approval. The drawings to be supplied by the Sub-contractor shall be as follows:-

- Arrangements.
- Dimensional Plans, elevations and front view.
- Foundation Plan, anchors and configuration.

- Incoming and outgoing cable termination positions.
- Earthing arrangement.

Electrical Drawings showing.

- One-Line diagram.
- Detailed wiring diagram.
- All interconnections.
- Instrument transformers.
- Relays, their locations and internal wiring diagrams.
- Other electrical devices including meters instruments and their wiring diagram.
- Signal and alarm circuit.

TP.12 SHOP DRAWINGS

The design drawings show approximate conduit routes and depict only the position of various fixtures and outlets. All the actual planning for the conduit routes shall be carried out, well in advance of the actual execution of work, by the Sub-contractor to the satisfaction of the Engineer. For this purpose the Sub-contractor shall prepare shop drawings and obtain prior approval of the Engineer. Three prints of each shop drawings shall be submitted for obtaining approval.

No piece of work shall be allowed to be executed at site without the availability of these approved shop drawings. These shop drawings shall clearly depict the load balancing chart of each distribution board. Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

TP.13 SETTING OUT OF WORK

The Sub-contractor shall set out the work himself and if any discrepancy is found, he shall report the matter to the Engineer and shall act as directed. If any defective or modified setting out is carried out by the Sub-contractor on his own, he shall rectify or make it good at his own cost.

TP.14 PROGRAMMING

The sub-contractor shall keep pace with the work of the Civil Sub-contractor and any other specialist sub-contractor. The engineer shall be kept informed about the programme and the progress of work so that there is no hindrance in the execution of work at site.

TP.15 PROTECTION

The sub-contractor shall take care not to damage the structure , material, equipment and property belonging to and/or installed by other sub-contractors during execution of work and shall repair and make-good all losses at his own cost, if found damaged in the opinion of the Engineer.

TP.16 CHANGE OF SPECIFICATIONS.

No change in specification of the equipment / material will be allowed at any stage, except with the prior approval of the Engineer before the opening of Tenders.

TP.17 PURCHASE OF EQUIPMENT / MATERIAL.

All the equipment and material e.g. transformers, switchgear, cables, conduits, light fixtures and fans etc. will be purchased direct from the manufacturer. Certificate and copies of delivery challans for all such material will be produced as and when desired.

TP.18 MANUFACTURERS AND BRANDS.

Where brands and names of Sub-Station equipment or any other system are specified by name, alternative can be offered provided these are equal in quality to those specified. Satisfaction of the Engineer in this respect shall be essential and prior approval for such deviation shall have to be obtained before submission of Tenderers. However all equipment for substation or system shall be from one manufacturer only.

TP.19 FACTORY TESTS

All routine and type tests on HT LT switchgear (ACBs, MCCBs , Relays , Magnetic Contactors , PFI Equipment and Enclosures),HT & LT cables , Emergency Diesel Generating Sets and other equipment shall be performed at the manufactures facility or at a recognized independent test laboratory in the presence of the “Engineer” as per applicable international standards .The term “Engineer” henceforth in the rest of the technical specification of electrical works shall mean an assigned, qualified electrical engineer of Client and Consultant. The presence of bothengineers shall be ensured at all times during factory tests and inspection. The sub- contractor shall be allowed to supply equipment to site only after successful and satisfactory testing and inspection at factory / laboratory with 3 copies each of test reports dully issued to be maintained in client’s and consultant’s record. The sub- contractor shall inform the engineer about the date and time of tests on eachequipment at least two weeks in advance. The witnessing of tests by the engineer shall not absolve the sub-contractor of his responsibility for proper functioning of the equipment , and for furnishing the guarantee. Sub-contractor shall at its own expense make all arrangement of transportation loading etc for the engineer, without any claim of addition charge or cost to the client for tests and inspection.

TP.20 OWNER'S SUPPLIED MATERIAL.

Material and equipment if supplied by the Owner shall be made available at site store to the sub-contractor for installation. Any lead and lift upto and within the site of work shall be at the cost and responsibility of the Sub-contractor . The sub- contractor shall ensure safe handling and proper protection after the material and equipment are issued to him at site store and shall provide and maintain required plant and equipment for handling, proper protection and installation at his own cost.

TP.21 SPARE PARTS LIST

A list of spare parts required for one year's operation of each equipment where

deemed necessary "except OFM" together with unit price of each part, shall be supplied by the sub-contractor.

TP.22 **GUARANTEE**

The sub-contractor shall furnish written guarantee, in triplicate, of the manufacturer for successful performance of each equipment. Such guarantee shall be of material and / or workmanship. The guarantee shall cover a minimum period of 12 months effective from the date of completion certificate.

TP.23 **AS-BUILT DRAWINGS.**

The sub-contractor shall, during the progress of work keep a careful record of all changes and revisions where the actual installation differs from that shown on shop drawings. These changes and revisions shall be accurately carried out on the shop drawings and submitted to the Engineer for approval. After approval these drawings shall become the property of the Owner. These updated and approved shop drawings depicting clearly As-Built drawings shall be submitted to the Engineer. Reproducible tracings of all these As-Built drawings shall be handed over to the Engineer. Final payment will be withheld until the receipt of the approved As-Built Drawings.

TP.24 **TEST REPORTS.**

The sub-contractor shall be responsible for submitting the test reports/ certificates and get the installation inspected / passed by the Regional Electric Inspector at his own cost.

TP.25 **PESCO REQUIREMENT.**

The sub-contractor shall assist the Owner in sponsoring application for Electrical Connection, with PESCO and carry out necessary formalities. Any special

requirement of PESCO shall be complied with by the sub-contractor. The Owner shall arrange to deposit all amounts, on demand, to PESCO for providing service connection and security deposits thereof.

TP.26 **T & T REQUIREMENT.**

For the supply, installation and regularization of Telephone system, the sub-contractor shall obtain N.O.C. from Director General, T&T Department, Ministry of Communications, Govt. of Pakistan, Islamabad if required. Any special requirement of the T&T Department shall be complied with by the Sub-contractor . The Owner shall arrange to deposit all amounts on demand from T&T Department for obtaining telephone connections to public Exchange and security deposits etc.

SECTION – 2 PVC CONDUITS AND ACCESSORIES

2.1 SCOPE

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

2.2 SUBMITTALS

Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

2.3 MATERIALS

A. CONDUIT PIPE

The conduit for wiring of circuits, lights, socket outlets and other systems shall be made of PVC manufactured under the trade names of "Polo" or “Popular” conforming to BS6099.

Steel conduit shall conform to BSS 31/latest and shall be 'International', Hilal and/or Premier "brands. The conduit shall be enameled with good quality non-cracking and non-flaking black paint.

B. FLEXIBLE PIPE

Flexible conduit shall be furnished and installed where necessary for convenient dismantling and/or avoiding vibrations to be transmitted. Flexible conduit shall be spiral interlocked type made of steel strip construction and coated with zinc or chromium plated.

C. CONDUIT ACCESSORIES.

Factory made round PVC. junction boxes shall be installed with non pressure type Pvc conduits. Junction boxes shall be of 2-1/4" dia and 3" long to receive Pvc conduit and shall be concealed in RCC of slab. The wall type junction boxshall also be factory made round PVC boxes having minimum dimensions of 2- 1/4" dia and not less than 1-1/4" long. Each junction box shall be provided with one piece cover which shall be fitted on the box with chromium plated screws

a. Conduit accessories such as switch boxes, socket outlet boxes, pull boxes and inspection boxes shall be made of 16 SWG sheet steel having dust tight covers. All boxes shall have required number of conduit entry holes and earth terminals for connecting E.C.P. All the rectangular or square shaped boxes shall have nipples to receive PVC conduit with force fit. All these boxes shall be painted inside and outside with black enamel, over a base coat of red oxide antirust paint. Shapes and sizes of these boxes shall be determined on each application.

b. Manufactured smooth bends shall be used where conduit changes direction. Bending of conduit by heating or otherwise shall be allowed only at special situations with the permission of the Engineer. Use of shape 90 degree bends and Tees is prohibited. Bends shall have enlarged ends to receive the conduit without any deduction in the internal diameter of the PVC pipe.

c. All accessories e.g. boxes, couplings, bends, solid plugs, bushes, reducers, checknuts etc. shall be equal in quality to the specified conduit.

d. Where inspection boxes occur in floor slabs a special cover on the box shall be installed to the satisfaction of the Engineer.

e. The use of looping in box shall be allowed in places where floor slab thicknesspermits 90 degree bends in conduit.

EXECUTION

The sub-contractor shall furnish all labour and material for the installation of conduit as required.

2.4.1. Conduit shall be installed concealed in RCC ceiling slabs, columns, walls and floors etc., Recessed conduit shall be laid over the first tier of reinforcement and under the second tier of reinforcement before pouring of concrete. All conduit outlet boxes to be concealed shall be laid firmly flush with the soffit of the slab or beam. The conduit should betied to the reinforcement firmly so that the alignment is not disturbed by vibrators. All the outlet boxes installed shall be stuffed and their cover plates fixed so as to prevent concrete entering the outlet boxes.

2.4.2. Under no circumstances shall chasis be made for recessing conduit in the RCC structure after it has been cast without the permission of the Engineer. Where conduits have to be concealed in cement concrete or brick masonry, chasis shall be made with appropriate tools not deeper than required. The conduit shall then be fixed in the chasis with iron hooks before covering it up with at least 20mm thick plaster. Conduit ends pointing upward shall be properly sealed to avoid entry of foreign material.

2.4.3. The drawings show conduit routes but planning for proper arranging conduit routes shall be carried out by the sub-contractor to the satisfaction of the Engineer.

2.4.4. The entire conduit system shall be essentially completed before the wire pulling is taken in hand. Each conduit run shall be tested for continuity and obstructions. All obstructions shall be cleared in an approved manner. Water and moisture that has entered any section of the conduit installation must be dried with suitable swabs to the satisfaction of the Engineer.

2.4.5. Adequate expansion joints shall be provided in all conduit runs passing across the expansion joints in the concrete slabs of the buildings. A typical arrangement is shown on drawing.

2.4.6. Pull boxes shall be installed in conduit runs at intervals mentioned below to facilities the pulling length of wires:-

i)	Straight runs.	-	20 meter.
ii)	Runs with one 90 degrees bends.	-	15 meter.
iii)	Runs with two 90 degrees bends.	-	10 meter.

2.4.7. Conduit runs between two outlets shall not contain more than two quarter bends or one 90 degree bend.

2.4.8. All the free ends of conduit shall be solidly plugged till such time as final and proper terminations are made.

2.4.9. All conduits of a system shall be run at least 6" away from the other systems and services where conduit of one system crosses the other it shall be done so at right angle i.e. 90 degree.

2.4.10. All multiple runs of conduit shall be arranged symmetrically.

2.4.11. Exposed runs of conduit where required shall be firmly held by means of G.I. saddles, clamps and brackets etc., to the surfaces of walls, columns and ceiling . Rawal plugs or phil plugs may be used for fixing saddles, clamps and brackets etc. The spacing between two saddles may not be more than 30". The straight runs on walls may be 18" to 24" below the ceiling and in the event of any obstruction due to beams the runs may be routed them. The conduit shall have a minimum clearance of 6 mm

from the surface supporting it. Purpose made special clips and bracketsmay be required at some situations to support the conduit.

2.4.12. No conduit less than 20mm dia. shall be used for point wiring and 25mm dia. for power wiring. The size of conduit shall however be determined from the number of wires required in the conduit run according to number of wires allowed as per IEEE Regulations.

2.4.13. Use appropriate size sleeves for crossing of beams lintels retarding walls etc. for providing conduits / cables at later stage.

APPLICATION

A. Outdoors - General:

1. Exposed: PVC
2. Concealed: PVC
3. Underground, PVC SCHEDULE 80
4. Boxes and Enclosures: NEMA 250, Type 3R.

2.5. JOB CONDITIONS

2.5.1. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

2.5.2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2.5.3. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer

SECTION – 3 WIRES, CABLES AND CORDS.

3.1 SCOPE

The wires & cords for conduit wiring shall be single core, made of stranded copper conductors, PVC insulated, tested to B.S. 6004, 1975. The voltage grade shall be 300/500 volts or 450/750 V unless otherwise specified on drawings and Schedule of values. The cables shall be of M/s. Pakistan Cables Limited, M/s. PIONEER Cable, M/s. Newage Cables.

3.2 MATERIALS

In order of preference as approved by the Engineer. The size of the wire shall be as follows:

i) for light or fan point wiring with 1.5MM square (or 3./029) or as specified in the SCHEDULE OF VALUES.

ii) for light circuit wiring with 2.5MM square (or 7/0.29) or as specified in the SCHEDULE OF VALUES.

iii) for power plug 15A wiring with 4 MM square (or 7/.036) or as specified in the SCHEDULE OF VALUES.

iv) the sizes of cables from Main Panel Board to Sub-Main Panel board to distribution boards shall be as shown on drawings or as specified in SCHEDULE OF VALUES.

3.3 EXECUTION

3.3.1 The sub-contractor shall furnish all material and labour to pull in and install wires and cables as required. The sub-contractor shall also supply, without extra cost, wire accessories e.g. plugs, solder, clamps, supports,

bushes, fixing pins, adhesive tapes, connectors, identification tags, straps, filling compound and earthing clips etc. as are required to be furnished for complete wiring installation in accordance with standard practice. The pulling of wires shall be taken in hand only when all conduit system is complete. All termination shall be mechanically strain free and electrically sound.

3.3.2 The wiring of the installation shall be strictly in accordance with the scheme, cable sizes and circuit details as shown on drawings and specified in WCC.1

3.3.3 All wiring shall be continuous between terminations and use ofconnectors or joints disallowed. Spur and Tee connections are strictly prohibited. Looping in system shall be followed throughout.

3.3.4 Manufacturers recommended lubricant shall be allowed to facilitate pulling of wires, use of all other kind of oil and soap is prohibited.

3.3.5 All wires occupying the same conduit shall be pulled together. Wires and cords at the time of pulling shall not be subjected to a bending radius more than 10 times the overall diameter of cables. Cable manufacturer's recommendation of pulling speed and pulling tension on cables shall govern the pulling operation.

3.3.6 Not more than 2 circuit wires shall be bunched in the same conduit. Wires of two different phases, however, shall not be run or terminated in the same outlet box for single phase wiring of lights, switches and sockets.

3.3.7 Porcelain or molded plastic connectors shall be provided for a joint between light point wiring and light fixture wiring and housed in the outlet box provided for this purpose. The sub-contractor after terminations are made shall be wrapped in PVC insulation tape.

3.3.8 The quantity and the size of the wire contained in any one conduit shall not be in excess of the numbers permitted by I.E.E. regulations.

3.3.9 All point and circuits wiring shall be solidly earthed by 14SWG (2.5mm square) PVC insulated wire of color Green, Yellow to serve as CPC which shall be run inside the conduit.

3.3.10 All 5A & 15A socket shall be wired separately direct from D.B. without any claim of circuit and distinctly from light point wiring, or as specifiedin SCHEDULE OF VALUES. However 5 Amps socket shall be controlled by D.B, or as specified in SCHEDULE OF VALUES.

SECTION – 4 WIRING ACCESSORIES

4.1. SCOPE

A. This Section includes the following:

1. Single and duplex receptacles, and ground-fault circuit interrupters.
2. Single- and double-pole switches and dimmer switches.
3. Device wall plates.
4. Floor service outlets and multi outlet assemblies.

4.2. SUBMITTALS

a. Product Data: For each type of product indicated.

b. Shop Drawings: List of legends and description of materials and process used for pre marking wall plates.

c. Field quality-control test reports.

4.3. MATERIALS

4.3.1. SWITCHES

a. Indoor switches controlling lights and fans shall be single pole, 10A, one or two way, suitable for 250V, 50Hz. The body of the switches shall be made of moulded plastic, one, two, three, four or six gang with integral built in moulded plastic face plate suitable for fixing on a sheet steel outlet box. The switch contacts shall be silver alloy tipped and these shalloperate with snapaction. The switches shall be piano type, ivory white in colour. The switches shall conform with BSS 800.

b. Weather proof switches on external lighting circuits shall be rotary type with quick make quick break action rated 5/10 Amps, 250 V, 50 Hz.

4.3.2. SWITCH SOCKET OUTLET UNITS

a. Switch and socket units shall be single pole, 3 pin rated 13A or 15A, 250V, 50 Hz. These shall be moulded plastic type with ivory white integral built-in face plate. Each socket shall have its control switch by the side of it on a common face plate. Thus the complete unit specified in SCHEDULE OF VALUES shall be as switch and a socket outlet unit. The switch socket outlet unit shall comply with BSS 546 and BSS 5733 or BSS 3052. Bells / chimes/Buzzers and bell pushes shall be suitable for operation on 230 Volts

b. Weather proof switch units shall have a cast iron outlet box with threaded conduit entry holes or nipples, rubber gasket and a spring loaded sheet steel cover.

c. Ceiling roses shall conform to BSS 67/1969. Lamp batten holders shall conform toBSS 5042 Part-I.

EXECUTION

All the switches and switch socket outlet units shall be installed on 16 SWG thick sheet steel outlet boxes of appropriate sizes All sheet steel boxes shall have conduit entry and terminals for connecting 14 SWG or 2.5mm (sq) PVC insulated circuit protective conductors.(CPC)

A. Install devices and assemblies level, plumb, and square with building lines.
B. Install equipment in accordance with manufacturer’s installation instructions.
C. Define each dimmer’s load type, assign each load to a zone, and set control functions.
D. Provide equipment at locations and in quantities indicated on drawings. Provide any additional equipment required to provide control intent.
E. Perform full-function testing on all completed assemblies. Statistical sampling is not acceptable.
F. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.
G. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.
H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates where possible.

I. Remove wall plates and protect devices and assemblies during painting.

J. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

4.5. DENTIFICATION

1. Receptacles: Identify panel board and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
2. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.

4.6. QUALITY ASSURANCE

Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.

5.1. SCOP E SECTION – 5 POINT WIRING & CIRCUIT WIRING

The work included under this Section consists of furnishing all labour, material, services and skilled supervision necessary for the construction, erection, installation and connection of all circuits and equipment specified herein or shown on the drawings and

/ or normally required for an installation of this type including but not limited to testing of the installation and its handing over to the Owners. The extent of work specified herein and/or shown on the drawing represent the minimum requirements. The installation on the whole should conform to the best form of workmanship and shall be accomplished by workmen, licensed and skilled in this type of work.

5.2. MATERIALS

5.2.1. POINT WIRING.

For the purpose of measurement of light / fan point wiring the following work shall be deemed to constitute the work of a point wiring:-

a) Providing and fixing conduit from a switch to wall / column / ceiling outlet, or fan / fixture excluding final sub-circuit conduit from distribution board to the switch as described in section 2 or as specified in SCHEDULE OF VALUES.
b) Providing and pulling of wires from switch to fan / fixture outlet excluding providing and pulling of final sub-circuit wiring in the conduit laid as in (a) above and as described in Section 3 or as specified in SCHEDULE OF VALUES.

5.2.2. SOCKET OUTLET WIRING.

a) For 5A socket on the light switch board and also away from the board the basis of the measurement shall be the same as in section 2.1.
b) For 13A/15A socket outlets the work shall comprise as under:-
    i) Providing and fixing conduit from distribution board to the socket outlet as described in section 2

Electrical

ii) Providing and pulling of wires in the conduit as in (a) above as described in section 3

5.2.3. CALL BELL POINT WIRING.
This shall be identical to section W.1 i.e. wiring for light point or as specified in SCHEDULE OF VALUES.

SECTION – 6 LIGHT FIXTURES

6.1. SCOPE

Light fixture schedule is provided in the drawings along with catalogue numbers of the manufacturers which are meant to serve as illustrations of the types of fixtures required for various applications.

The sub-contractor shall be required to submit samples of each and every light fixturefor the approval of the Engineer, before commencing with mass production of the fixtures. The sub-contractor should be prepared to carry out any number of modifications and improvements in the submitted sample free of cost until a finally acceptable sample is produced. Mass production shall be taken in hand only after a finished and modified sample has been produced and approved in writing by the Engineer. The sub-contractor has the option to offer acceptable equivalent of the specified light fixtures but to be installed with prior approval from Engineer.

This Section includes the following:

1. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.
5. Accessories, including occupancy sensors.

6.2. SUBMITTALS

A. Product Data: For each type of lighting fixtures, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast type and ballast factor.
4. Energy-efficiency data.
5. Sound Performance Data
6. Life, initial lumen rating, CRI, CCT, mercury content, and energy-efficiency data

for lamps and ballast system.

7. Photometric data,

B. Shop Drawings: Show details of nonstandard or custom lighting fixture. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached
   [including seismic strengthening].

4. Other items in finished ceiling including the following:
   a. Air outlets and inlets.
   b. Speakers.
   c. Sprinklers.
   d. Smoke and fire detectors.
   e. Occupancy sensors.
   f. Photosensors
   g. Access panels.

5 Perimeter moldings.

D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture/Luminaire Schedule. Each sample shall include the following:

1. Lamps and Ballasts: Specified units installed.

2. Accessories: Cords and plugs.

E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled lighting fixture, signed by product manufacturer.

F. Qualification Data: For agencies providing photometric data for lighting fixture.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lighting equipment, controls and fixtures, including emergency, operation, and maintenance manuals.

6.3. MATERIALS

The LED lights fixtures shall be down lighters/light panels/floods lights as shown in drawings and given in SCHEDULE OF VALUES. These will be surface mounted or recessed in false ceiling as per requirement of the project. The light fittings shall be CE/IEC & ROHS approved according to ambient temperature comprising of LED's of having life span of **50,000 hours**. All the light fixtures shall by certified by 3rd party having following certificates

1.	Lumen Maintenance of LED Source:	IES LM-80-08
2.	Luminaire Fixtures Type Test	IEC 60598
3.	Photo biological Safety:	IEC 62471
4.	EMC Test Report	EN 56100-3-2, EN 61000-3-3

LF.1 LED & DRIVER

LED shall be class-I having at least 100 lumens/Watt and make of CREE/EPISTAR/BRIDGLUX/LG/NICHIA or approved equivalent having color shifting SDCM Level of <=5 for indoor light & <=7 for outdoor light. The Driver unit having tolerance range of 110V to 277V with surge protection device & Power Factor PF of >0.9, total harmonic distortion should be less than 15%. The driver should be MEANWELL or approved equivalent.

LF.2 EMERGENCY LIGHTING

Emergency light fixtures shall be of the self-contained 3-hour maintained/non-maintained type, as specified, with 8 watt high efficiency fluorescent lamp and prismatic diffuser, with maintenance-free NiCad batteries, separate baseplate, plug-in luminaries with locking screw. The emergency output shall typically be 180 lumens.

Exit sign and other legends, which shall be chosen and approved by the Engineer, shall be to BS formats, 180mm or 90mm high, as required.

Converter systems shall be of the type suitable for mounting within luminaries, to convert an ordinary fluorescent luminaries into a self-contained battery-powered emergency luminaries. The emergency output shall typically be 600 lumens minimum.

6.4. EXECUTION

The light fittings shall be installed according to manufacturer's recommendations or as approved by the Engineer.

1. Flexible connecting wires from outlet box to the fixture shall be provided by the Sub-contractor; connector made of porcelain or thermoplastic material shall be provided and installed in the outlet boxes for connecting flexible wires to the

point wires.

2. Outlet boxes or any openings in the ceilings or walls shall be covered with appropriately fabricated accessories to provide an architectural entity to conceal them.
3. Rawal plugs or nylon plugs with good screws shall be used for fixing purposes.
4. Completely connect and securely mount lighting fixtures. Provide additional supports and hangers as necessary to securely fasten and support lighting fixtures to ceiling or structure.
5. Install lighting fixtures plumb and true, and square with ceilings and walls. Install continuous rows of fixtures such that rows appear as continuous system without visible vertical or horizontal undulation.
6. Hang pendant fixtures plumb, and with no "kinks" in pendants or cable.
7. Install lamps in each fixture.

6.5. QUALITY ASSURANCE

6.5.1. Mockups: Provide lighting fixtures for room or module mockups. Install fixtures for mockups with power and control connections.

1. Obtain Project Director/COR's approval of fixture for mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
4. Inspect each installed fixture for damage. Replace damaged fixtures and components
5. Verify normal operation of each fixture after installation
6. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

6.6. EXTRA MATERIALS

Extra materials described below that match products installed and that are packagedwith protective covering for storage and identified with labels describing contents.

6.6.1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

6.6.2. Plastic Diffusers and Lenses: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

6.6.3. Battery and Charger Data: One for each emergency lighting unit.

6.6.4. Ballasts: 5 for every 100 of each type and rating installed. Furnish at least one of each type.

6.6.5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

6.6.6. Control Devices: 1 for every 10 of each type and rating installed. Furnish at least one of each type

SECTION – 7 POWER CABLES

7.1. SCOPE

This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and above.

7.2. SUBMITTALS

A. Product Data - General: For each type of product indicated.
B. Qualification Data: For testing agency.
C. Field quality-control test reports.

7.3. MATERIALS

A. **11 KV POWER CABLES.**

a. All XLPE cables shall be manufactured to I.E.S. standard 502 or BSS-5467.
b. The XLPE cables shall be provided with extruded semiconducting conductor screen over stranded circular copper conductors before XLPE insulation is provided. On each core of conductor another layer of extruded semi-conducting core screen and copper tape screen are provided. The number of cores required then shall be put together and the anti spaces filled with non hygroscopic fiber filler and binding tape. The core is extruded with another PVC bedding.
c. Galvanized steel armour is provided underneath an overall PVC sheath.

B. **L.T. CABLES.**

The low tension cables shall be manufactured to the requirements of B.S 2004 ,

B.S. 6004, and rated at 250/400 and 600/1000 Volts as the case may be.

1 The conductors shall be annealed copper conductors, single or strandard circular or shaped as the case may be , to B.S.S. 6360/69.
2 The conductors specified for use in the cables shall be of at least 98% IASCconductivity.
3 The reference temperature for the purpose of determining the standard resistance of the conductors shall be 20 degree centigrade.
4 The conductors shall be insulated with poly-vinyl chloride insulation. The minimum thickness of the insulation shall be in conformity with the specifications to which it is manufactured.
5 Power cables shall be multicore cables, insulated and sheathed, armoured or unarmoured as required.
6 Various conductors forming the cables shall be laid together and voids shall be filled with soft plastic or fibers materials so as to give a circular shape to the cable.
7 A tough PVC shall be extruded over the cable so as to cover the insulated conductors and fillers.
8 Where armouring is required, a soft PVC jacket shall be provided over the laid up cable. Steel wire armouring shall be applied on a tough PVC sheathed extruded over the cable so as to cover the insulated conductors, fillers, jacket and armouring.
9 Complete identification of the cable together with Owner's identification markings if required shall be embossed on the final over sheath of the cable at every meter length.

C. CABLES TERMINATIONS.

All PVC power cables shall be terminated with suitable brass cable glands for securing the armour wires and incorporating a packing ring for excursion ofwater and moisture. The cables shall be secured at required spacing by means of cleats fixed to walls or roofs or hangers and where multiple runs occur perforated metal tray made of heavy gauge galvanized steel shall be used.

D. CABLE MARKERS.

For underground installation cable position markers shall be sited in the ground where cables change direction and at 30 meter intervals along straight runs of the cables. Markers shall also be provided to locate the position of joints. Cable markers shall be made of cast iron. Any one of the following words shall be embossed / engraved for the identification of cable routes.

11000 V. Cable.

440 V. Cable.

The markers shall comprise of a cast iron circular disc of 115 mm dia. and 10 mm thick to which an angle iron 25x3 mm bar 710 mm long shall be riveted at one end. The end of the bar shall be frok-opened upto a length of 75mm. this end shall be embedded in a cement concrete block of ratio 1:3:6 to a length, of 180mm. The concrete block shall have a shape of truncated pyramid with base 152x152 mm and a vertical height of 200 mm. The cable marker shall be buriedin the ground such that its total height above ground level is 267 mm.

E. CABLE JOINTS.

The sub-contractor shall be in possession of cable jointing kit and all termination shall be made by a bonafide and experienced cable jointer. All cable termination boxes kits and glands shall be of recognized makes and complete with claw clamps, ferrules, lugs, tapes, solders and jointing compounds.

F. WIRES & CORDS.

The wires & cords for conduit wiring shall be single core, made of stranded copper conductors, PVC insulated, tested to B.S. 6004, 1975. The voltage grade shall be 300/500 volts or 450/750 V unless otherwise specified on drawings and Schedule of values.

In order of preference as approved by the Engineer. The size of the wire shall be as follows:

i) for light or fan point wiring with 1.5MM square (or 3./029) or as specified in the SCHEDULE OF VALUES.
ii) for light circuit wiring with 2.5MM square (or 7/0.29) or as specified in the SCHEDULE OF VALUES.
iii) for power plug 15A wiring with 4 MM square (or 7/.036) or as specified in the SCHEDULE OF VALUES.

iv) the sizes of cables from Main Panel Board to Sub-Main Panel board to distribution baords shall be as shown on drawings or as specified in SCHEDULE OF VALUES.

7.4. DELIVERY, STORAGE AND HANDLING

The cables shall be delivered wound over strong drums of suitable dimensions. The cables ends shall be fastened to the drums and completely protected in suitable mannerto protect any injury to the cables during transportation and handling. The direction of rolling shall be clearly marked with bold arrows on both faces of the drums.

7.5. EXECUTION

1. The sub-contractor shall be under obligations to provide all labor, material and accessories for the installation of cables shown on drawings and listed in the SCHEDULE OF VALUES conforming to the specifications in this section.

2. The sub-contractor shall provide, without any extra cost, all material for termination of cables such as lugs, solders, clamps, supports, ferrules, bushes, fluxes, taps, fixing pins, identification tags, , earthing clips, straps for a complete terminal jointing operation in accordance with the best modern practice.

3. For underground cable installation the depth of digging the trench shall be such that the top surface of the cable shall not be less than 900mm and more than 1100 mm from the finished ground level. It will be sub-contractors responsibility to obtain true trench levels.

4. Cable routes indicated on the drawings shall be followed unless otherwise specified or agreed to by the Engineer. Where change in direction of the cable is necessitated, the bending radius of the cable shall not be less than the diameter of the cable drum or 12 times the diameter of the cable whichever is greater.

5. At all road crossing the cables shall pass through 100/150mm dia. core thickness minimum 1-1/2” RCC pipes with A class specifications sleeve shrouded in cast concrete , the mouths of which shall be sealed with cable bitumen compound of approved quality after drawing the cable. The road cuts shall be first filled with mud and 50mm size ballast upto 182mm level below the road surface and after ramming it properly 1500mm thick layer of cement concrete 1:3:6 shall be laid over it.

6. The cushion of sand to be provided in the trench before laying the cable shall not be less than 75mm and after laying the cable 150mm. The total depth of cushion of sand shall be not less than 225mm. Over the final layer of sand, tiles/bricks or concrete masonry blocks of adequate strength 2" thick and 300mx200mm in size shall be provided to the satisfaction of the Engineer. The rest of the trench shall be backfilled with earth, in 150mm layers and rammed properly before dressing.

7. All trenches and holes dug for laying the cables shall not be left open and unprotected for any length of time without completing the job and backfilling it to the satisfaction of Engineer. Where trenches are left open due to some unavoidable reasons the sub-contractor shall exhibit suitable danger signals such as banners, red flags and red lamps etc.

8. All cables shall always be lead out or lead into the ground through 2.5 meter long G.I. pipes of 75mm dia. or suitable size with 40% clearance as approved by the Engineer. The length of the pipe in the ground shall be 600mm. The pipe should be attached to the poles with approved clamps.

9. Markers of approved design and inscription shall be installed as specified.
10. For installation of cabl in perforated metal trays, the cable shall be tied or bunched properly in an approved manner. Similarly for installation of cables on cleats or raceway approval of the Engineer shall be obtained.
11. The sub-contractor shall furnish all material and labor to pull in and install wires and cables as required. The sub-contractor shall also supply, without extra cost, wire accessories e.g. plugs, solder, clamps, supports, bushes, fixing pins, adhesive tapes, connectors, identification tags, straps, filling compound and earthing clips etc. as are required to be furnished for complete wiring installation in accordance with standard practice. The pulling of wires shall be taken in hand only when all conduit system is complete. All termination shall be mechanically strain free and electrically sound.
12. The wiring of the installation shall be strictly in accordance with the scheme, cable sizes and circuit details as shown on drawings.
13. All wiring shall be continuous between terminations and use of connectors or joints disallowed. Spur and Tee connections are strictly prohibited. Looping in system shall be followed throughout.
14. Manufacturers recommended lubricant shall be allowed to facilitate pulling of wires, use of all other kind of oil and soap is prohibited.
15. All wires occupying the same conduit shall be pulled together. Wires and cords at the time of pulling shall not be subjected to a bending radius more than 10 times the overall diameter of cables. Cable manufacturer's recommendation of pulling speed and pulling tension on cables shall govern the pulling operation.
16. Not more than 2 circuit wires shall be bunched in the same conduit. Wires of two different phases, however, shall not be run or terminated in the same outlet box for single phase wiring of lights, switches and sockets.
17. Porcelain or moulded plastic connectors shall be provided for a joint between light point wiring and light fixture wiring and housed in the outlet box provided for this purpose. The contactor after terminations are made shall be wrapped in PVC insulation tape.
18. The quantity and the size of the wire contained in any one conduit shall not be in excess of the numbers permitted by I.E.E.E regulations.

19. All point and circuits wiring shall be solidly earthed by 14SWG (2.5mm square) PVC insulated wire of color Green, Yellow to serve as CPC which shall be run inside the conduit.
20. All 5A & 15A socket shall be wired separately direct from D.B. without any claim of circuit and distinctly from light point wiring, or as specified in SCHEDULE OF VALUES. However 5 Amps socket shall be controlled by D.B, or as specified in SCHEDULE OF VALUES.

7.6. QUALITY ASSURANCE

The cables should be tested according to BS 6004. The following tests shall be carried out at least

i) Dielectric Strength Test.
ii) Instantaneous and long time break down strength test.
iii) Temperature rise test.
iv) High voltage test.

Test certificates covering all these tests shall accompany the cables supplied by the Sub-contractor. After carrying out the tests as laid down in these specifications both ends of the cables shall be sealed at the manufacturer's works.

The owner may require the Engineer to witness the tests as specified herein and the sub-contractor shall make necessary arrangements for the presence of the Engineer on such tests and obtain their signatures in testimony thereof without any cost to the Owner.

SECTION – 8 EMERGENCY DIESEL GENERATOR SET

8.1 SCOPE

The sub-contractor is under obligation in providing materials, equipment and accessories and providing skilled labor, Technical (Generator Installation) supervision and experience in carrying out all necessary works for the complete execution of the emergency supply system specified hereinafter, as shown on drawings and listed in schedule and which, without excluding the generality of the foregoing, shall include but not be limited to the following scope of work. The specifications relate to the design, manufacture and works testing of a fully automatic mains failure diesel generating system.

This system shall provide an alternative source of supply to essential lights and equipment in the event of PESCO supply failure. This system shall comprise of Diesel Generating set feeding through Automatic Main's Failure control panel to emergency supplied Main L.T. switch board all housed at Basement. This Main L.T. Switch board shall be connected, through suitably rated feeder cables, to emergency supply sub main switch boards and/or distribution of each floor of buildings.

The PESCO supply shall be monitored and in the event of its failure shall 'start' the generating set automatically and deliver 90% load in 15 seconds. On the restoration of PESCO supplies, the D/G set shall stop automatically in 3-15 minutes (adjustable).

The sets shall be manufactured by any one of the manufacturers as mentioned in Annexure "B". The Sub-contractor shall provide sufficient technical details and data to

establish the suitability of the offered D/G set in accordance with the minimum requirements laid down hereunder. The sub-contractor should provide certificates from the Gene-set manufacturer that the Gen-set supplied is brand new/unused and the manufacturer has arrangements of providing after sale services and parts through his distributors or his own sources. Incase the supplier / sub-contractor installs used / second hand Gene-set, it shall be rejected without any claim whatsoever and the rejected equipment shall be replaced / installed at the cost of the Sub-contractor.

8.2 MATERIALS

Standard Diesel Generating sets supplied shall consist of the following:

A. Diesel Engine

Complete Industrial Diesel Engine Turbocharged, Water cooled, Four Stroke, inline cylinder arrangement, direct injection type, of approved make as per Annexure A generally to following specifications and capable of delivering enough power to serve the peak loads and adequate power margin to recover

frequency after abrupt load application. The Engine design shall be such that, it shall give very quick response to maintain frequency within specified limits.

a) Engine cooling system - Pressurised water cooling system with engine driven water circulating pump, Pusher type cooling fan, Set mounted tropical radiator suitable for ~~50°C~~ 65°C Air on temperatures (AOT) complete with exhaust duct (Flexible connection).

b) Engine Starting system. - 24 Volt D.C. starter Motor.

c) Engine charging system. - 24 Volt Battery charging Alternator Heavy duty Imported 24 Volt Lead Acid batteries.

d) Engine Governing system. - Electronic Governor giving Regulation to BS:5514 Class A1.in accordance with ISO 3046/IV, Class A1 and ISO 8528-5 Class G3

e) Engine Lubrication system. - Wet Sump with Gear driven pump, lubricating oil filters having replaceable elements and oil heat exchanger.

f) Engine Fuel System. - Fuel Oil Filters with replaceable Elements, Fuel pump, manifold, Injectors etc.

g) Engine Exhaust System. - Residential Silencer with suitable flanges and Rock wool thermal insulation.

h)	Engine Instruments and fault protection.	- Electrical Engine Temperature Gauge Electrical Oil pressure Gauge, Battery charge Ammeter, Low Oil Pressure High Engine Temperature, Low fuel level; Max power; Over-speed; Missed start; Missed stop; Min coolant level and Over Speed shutdown/warning with LED indications on control Panel. Coolant liquid temperature; Oil pressure; Oil temperature; Oil level
i)	Engine Air Filtering System.	- Heavy Duty Air Filters Dry Type, Replaceable element and with restriction indicator, overall efficiency 99.9% Acc Duct.
j)	Damping.	- Damping at the engine shall be achieved through suitably designed fly wheel to achieve flicker free operation.
k)	Tools.	- Routine Maintenance Tool Kit.
l)	Keys.	- Two Sets of starting keys.

B. Generator

- Complete Generator with excitation system, brushless type, single bearing type, Class "H" Insulations complying with BS5000 BS EN 60034.
- Type of protection - Tropical, Screen protected enclosure with Protection Class IP 23.
- Trivialized painted.
- Vibration Dampers.
- Directly coupled through a disc coupling with Engine and mounted on common skid.

C. Enclosure

The diesel generating set shall be housed in a sound proof enclosure so as todown the noise to acceptable limits 85 dba at 1 meter.

D. Fuel Tanks

Daily services tank suitable for 6-8 operation hours at full load of generator with level indicators and low level alarm, complete with piping built-in shall be provided.

E. Batteries

Heavy duty imported batteries 24 Volt D.C., lead acid type mounted on a frame/tray/stand, battery terminals, complete in all respects.

F. Literature / Drawings

Three sets of the following documents shall be handed over to the Project Manager prior to the commissioning and hand over of the gen. sets to the client.

- Installation instructions.
- Operating Manuals.
- Spare parts catalogue.
- Wiring / Foundation Diagram.
- Four wall charts (Operation, Maintenance, Trouble shooting, cautions.

8.3. Operating Conditions

All components of the sets are to be suitable for use indoors in tropical conditions and are to be designed to give desired output in an unheated, ventilated building, with the site conditions of humidity and temperature.

The generating set should have following characteristics:

a. As the set may be required for either stand-by duty or for base load operation, it should be possible to start, operate and stop the set manually by push buttons,in addition to automatic operation.

b. The set's engine shall be equipped with appropriate filters on the air intake(s), capable of operating in a dust-laden atmosphere.

c. The set is to be capable of starting and accepting full load within 15 seconds at lowest ambient conditions as stated above. It shall stop automatically in 3-15 minutes (adjustable) after resumption of normal supply.

d. The steady state voltage is to be maintained with in ± 1.5% of rated voltage at loads between no load to full load at any P.F between unity and 0.8 lagging , hot to cold . After any change of load the voltage is not to vary by more than ± 2% of the rated voltage and is to return to rated voltage within 3 seconds. The voltage over shoot on starting is not to exceed 5% and is to return to within 3% in not more than 3 seconds.

e. The frequency regulation of the set is to be such that when it is taking full load at rated frequency and the load suddenly removed, the frequency is not to rise more than 4% of rated frequency and is to return to its rated frequency within 3 seconds. The resultant steady state frequency is to be maintained ±2%.

f. The cycle irregularity of the set at full load is not to be worse than 1/150.

g. The deviation of the wave-form of the line voltage output from a pure sine wave is not to exceed the limits specified in BS 2613, but no single harmonic is to exceed 2%

h. Radio interference suppression is not to exceed limits ~~specifi~~ed in BS-800 BS EN 61000-6-2, BS EN 61000-6-4.

8.4. System of Operation

The diesel generating plant in the system will be arranged for fully automatic starting upon mains failure. Starting of the system will be initiated by a sensing loop from the main incoming panel. When the main fail, a signal will be given to initiate the start of the generating set.

The automatic start system incorporates a start delay timer set at 5 seconds for generator in the system to ensure that a momentary change in the mains supply will not start the generating plant. The control system also incorporates a run on timer.

A. Engine Protection (Each Generator Set)

Automatic shut down and lockout will take place in the event of the following faults occurring with the generating plant. Each fault will be of the first up lockout type and is shown by a visual indication on the front fascia of the main control panel together with the sounding of an audible alarm. Each lamp will incorporate a push to test feature. The shutdown faults will be as follows:

Engine fail to start

Engine overload

High engine temperature

Low oil pressure

Engine over speed

B. Lamp Indication

The following indicators will be supplied on the front fascia of the diesel generating set control panel and will be DC type and fed from the main battery source. All the failure circuits incorporate a press to test facility, which when operated will simulate the fault and shut the generating plant down. Lamp indication will be as follows:-

Fail to start

Overload

High engine temperature

Low oil pressure

Engine over speed

Plant called up

Plant off load

Battery charger off

Engine heaters on

C. Generator Automatic Start Sections 1 and 2

Engine start control panel will contain the following:

Voltmeter

Frequency meter

KW meter

Hours counter.
Current transformers as necessary.

Volts/Amps phase selector switch.

Start delay timer set at 5 seconds.

Stop delay timer set at 1 minute.

Duty selector switch.

Alarm/mute reset switch.

Battery charger with failure warning lamp.

Shutdown circuits as listed under `Engine Protection'.

Lamp indication.

Control fuses in auxiliary

circuits.Engine heater on/off

switch.

Manual control equipment.

D. Duty Selector Switch

A rotary type duty selector switch will be positioned on the front fascia of the generating set main control panel giving full facilities for automatic testing and manual control of the generating plant as follows:-

OFF Automatic starting and control circuit isolated.

NORMAL (AUTOMATIC)..... Automatic standby to mains supply.

TEST START ..... Test off load.

E. Alarm/Mute Reset Switch

A rotary type switch will be provided on the front fascia of the main control panel and will give the following functions:-
NORMAL .....Alarms operational.

MUTE .....Alarm horn cancelled.

RESET .....Reset fault shutdown circuit cancel indicator lamps.

8.5. Specifications

Diesel generating set comprises of AC Generator, flexible coupling, diesel engine, exhaust silencer, batteries heavy duty, radiator (for water cooled engine), fuel tank and engine / alternator control panel. The complete integrated unit is resilently mounted on common steel fabricated base frame.

8.5.1. Technical Data

Ratings:	KVA	KW

Prime Rating as per SCHEDULE OF VALUES. 10% overload for 1 hours within 12

hoursPower Factor	0.80
Voltage	415/240 V
Frequency	50 Hz.

Speed 1500 RPM

8.5.2. Site Conditions:

Relative humidity	90 %
Ambient temperature.	50°C
Altitude above sea level	1000 meters.

8.5.3. Engine Technical Data

Design.	Turbo charged, direct injection, 2/4 stroke, multi-cylinder, arrangement
Standards	DIN 6271/ 5514 relative humidity.

Prime rating as per SCHEDULE OF VALUES. 10 % overload for 1 hour within 12 hours.Speed 1500 RPM

Speed Regulation	By means of hydraulic or electronic governor.
Protection	Low oil pressure / high engine temperature.

8.5.4. Alternator Technical Data

Complete Alternator of suitable frame size complying with BS:5000 part 99, revolving field single bearing type, brushless, class "H" Insulation.

Out Put Voltage.	-	3 Phase 380 Volts - 415 Volts.1 Phase 220 Volts - 240 Volts.
Frequency.	-	50 Hz when running at 1500 RPM.
Power Factor.	-	0.8 - 1.0.
Voltage Regulation.	-	Automatic +/-

0.5%Frequency Regulation. - Automatic +/- 2%

Climatic Conditions. - Ambient Temperature 40^{o} C

Rel. Humidity. - 60 %Protection. -

Automatic short circuit and sustained over load protection

should be provided for the generator. It should be tropicalised

and screen protected.

Vibration Isolation. - Suitable Vibration

damping arrangement

should be provided.

Mounting. - The machine should be directly coupled through a disc coupling with the engine and mountained on a common skid.

8.5.5. Fuel Tanks

A fuel day tanks for 8 hours full load operation of the set shall be supplied with the generator set. The tank shall be suitable mounted on a pedestal at wall brackets or base frame and will be complete with content gauge. The fuel line from day tank to the machine shall be of the internal dia as specified by the manufacturers. In addition to this one 1/2" dia. connection for diesel oil feed line and one 1/2" dia. connection for over flow pipe will be provided in the day tank.

8.5.6. Batteries

A mains operated trickle charge shall be supplied with the D/G set in order to maintain the battery in charged condition. It shall be provided with ON/OFF switch, indicator light, input and output fuses and reverse current protection. Upon operation of the standby plant, the charger shall be disconnected from the battery and from the mains. An ammeter to indicate the rate of charging current and a voltmeter to indicate battery voltage shall be required.

8.5.7. Miscellaneous

R.C.C. inertia block including vibration mounting shall be supplied by the sub-contractor. All trenches, duct , covers, railings, gratings, and the like required for the D/G set shall be provided by the sub-contractor. The sub-contractor shall

supply and install all piping , cabling and all other accessories for completion of this work to the entire satisfaction of the Project Manager.

8.5.8. Automatic Mains Failure Panel

A floor mounting automatic control panel sheet steel clad, welded construction with access through a locked front door, finished in battleship gray enamel paint and containing the following equipment:-

1- 4pole Motorized circuit breaker suitably rated.
2- Voltmeter, 240 degree scale, scaled 0-500 volt.
3- Voltmeter with seven position selector switch for RN, YN, BN, RY,YB-BR-OFF.
4- M.I.S.C. ammeter 240 degree scale suitably scaled for flushed panel mounting.
5- Ammeter selector switch for R-Y-B-OFF.
6- Frequency Meter, 45-55 Hz, and a 240 degree scale.

7- KWH meter, 3 element type, 3 phase, 4 wire loads.

8- Suitably rated class "C" accuracy, ring type current transformers.

9- Set instrument fuses.alternator voltage monitoring relay suitable

for operating on a risein voltage and frequency.

10- Static time delay unit for engine starting and stopping lockout.

12- Pneumatic timer for engine starting and stopping lockout.

13- Triple pole magnetic or voltage controlled, I.D.M.T. overload relay.
14- Percentage differential relays for protection of phase to phasefaults in stator winding.
15- Reverse power relay for protection against motoring.

16- Auxiliary relay for controlling circuit breaker trip

coil.17- Over voltage relay with time lag characteristics.

18- Synchronoscope and Synchronizing

switch.19- Set push button for:

START : STOP : RESET

1- Failure to start signal lamp.

2- Load on mains signal lamp.

3- TP&N fully enclosed and interlocked Motrised Circuit Breakers with ON-

OFF indicators. One of these contactors would be connected to the normal supply and one would be connected to the cable coming from the emergency supply. There would be a common outgoing.

4- Set of five plug-in type 24 volt DC control relays, each fitted with international octagonal plug-in base and plastic dust proof cover.

5- Set of 230 volts mains operated battery charging equipment suitable for charging a 24 volt battery at a maximum rate of 2 Amps, complete with charging regulator, ammeter mains switch, AC and DC fuses including nickel cadium batteries of suitable capacity.

6- Inter-connections, designation labels etc.

7- Set incoming and outgoing cable glands mounted on a cable tray.

8.5.9. Warranty

The sub-contractor shall provide warranty from the manufacturer against design / manufacturing defects for a minimum period of 12 months from the date of installation / commissioning at site.

8.5.10. Maintenance Period

The Sub-contractor shall be responsible to maintain the Gen-set in perfect running conditions for a period of 12 months starting from the date it has been handed over to the Project Manager of the Client. All expenses for the maintenance and running of the gene-set including operating spares / services but excluding cost of fuel and lubricants shall be considered part of the contract. The sub-contractor shall provide the initial fill of lubricant with the Gensets and only top up lubricants during the maintenance period shall be to the Client's account.

8.5.11. Factory Test

After assembly, the engine shall be mounted on the test bed in the factory and running is carried out in accordance with manufacturer's standards. The engine shall then be installed on the base frame together with the alternator and all accessories and satisfactorily tested at the rated speed and load. Factory test report will be provided with the generator set.

8.5.12. Site Performance Test

Sub-contractor shall perform a 12 hours performance test at full load as per requirements, including 1 hour at + 10% overload. Provision of load shall be to Client's account. A test report shall be prepared and will include the Fuel

Efficiency Performance of Gensets/Diesel Engine and a deviation of a mean of 10% from the approved submittal shall be allowed

8.5.13. Fuel and Lubricants

All fuel and lubricants expenses required in connections with commissioning testing of the gene-set as per 6.11 above shall be form by the sub-contractor. Commissioning and testing shall be carried out in the presence of nominated authorized Project Manager of the Client.

8.6. Installation Instructions

Manufacturer's recommendations shall be followed strictly.

SECTION – 9 MAIN L.T SWITCH BOARD

9.1 SCOPE

This Section includes metal-enclosed, low-voltage, power circuit-breaker switchgear rated 1000 V and less for use in AC systems.

The L.T. switchboard shall be indoor type, free standing, free supporting , floor mounted, totally enclosed, sheet steel clad, dust and vermin proof, completely wired, factory assembled and suitable for installation back to the wall and capable of front attendance. The switchboard shall comprise of multipanels suitable for housing, air circuit breakers, moulded case breakers or load break switches as shown on the drawings and as listed in the schedule of quantities. The switch board shall be designed to suit services conditions and ensure security and safety during operation, inspection, operation, cleaning and maintenance. The switch board shall be designed and tested to IEC recommendations. Each panel shall withstand strain of 2000 Volts insulation level forone minute power frequency test. The switchboard shall comprise of the following main components and each removable component of the same rating shall be physically and electrically interchangeable. Switchboard to British Electrically Standard 41-5 are also acceptable.

9.2 SUBMITTALS

A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each type of switchgear and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

a. Tabulation of installed devices with features and ratings.

b. Enclosure types and details.

c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.

d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.

e. Current rating of buses.

f. Short-time and short-circuit current rating of switchgear assembly.

g. Nameplate legends.

h. Mimic-bus diagram.

i. Utility company's metering provisions with indication of approval by utility company.

j. Features, characteristics, ratings, and factory settings of individual over current protective devices and auxiliary components.

Wiring Diagrams: Power, signal, and control wiring.

a. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipe and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

b. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.

c. Field quality-control test reports.

d. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

e. Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals

i. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

ii. Time-current curves, including selectable ranges for each type of over current protective device.

9.3 MATERIALS

AIR CIRCUIT BREAKERS.

a. The air Circuit breaker shall be triple pole of specified rating, front mounted, trip free, spring charged, quick make, quick break manually operated mechanism and

visual ON/OFF position indicator. The circuit breaker shall be suitable for continuous period of time under service conditions. The circuit breaker shall have 50/65 KA (or as specified) breaking capacity and shall be capable of the following make / break operations:

Electrical - 500 Cycles.

Mechanical - 8000 Cycles.

The A.C.B. shall conform to BS 4752/1977. The contacts of the A.C.B. shall be heavy duty, spring charged and silver plated. Replaceable arcing contacts and arc chutes shall be provided. The operating handles if made of metal shall be either earthed or additionally insulated to withstand full insulation voltage. A certified copy of full type tests carried out by an independent agency on identical breakers shall be acceptable in lieu of the following type and routine tests :-

i) Making capacity, breaking capacity and short time current tests.
ii) Mechanical and electrical life endurance tests.
iii) Temperature rise test.
iv) Power frequency with stand test.
v) Milli volt drop test.

However all other routine tests shall be witnessed by the Engineer at no additional cost to the Owner.

b. The relays shall have three elements, two for the over current and one for the earth fault. These shall be inverse over-current definite minimum time induction type with inverse characteristics. The relays shall be AC operated and provided with time and current setting adjustment of suitable range. The relays shall be equipped with instantaneous elements which have infinity setting or lock out position to make the instantaneous element in operation . The rated error of all the relays shall not be more than 7.5% at full setting. The relay characteristics shall not change plus and minus 7.5% with changes in ambient temperature of ± 10% from the reference temperate of 25 degree centigrade and with changes in the frequency. Certified tests carried out by an independent agency shall be supplied in lieu of the following type tests:-

i) Limit of error test.

ii) Temperature rise test.

iii) Overload test.

iv) Contact rating test.

v) Mechanical durability test.

vi) Variation of characteristics with ambient conditions and frequency.

The relay shall conform to BSS 142/latest.

c. Three single pole, resin filled current transformers, 15VA burden, suitable for metering and manufactured and tested to IEC publication 185 shall be provided. The standard accuracy class shall be 0.5% . The rated dynamic peak current rating shall be according to IEC recommendations. The following type tests shall be carried out on C.T.'s:

i)	Short time current test.	-	clause 19
ii)	Temperature rise test	-	clause 20
iii)	Accuracy test	-	clause 29
iv)	Instrument security current test	-	clause 31

The following routine tests shall be carried out on C.T.'s:

i)	Verification of terminal marking.	-	clause 14
ii)	Power frequency test at primary & secondary windings.	-	clause 16
iii)	Over-voltage inter-turn test.	-	clause 17

C.T.’s conforming to B.S. 3938/1973 are also acceptable.

d. The following instruments shall be provided unless otherwise specified:-

1 - KWH meter.

1 - Voltmeter 0-500 volts.

1 - Voltmeter phase selector switch.

1 - Ammeter commensurate with rating of

ACB.1 - Ammeter phase selector switch.

All the instruments shall be flush mounted and back connected in a transparent dust proof cover with 144x144mm (6"x6") dial which shall have prominent black graduations on white surface. The instruments shall be manufactured and testedin accordance with IEC publications 51 or B.S.89 part 1/1970.

MOULDED CASE CIRCUIT BREAKERS

The moulded case circuit breakers shall be triple pole and of the rating specified in the schedule of quantities and/or shown on drawings. The MCCB shall be of fixed type, having trip free, solenoid & manually operated mechanism and ON/OFF/Trip position indicators. The MCCBS shall comprise of adjustable hydraulic magnetic releases for overload protection and instantaneous adjustable electro-magnetic releases for short circuit protection. The tripping devices shall have time current characteristics so that positive discrimination and selective tripping is obtained assuring the tripping under fault conditions of only the breaker in the circuit ahead of the fault location. The MCCB shall have a ruputring capacity of 35 KA (or as specified) and shall be manufactured and tested to IEC publication 157-1 Part I or BS 4752/1977 or BSS 3871 Parts I & II. The MCCBS manufactured by Merlin GERIN, Terasaki, ABB, Legerand are acceptable.

BUS BARS AND CONNECTIONS

A set of four bus bars, three for phases and one for neutral, made of copper having 98% IASC conductivity shall be provided. The bus bars in panels and chambers shall be tin plated, PVC insulated having minimum clearance of 50mm between phase to phase and 25mm between phase to earth. The neutral bar shall be of the same section. All the bus bars shall be mounted on insulators at suitable intervals and should be extensible on both ends. The marking and arrangement of bus bars, main connections and small wiring shall conform to BS 158/1961. Bus bars and bus bar connections shall conform to BS 159/1957.

ENCLOSURES

The enclosures shall be fabricated from 3mm thick high grade sheet steel and shall be designed to house all the live parts which shall be accessible through front doors. The enclosure shall be tropical in design completely dust and vermin proof and liquid repellent, with special regard to danger of flashover both in service and in isolated position. Hinged lockable doors shall be provided on the front and bolted plates at the rear. Adequate air circulation by means of vent covered with suitable metal gauze shall be provided in the enclosures. All exterior and interior surfaces of the enclosure shall be thoroughly cleaned and freed of dust, rust and greasy matter. The enclosures shall be

given three coats of paint. The primer shall be Zinc Chromate and/or iron oxide. The second and third coats shall be top quality battleship gray enamel. Enclosure for each panel shall be provided with designation labels as directed by the Engineer. The enclosures / enclosure door shall be double earthed with appropriate size of copper conductor.

EARTHING

The switchboard shall be effectively earthed by means of a copper strip of 25mmx3mm (1"x1/8") Cross-section bolted to connections near the bottom of the switchboard.

ACCESSORIES

Designation labels, lifting lugs, foundation bolts, interconnecting nuts bolts, and washers, thimbles, lugs, leveling shims cable glands and/or cable end boxes for all the sizes of incoming and outgoing cable shall be supplied with the switchboard.

SUBMAIN PANEL BOARDS

The Sub-Main panel board shall be similar to the Main L.T. board and the components in its fabrication may differ and shall comprise of the components as shown on drawings and as described or listed in the Schedule of quantities. The rupturing capacity of the each component for sub-main boards shall be as under:-

1)	Air circuit breakers.	-	35 KA (or as specified)
2)	Moulded case circuit breaker.	-	25 KA

All the other details and specification as in section 9 shall be applicable to this section.

9.4 DELIVERY, STORAGE, AND HANDLING

a. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.
b. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.
c. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent condensation.

9.5 EXECUTION

All labor, equipment, tools and plant required to complete the installation shall be provided by the Sub-contractor. The switchboard shall be fixed firmly on the floor in perfect line, plumb and level position. All incoming and outgoing cable connections shall be made including earth connections.

3.1 EXAMINATION

A. Examine elements and surfaces to receive switchgear for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have beencorrected.

9.6 PROJECT CONDITIONS

Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

Notify Project Director/COR not less than seven days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.

Indicate method of providing temporary utilities.

Do not proceed with utility interruptions without Project Director/COR's written permission.

9.7 QUALITY ASSURANCE

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage factory-authorized service representative to perform the following:
   1. Inspect switchgear installation, including wiring, components, connections, and equipment.
   2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
   3. Complete installation and startup checks according to manufacturer's

written instructions.

4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
5. Report results in writing.

C. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Perform the following field tests and inspections and prepare test reports:

TYPE TESTS.

i) Temperature rise test.
ii) Mechanical endurance test.
iii) Making / breaking capacity test.

ROUTINE TEST

High Voltage tests.

VISUAL AND MECHANICAL

c) Perform each visual and mechanical inspection and electrical test

1. Switchgear.
2. Circuit breakers.
3. Protective relays.
4. Instrument transformers.
5. Metering and instrumentation.
6. Ground-fault systems.
7. Battery systems.
8. Surge arresters.
9. Capacitors.

d) Remove and replace malfunctioning units and retest as specified above.

TRAVELLING, BOARDING/LODGING, FOOD OF THE TESTING AGENCY TO BE BORNE BY THE SUB-CONTRACTOR

ADJUSTING

Set field-adjustable, protective-relay trip characteristics

PROTECTION

Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

SECTION – 10 DISTRIBUTION BOARDS

10.1 SCOPE

A. This Section includes load centers and panel boards, over current protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panel boards.
2. Distribution panel boards.
3. Transient voltage surge suppressor panel boards.

The distribution boards shall be either free standing, cubical type or wall mounting type suitable for surface and/or recessed mounting. Each distribution boards (D.B.) shall be tropical in design, fully dust and vermin proof and liquid repellent. The cabinet housing the main components shall be fabricated from mild steel sheets 16 SWG thick and reinforced with structural steel members welded to it. Front access, mechanically locked and hinged doors, fully gasketed,having one or two leafs depending upon the size of the cabinet shall be provided on each cabinet. All openable parts shall be provided with gaskets or lining and screwed to the main body with chromium plated screws. The cabinets after fabrication shall be thoroughly cleaned completely derusted and degreased before applying one coat of zinc or lead based primer and then two coats of top quality synthetic emulsion or stove enamel paint in battleship gray colour. All exposed parts of the D.B's shall be covered with 5mm thick bakelite sheet. A load distribution chart shall be provided in each D.B showing the areas fed by each circuit and a suitably sized pocket inside the front door shall be provided for the purpose. Each D.B.shall be delivered complete with all instruments accessories, rating plates, designations, as approved by theEngineer.

Suitable cable entry glands shall be provided as required for floor mountedboards on the incoming cables but for outgoing cables and/or wall mounted boards exact number of conduit entry holes as are required shall be provided with male brass bushes. The bushes shall be tin plated and fully shrouded or housed in gasketed compartments.

10.2 SUBMITTALS

A. Product Data - General: For each type of panel board, over current protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features,

performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings For each panel board and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panel boards and over current protective devices.
      d. Features, characteristics, ratings, and factory settings of individual over current protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panel board Schedules: For installation in panel boards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panel boards and components to include in emergency, operation, and maintenance manuals. Include:
   1. Manufacturer's written instructions for testing and adjusting over current protective devices.
   2. Time-current curves, including selectable ranges for each type of over current protective device.

10.3 MATERIALS

COMPONENTS.

The main components e.g. earth leakage circuit breakers (ELCB / RCCB), moulded case circuit breakers, **load break switches,**HRC fuses and instrument as shown on the drawings and as described in schedule of quantities shall be the same as described in section 9. However miniature circuit breakers (MCBs) used in D.B's are briefly described hereunder:

MCBs

The incoming shall have triple pole mcb's suitable for use on 415V 50Hz, AC and the outgoing mcbs shall be single pole or single phase for use on 220V, 50Hz, AC. The ratingsare as shown in drawings and/or described in the schedule of quantities.

The mcbs shall be moulded case type having hydraulic magnetic short circuit releases, contacts , operating mechanism and arcing chambers.

The mcbs shall be manufactured and tested to BSS 3871/1966, and shall have a rupturing capacity of 7.5 KA or as specification SCHEDULE OF VALUES. The final circuit mcb's on the outgoing, shall however be rated 5KA.

FABRICATION AND FEATURES

A. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box
B. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatmentor primer coat.
D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panel board door.
E. Bus: Hard-drawn copper, 98 percent conductivity.
F. Bus Bars of Power Distribution and Branch Circuit Panel boards: Provide hard drawn copper. The neutral bus shall be isolated from both the ground bus and thecabinet, except at the service entrance or at the output of separately derived systems and shall be grounded in accordance with the NEC.
G. Main and Neutral Lugs: Compression or mechanical type suitable for use with conductor material.
H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

L. Split Bus: Vertical buses divided into individual vertical sections.

M. Skirt for Surface-Mounted Panel boards: Same gage and finish as panel board front with flanges for attachment to panel board, wall, and ceiling or floor.

N. Feed-through Lugs: Compression or mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

O. Provide 10 percent spare circuit breakers, 20 percent spaces for future breakers, and 20 percent overall spare current carrying capacity for future expansion.

10.4 EXECUTION

All labour, equipment, tools, plant and accessories required to complete the installation shall be provided by the Sub-contractor. The distribution board shall be fixed as required in perfect line and plumb. All earth terminations shall be made on the neutral block.

TESTING.

All D.B's shall be tested at manufacturer's works and tests shall be witnessed by the Engineer without incurring any additional expense to the Owner.

SECTION – 11 TELEPHONE

11.1 SCOPE

The work under this section consists of supplying, installing, testing and commissioning of all material and services for provision of Structured Cabling as specified herein, as shown on Tender Drawings and stated in the Schedule of values.

The Sub-contractor shall discuss the Structured Cabling Layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the system.

To ensure optimum performance, components of the structured cabling shall be sourced from the one manufacturer. This shall eliminate potential problems such as electrical and mechanical mismatch between different manufacturers.

Structured Cabling shall be covered under the manufacturers Certified Installation Program and installed by Certified Installation Company. Under this arrangement, the supply of components from the one manufacturer will facilitate the manufacturers Certification requirements of sole supply.

The Structured Cabling shall support the following systems, but not be limited to these systems.

11.2 MATERIALS

Data Communications

EIA-232-D, RS-422, RS-423, ISDN, Ethernet (10 Base-T, 100 Base-T and 1000 Base-T & 10Giga), 100 Base VG Any LAN, Token Ring, Fibre Distributed Data Interface (FDDI), Twisted Pair-Physical Medium Dependant (TP-PMD) and ATM (155 Mbs and 622 Mbs), etc.

APPLICABLE STANDARDS AND CODES

The following standards and all “normative addendums” shall be applicable to this document and must be adhered to for any installation work performed.

EIA/TIA 568-A Commercial Building Telecommunications Cabling Standard.

EIA/TIA 569-A Commercial Building Telecommunications Cabling Standard Pathways and Spaces.

TSB 67 Transmission Performance Specifications for Field-Testing of Unshielded Twisted-Pair Cabling Systems.

IEEE 802.3 Wire Speed Performances

EEE 802.1Q VLAN

All copper/optical fibre cabling, components and connecting hardware shall be in accordance with latest revision of ISO/IEC 11801, ISO/IEC/TR3 8802-1, ISO/IEC/8802- 3, ISO/IEC 61935-1, IEC 60364-1, IEC 60950, EN50173, EN50174-1, EN50174-2, and EIA/TIA TSB 72/73.

MATERIALS

A. Category – 6 Cable (Telephone Network)

The horizontal cabling shall be Category – 6 U/UTP or S/FTP, 4 pair cable with 1.0 Gigabit support and specified up to 250MHz. The cable employed shall have excellent electrical characteristics and shall posses low weight, have slim design and shall be non corrosive (to IEC 60754-2), low smoke (to IEC61034), and flame retardant (to IEC 60332-3) and DIN VDE 0472, Part 804, test type C). The cable shall meet the requirements for EN 55022 Class B emission and EN 55024 immunity to be compliant with standards of electromagnetic compatibility and shall comply with following specifications:

Compliance

IEEE 802.af, IEEE 802.3at for PoE applications ANSI/TIA-568-C.2:2009 Category6ISO/IEC-11801, 2nd Edition Class EIEC 61156-5:2002 Category 6LSZH: IEC 60332-

1, IEC 60754, IEC 61034

Electrical Specification

- DC Resistance - 72 Ohms / Km

- DC Resistance Unbalance - 2% Max
- Insulation Resistance - 5000M-KM/Min
- Wiring Sequence - TIA/EIA 568 A+B
- Delay Skew - 25 ns/100 meter Max

Mechanical Specification

- Diameter of Copper - AWG 24
- Wire Insulation - PVC/PVC
- Deployment Area - Dry and Damp Rooms
- Temperature Range (moving) - 0 ^{o}C to +50 ^{o}C
- Operating Temperature - -20 ^{o}C to +60 ^{o}C
- Min. Bend Radius for Single Flexure - $\geq$ 40 mm
- Min. Bend Radius during Installation $\geq$ 60 mm

B. Category – 6 Outlets (Telephone Network)

The horizontal cabling shall be terminated on Un-shielded or Shielded Cat-6 RJ-45 keystone Jacks support 250 Mhz as per SCHEDULE OF VALUES on white plasticwall plate with shutter. The category-6 outlets shall have provision of two outlets and shall accommodate one or two inserts (as per SCHEDULE OF VALUES). To maintain security, the module shall not be removable from the front of wall plate. The Cat-6 RJ-45 outlets shall be protected by a spring-loaded shutter which will cover the outlet when not in use. Outlets shall comply with following specifications:

Compliance

IEEE 802.af, IEEE 802.3at for PoE applications.

ANSI/TIA/EIA 568AB.2.2001,

ISO/IEC11801:2002

EN50173-2 Category 6 standards

Electrical Specification

- DC Resistance - < 200 milli Ohms
- DC Resistance Imbalance - < 50 milli Ohms
- Insulation Resistance - > 500 Mega Ohms min
- Wiring Sequence - TIA/EIA 568 A+B
- Delay Skew - < 1.25 nanoseconds

Mechanical

SpecificationJack

Contact

- Material of RJ45 pins - Copper alloy
- Plating of RJ45 pins - Gold plate 1.4 µm
- Operating Life (number of RJ45Insertions) - 1500
- Plastic Housing (material type) - Polycarbonate (VO)

IDC Block

- Material of metal terminals - Copper alloy
- Wire Accommodation (diameter range) - AWG 22-24
- Tool Accommodation (required or not) - NO
- Gas Tight IDC Cable Termination (yes/no) YES
- Plastic Housing (material type) - Polycarbonate (VO)
- Operating Life (number of re-terminations) up to 5

C. Patch Cord: (Telephone Network)

The U/UTP or S/FTP Cat-6 patch cords should be designed for 1.0 Giga applications up to 250 MHz and provides transmission performance meeting Category 6 specifications. Cables should be low skew products. I.e. the difference in propagation delay between the individual pairs is very low. Additional features are the slim design and low weight of the cables. The cable should meet or exceed the requirements for EN 55022 Class B emission and EN 55024 immunity allowing for networks to be built that are compliant with the standards on electromagnetic compatibility.

Compliance

IEEE 802.af and IEEE 802.3at for PoE applications

ANSI/TIA-568-C.2 and ISO/IEC-11801 (2nd Edition), IEC 61156-2,

EN 50173; EN 50288-6-2 Category 6 standard

D. Patch Panel: (Telephone Network)

Industry Standard 19" UTP / STP Patch panel capable of accommodating 24 No. Category – 6 U/UTP or S/FTP outlets. The patch panel should be modular having 1U height with integral strain relief. Front panel of patch panel should be made of high-grade steel.

Compliance

EEE 802.3an, IEEE 802.3af (PoE), IEEE 802.3at

(PoE+)ISO/ IEC 11281:2002

IEC 60603-7, TIA-968-A (formerly FCC Part 68 Subpart F)

11.3 EXECUTION

All cable installations shall be completed according to the local regulatory board and conform to EIA/TIA 568-A and shall comply with the following criteria.

A. UTP Cable Installation

Cables shall be installed in already laid steel cable trunking (within suspended ceilings) suitably anchored to the building structure, and in conduit in floor and partitions (concealed). Cables shall be secured every 600mm using hook and loop fastening ties. Due care shall be taken to not over tighten ties and place undue strain on the cabling infrastructure.

Cables shall be bundled to a maximum of 24 UTP cables and each bundle individually supported within the cable trunking.

Bend radius shall be limited to 10 times the cable diameter (UTP)

During the installation of a UTP cable (maximum 90 metres) the pull distance should not exceed 30 metres at any one time.

Internal Multi-pair Telephone cables should be in accordance with BT type CW 1308. These cables are used for connecting telephone systems and data exchange systems with a plain annealed copper conductor of 0.4mm, 0.5mm, 0.6mm &; 0.9mm diameter with PVC insulation. These are twisted to form a pair and over sheathed in white, cream, gray &; black PVC. A rip cord is laid under thesheath to facilitate its removal. An optional 1.38mm diameter earth copper wire is available on 50 pair cables and above.

Conductor:	Class 1 Solid annealed Bare Copper Conductors to BS 6360:1991/IEC 60228:2005 (note - IEC 60228:2005 replaces BS 6360:1991)
Insulation:	PVC (Polyvinyl Chloride)

Twisted Pair:	Two single wires are twisted to form a Pair
Separator:	Polyester Tape longitudinal wrapped
Rip Cord:	Nylon
Earth Wire:	PVC insulated Bare Copper
Outer Jacket:	1) PVC 2) LSZH (Optional)
Jacket Colour:	Cream

11.4 TESTING AND COMMISSIONING

The following tests shall be carried out and the results shall be documented and maintained to form part of the "AS BUILT" drawings.

1. Test all of the UTP copper cable installation for termination and twisted pair integrity, including continuity, polarity, pin-assignment and color codes

2. Perform visual inspections to ensure that each pair of wires remains twisted as close as possible to the termination point, to maintain the impedance and minimize attenuation losses.

3. Test that the UTP cable pairs comply with the Specification using measuring device for Near End Cross-talk and Signal Attenuation complying with EIA/TIA 568-A.

The documentation required at the completion of the installation phases shall containall of the following information, together with any other information the installer has acquired during the installation.

1. "As-Built" documentation, showing total cabling and connection installed, utilizing floor space plans and cable record sheets. This documentation shall show all cables and outlets incorporating the full numbering and marking convention supplied.

2. All test results and certification information, identified by cable, connection and numbering convention, necessary for all copper cables.

All components of the Structured Cabling should be sourced from one manufacturer to

ensure minimal impedance mismatch and best possible NEXT performance and to guarantee the Category-6 performance from end to end.

The Structured Cabling System should operate without introducing or being affected by electromagnetic radiation from other sources. Maintaining segregation from other services or screening is to be ensured to achieve acceptable immunity.

SECTION – 12 DATA

12.1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services for provision of Structured Cabling as specified herein, as shown on Tender Drawings and stated in the Schedule of values.

The Sub-contractor shall discuss the Structured Cabling Layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the system.

The Structured Cabling work with accessories shall also comply with the General Specifications.

A. GENERAL

To ensure optimum performance, components of the structured cabling shall be sourced from the one manufacturer. This shall eliminate potential problems such as electrical and mechanical mismatch between different manufacturers.

Structured Cabling shall be covered under the manufacturers Certified Installation Program and installed by Certified Installation Company. Under this arrangement, the supply of components from the one manufacturer will facilitate the manufacturers Certification requirements of sole supply.

The Structured Cabling shall support the following systems, but not be limited to these systems.

Data Processing

Mainframe access, Client Server, Enterprise Server, Messaging Systems and Electronic Mail, common document utilization, Client Database, Voice and Video,etc.

Data Communications

EIA-232-D, RS-422, RS-423, ISDN, Ethernet (10 Base-T, 100 Base-T and 1000 Base-
T & 10 Giga), 100 Base VG Any LAN, Token Ring, Fibre Distributed Data Interface (FDDI), Twisted Pair-Physical Medium Dependant (TP-PMD) and ATM (155 Mbs and 622 Mbs), etc.

B. APPLICABLE STANDARDS AND CODES

The following standards and all "normative addendums" shall be applicable to this document and must be adhered to for any installation work performed.

EIA/TIA 568-A Commercial Building Telecommunications Cabling Standard.

EIA/TIA 569-A Commercial Building Telecommunications Cabling Standard Pathwaysand Spaces.

TSB 67	Transmission Performance Specifications for Field-Testing of Unshielded Twisted-Pair Cabling Systems.
IEEE 802.3	Wire Speed Performances
IEEE 802.1Q	VLAN

All copper/optical fibre cabling, components and connecting hardware shall be in accordance with latest revision of ISO/IEC 11801, ISO/IEC/TR3 8802-1, ISO/IEC/8802-3, ISO/IEC 61935-1, IEC 60364-1, IEC 60950, EN50173, EN50174-1, EN50174-2, and EIA/TIA TSB 72/73.

12.2 MATERIALS

A. Category – 6a Cable

The horizontal cabling shall be Category – 6a U/UTP or S/FTP, 4 pair cable with 10 Gigabit support and specified up to 500MHz. The cable employed shall have excellent electrical characteristics and shall posses low weight, have slim design and shall be non corrosive (to IEC 60754-2), low smoke (to IEC61034), and flame retardant (to IEC 60332-3) and DIN VDE 0472, Part 804, test type C). The cable shall meet the requirements for EN 55022 Class B emission and EN 55024 immunity to be compliant with standards of electromagnetic compatibility and shall comply with following specifications:

Compliance

IEE 802.3an :2006 (10GBASE-T)

ANSI/TIA-568-C.2:2009 Category

6A

ISO/IEC-11801, 2nd Edition Class

EAIEC 61156-5:2002 Category 6A

LSZH: IEC 60332-1, IEC 60754, IEC 61034

Electrical Specification

- DC Resistance - 72 Ohms / Km
- DC Resistance Unbalance - 2% Max
- Insulation Resistance - 5000M-KM/Min
- Wiring Sequence - TIA/EIA 568 A+B
- Delay Skew - 25 ns/100 meter Max

Mechanical Specification

- Diameter of Copper - AWG

23Zero Halogen foam - skin

- Wire Insulation - Material
- Sheath Material - Zero Halogen, Flame Retardant
- Deployment Area - Dry and Damp Rooms
- Temperature Range (moving) - 0 ºC to +50 ºC
- Operating Temperature - -20 ºC to +60 ºC
- Min. Bend Radius for Single Flexure - ≥ 40 mm
- Min. Bend Radius during Installation - ≥ 60 mm

B. Category – 6a Outlets

The horizontal cabling shall be terminated on Un-shielded or Shielded Cat-6a RJ-45 keystone Jacks as per SCHEDULE OF VALUES on white plastic wall plate. The category-6a outlets shall have provision of two outlets and shall accommodate one or two inserts (as per SCHEDULE OF VALUES). To maintain security, the module shall not be removable from the front of wall plate. The Cat-6a RJ-45 outlets shall be protected by a spring-loaded shutter which will cover the outlet when not in use. Outlets shall comply with following specifications:

Compliance

IEEE P802.3an and TIA/EIA TSB155 (draft) Category 6A specifications and Class Echannel requirements of 2nd edition.

IEC 60603-7-5, ISO/IEC 11801 and CENELEC EN50173-1, the Cat 6A channel requirements of TIA/EIA-568-B.2-10

Electrical Specification

- DC Resistance - < 200 milli Ohms
- DC Resistance Imbalance - < 50 milli Ohms
- Insulation Resistance - > 500 Mega Ohms min

- Wiring Sequence - TIA/EIA 568 A+B
- Delay Skew - < 1.25 nanoseconds

Mechanical

SpecificationJack

Contact

Material of RJ45

pins -

Copper alloy

- Plating of RJ45 pins - Gold plate 1.4 µm
- Operating Life (number of RJ45 Insertions) - 1500
- Plastic Housing (material type) -Polycarbonate (VO)

IDC Block

- Material of metal terminals - Copper alloy
- Wire Accommodation (diameter range) - AWG 22-24
- Tool Accommodation (required or not) - NO
- Gas Tight IDC Cable Termination (yes/no) YES
- Plastic Housing (material type) - Polycarbonate (VO)
- Operating Life (number of re-terminations) - up to 5

C. Patch Cord (Cat6a):

The U/UTP or S/FTP Cat-6a patch cords should be designed for 10 Giga applications up to 500 MHz and provides transmission performance meeting Category 6a specifications. Cables should be low skew products. I.e. the difference in propagation delay between the individual pairs is very low. Additional features are the slim design and low weight of the cables. The cable should meet or exceed the requirements for EN 55022 Class B emission and EN 55024 immunity allowing for networks to be built that are compliant with the standards on electromagnetic compatibility.

Compliance

IEEE 802.af and IEEE 802.3at for PoE applications IEEE 802.3an-2006, and ISO 11801 Class EA channel standards IEC 60603-7, ISO/IEC-11801, ANSI/TIA-968- **A,ANSI/TIA-568-C.2 Category 6A**

D. Patch Panel:

Industry Standard 19" UTP / STP Patch panel capable of accommodating 24 No. Category – 6a U/UTP or S/FTP outlets. The patch panel should be modular having 1U height with integral strain relief. Front panel of patch panel should be made of high-grade steel.

Compliance

IEEE 802.3an, IEEE 802.3af (PoE), IEEE 802.3at (PoE+), ISO/ IEC 11281:2002

IEC 60603-7, TIA-968-A (formerly FCC Part 68 Subpart F)

E. Fiber Optic Cable (Om3)- IF APPLICABLE

Backbone cabling from the system equipment (Data Centre) to the telecommunication closet shall be connected with optical fiber cable in Star / Ring topology with failover optical fiber link to connecting floors or buildings.

Om3 Fiber optic cabling shall be armored multi-strand 50/125 or Single Mode 9/125 micron support 10 Giga applications as per SCHEDULE OF VALUES for core/cladding diameter multimode / single mode graded index fibers, tightly jacketed. The sheath shall be colored orange or some other bright color to help distinguish fiber media from other wiring. The cable construction should bemetal free to avoid requirement of grounding, lightening protection etc.

Optical Fiber cables Om3 shall be constructed with a central tube filled with water blocking jelly giving it excellent water and moisture resistance. Two corrugated steel armoring and two steel wires strengthening with in the inner PE sheath and an outer PE sheath give this cable excellent tensile strength, mechanical and environmental protection. They have small diameter, light weight and installation friendly since they come in a single tube with loose tube fiber count up to 12 fibers. Their compact construction protects the loose tube from shrinking, the double armor makes it crush, rodent and impact resistance, the outer PE sheath gives it ultraviolet protection. This cable is suitable for outdoor distribution through ducts, conduits or aerial pipe lines. They come in larger delivery length, so can also be used in long distance communication system, service drop cables, building interconnections.

Specified Core multi-strand 50/125 micron multimode or single mode, tightly jacketed fiber optic indoor cable. Orange colored outer sheath. Metal free cable construction avoiding requirement of grounding, lightening protection having following physical and transmission characteristics:

Compliance

ITU-T G652.B OS1, ITU-T G652.D OS2, ITU-T G651.1 OM1, OM2, OM3, OM4.IEC60793-2-10 type A1a.1/A1b OM1/OM2 ISO/IEC 11801, ISO/IEC 24702, IEEE

802.3z Gigabit Ethernet ANSI/TIA/EIA 568C.3, RoHS Compliant Directive 2002/95/EC

No. of Fibers:	06, 08,12, 24, 48, 96,
Core Diameter	50.0$\pm$3.0μm or 9.0 micron
Numerical Aperture	0.200$\pm$0.0015
Cladding Diameter	125.0$\pm$2.0μm

Core-Clad Concentricity	≤3.0μm
Cladding Non-Circularity	<2.0%
Core Non-Circularity	≤5%
Coating Diameter	245±5μm
Coating Cladding Concentricity:	<12
Operating Wavelengths:	850 and 1300 nm
Bare Fiber Attenuation:	2.5 dB/km per 850 nm,
	0.8 dB/km per 133 nm
Cable Fiber Attenuation:	3.5 dB/km per 850 nm
	1.5 dB/km per 1300 nm

Fiber Type	Type. Attenuation in dB/km		Bandwidth-length product (OFL) in MHz x km	
Multimode Fibre	850 nm	1300 nm	850 nm	1300 nm
(50 um)	2.5	0.8	≥500	≥800

F. Fiber Optic Patch Cord (Om3) IF APPLICABLE

Fiber-optic Om3 patch cords support 10 Giga Applications shall be provided for connections with active networking hardware. The cable shall be manufactured from single pair optical fiber. Each patch cord shall be terminated at switch end with SC/MT-RJ/LC connector plugs design to be pushed on and pulled off active device as applicable to facilitate administration. The patch panel end shall be terminated with duplex SC/LC connectors.

Compliance

TSE: EN 61587-1 Mechanical Structures For

Electronic Equipment - Tests for IEC 60917 and

IEC60297Climatic and Environment: EN 61587-

1/4.2, IEC60068-2-1,IEC60068-2-2, IEC60068-2-

30,Earth Bond: EN61587-1/6.2Flammability:

EN61587- 1/6.3

G. Optical Fiber Distribution Frame (OFDF))- IF APPLICABLE

Fiber-optic distribution Frame in the Data center & Data cabinet with high-density Om3- SC or LC adaptors for terminating maximum number of cables in least space. The Data center patch panel should be equipped with Om3 SC or LC connectors, which have permanent cabling, connected at the rear and present forward facing SC sockets allowing patching with cords fitted with SC connectors. Provision shall be available for storing extra length of fibers and their dressing.

Optical fiber patch panels on the floors shall be equipped with Om3-SC/LC type connectors, which have permanent cabling, connected at the rear and present forward facing SC sockets, allowing patching with cords fitted with SC connectorsat both ends.

Patch panels shall have sliding drawer construction of facilitate easy access to the terminated fibers. Provision shall be available for storing extra length of fibers and their dressing. All fiber-optic cables shall be terminated using fusion- splicing technique via factory-finished pigtails with SC connectors. Patch Panel should have provision to provide secure storage to the fusion spliced pigtails by the use of splice tray/splice cassettes.

1. Optical Fiber Adaptor / Couplers (Om3))- IF APPLICABLE

Om3 Fibre Optic Adaptors are various types including single mode and multimode, Zirconia sleeve and Bronze sleeve, Simplex and Duplex versions. Standard female to female SC Fibre optic adaptor and hybrid SC Fibre optic adaptors are available.

Compliance.

TIA/EIA-568-C.3,TIA/EIA-604 FOCIS-3

2. Optical Fiber Pigtails (Om3))- IF APPLICABLE

Om3 Fibre pigtails are used in permanent connections between patch panels and incoming cables / single blown fibres. Pigtails are pre-constructed with connectors. Connector options include small form factors such as LC, E2000 and MT-RJ as well as SC, FC and ST. Pigtails shall based on 900µm tight buffered cores (600µm MT-RJ) and suitable for internal use only inside suitable Fibre Management Systems

Compliance.

ISO/IEC 11801

EN50173 -1,ANSI TIA/EIA 568B

H. Racks

All racks, shall be modular (Imported) 19 inch racking products. In all cases the backbone cabling sub-system shall be terminated into rack mounted panels and presented as MTRJ fibre connectors. The rack shall have Plexi glass door with pivoted handle and square key. Earthing point, multi socket strip for supplying power to the active components of data network and roof ventilator shall be provided in each rack.

Cable management shall be provided with manageable patching facility. Horizontal management side rings shall provide an environment for ongoing maintenance of all future patching and enable move and changes to be handled easily.

The Sub-contractor shall be responsible for all records and labeling of the rack mounted panels, both fibre and UTP, to the convention provided by the Client.

1. Wall Mounted Racks.

Wall Mounted Cabinets as per SCHEDULE OF VALUES (Size from 4U to 18U) structure is welded and painted with powder coated. Removable side panels ensure easy installation and maintenance. Easy cab available in different sizes. Comply with ANSI/EIA RS-310-D, DIN41497 part 1, IEC 297-2, DIN41497 part 7,

GB/T3047, 2-92 standards.

2. Floor Standing Racks.

Floor Standing Racks as per SCHEDULE OF VALUES (Size 22U to 47U) shall be modular with vertical cable manager, 4 Way Fans, Front Glass Door, and Rear Perforated with two side opening for easy access. These racks shall accommodate networking accessories and suitable for communication roomsand data centers. Comply with ANSI/EIA RS-310-D, IEC 297-2, DIN 41491, PART 1,DIN 41497, PART 7, GB/T3047.2-92, ETSI standards.

I. Metal Cable Management

Metal Cable management facilities within each rack at the Wiring Closet Sub-system are a mandatory requirement.

The cable management channels shall be made up of power coated mild steel 19-inch rack mount panels with integrated “fingers” in which to route the patch leads. The horizontal channel formed by these fingers shall be enclosed by a snap-on ABS metal cover at both ends of panel separate ABS plastic rings shall be mounted using the rack mount bolts of the panel to create a vertical ring run up the rack. These rings shall be sufficiently large enough to comfortably accommodate in excess of 50 patch leads, yet narrow enough not to overhang the width of the rack or obscure the horizontal ring run segment.

The cable management panels should be mounted on the patching facility between active and passive rows of RJ45 ports. In this way, patch leads from every RJ 45 patch panels port are directed to the cable management panels above or below the outlet, so that at no time even when fully populated, outlets are obscured by patch leads. Such a layout shall ensure the patching facility, when cable management is properly utilized, does not go out of control and can be efficiently utilized for adds, moves and changes over the life of the Structured Cabling System.

The metal rings shall be sufficiently large enough to comfortably accommodate in excess of fifty (50) patch leads at any time.

In view of the dynamic nature of the patching facility, the “fingers” of the cable management panels shall be made of mild steel and integral to the metal panel, so

that excessive force on the patch leads do not deform the channel formed within the “fingers”. The cable management panel shall be supplied with a snap on cover to discretely conceal the patch leads when the patching facility is static.

To facilitate effective patching during the life of the Structured Cabling System, the rack shall be laid out for minimal clutter and the shortest reasonable routefor patch cords.

J. Core / Access Switch (HP - 2920 Series Switches)

Access switch should be rack mountable and shall serve the floor users and should have provision to connect to the core switch via fiber optic backbone. Access switch shall have following specifications:

24 x 10/100/1000 ports with 2 Nos. SFP Gigabit

ports2 Nos1000 or 10 G-Base-T–LX–SX-SFP

48 10/100/1000 ports with 2 Nos. SFP Gigabit ports

2 Nos. 1000/10GBase-T-LX-SX SFP

Switching capacity:

24 Port Switch 85 Gbps;

48 Port Switch 148 Gbps

Forwarding rate:

24 Port Switch 6.6 Mpps

48 Port Switch 10.1 Mpps

Store-and-forward switching; latency <12 μs

Layer 2 Switching

MAC Address 8K MAC

addressesVLANs (IEEE

802.1Q)

Link Aggregation IEEE 802.1ad (LACP), Gigabit ports

onlyAuto-negotiation

Auto-negotiation of port speed, duplex, and connection

(MDI/MDIX)Traffic control IEEE 802.1w full-duplex flow control

Support for Broadcast Storm Suppression (3,000 pps threshold)

STP/RSTP IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)

Backward-compatible with STP

Fast-start mode
Spanning tree enable/disable per port

Layer 3 Switching

Hardware based routing

Multi-netting (multiple IP interfaces per VLAN)

RIP (Routing Information Protocol), v1 and v2

1. Split Horizon
2. MD5 authentication of the RIP packets
3. Password authenticated RIP packets
4. Host route advertisements

Multicast Filtering for 64 multicast groups

IGMP (Internal Group Management Protocol) snooping on Layer 2 interfaces

IGMP 1 and v2

IGMP Querier

Network protocol DHCP (Dynamic Host Configuration Protocol)

Helper/RelayUDP Helper

ARP, ARP Proxy

Convergence

Priority Queues for hardware queues per port

Weighted Round Robin queuing

Traffic Prioritization Priority based on:

1. DSCP (Diff Serv Code Point)
2. IEEE 802.1p Class of Service (CoS) VLAN priority
3. TCP/UDP destination port number

4. Default port priority
5. Auto classification of 3Com NBXR telephony traffic

Bandwidth Management Port-based bandwidth management:

1. 1 Mbps increments (10/100 ports)

2. 8 Mbps increments (Gigabit ports)

Security

Network Login IEEE 8.2.1X user

authenticationAccess Control Lists Port-based

ACLs

Switch Protocol Security MD5 cipher-text and clear-text authentication for RIP v2 packets

Switch Management Local or RADIUS management of switch

passwordsTrusted IP Management Addresses

Telnet

Management

Remote Management SNMP v1

Telnet

Web-based

SNMP

Mirror port/RAP (Roving Analysis Port) One-to-one

RMON (Remote Monitoring) four groups: statistics, history, alarm and events

K. Core / Access Switch (HP 1910 / 1920 Series Switches)

Access switch should be rack mountable and shall serve the floor users and should have provision to connect to the core switch via fiber optic backbone. Access switch shall have following specifications:

24 x 10/100/1000 ports with 2 Nos. SFP Gigabit

ports2 Nos1000 or 10 G-Base-T –LX-SX-SFP

48 10/100/1000 ports with 2 Nos. SFP Gigabit ports

2 Nos. 1000/10GBase-T-LX-SX SFP

Switching capacity:

24 Port Switch 45 Gbps;

Forwarding rate:

24 Port Switch 6.6 Mpps

Layer 2 Switching

MAC Address 8K MAC

addressesVLANs (IEEE

802.1Q)

Link Aggregation IEEE 802.1ad (LACP), Gigabit ports

onlyAuto-negotiation

Auto-negotiation of port speed, duplex, and connection

(MDI/MDIX)Traffic control IEEE 802.1w full-duplex flow control

Support for Broadcast Storm Suppression (3,000 pps threshold)

STP/RSTP IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)

Backward-compatible with STP

Fast-start mode

Spanning tree enable/disable per port

12.3 EXECUTION

All cable installations shall be completed according to the local regulatory board and conform to EIA/TIA 568-A and shall comply with the following criteria:

A. UTP Cable Installation

Cables shall be installed in already laid steel cable trunking (within suspended ceilings) suitably anchored to the building structure, and in conduit in floor and partitions (concealed). Cables shall be secured every 600mm using hook and loop fastening ties. Due care shall be taken to not over tighten ties and place undue strain on the cabling infrastructure.

Cables shall be bundled to a maximum of 24 UTP cables and each bundle individually supported within the cable trunking.

Bend radius shall be limited to 10 times the cable diameter (UTP)

During the installation of a UTP cable (maximum 90 metres) the pull distance should not exceed 30 meters at any one time.

B. Optical Fiber Cable.

Cables shall be installed in powder coated steel trunking with over including all accessories, supports, etc. as per site requirements, care shall be taken to ensure minimum bending radius requirements as per manufacturer's recommendations for optic fiber cable are maintained.

12.4 TESTING AND COMMISSIONING

The following tests shall be carried out and the results shall be documented and maintained to form part of the "AS BUILT" drawings.

1. Test all of the UTP copper cable installation for termination and twisted pair integrity, including continuity, polarity, pin-assignment and color codes
2. Perform visual inspections to ensure that each pair of wires remains twisted as close as possible to the termination point, to maintain the impedance and minimize attenuation losses.
3. Test that the UTP cable pairs comply with the Specification using measuring device for Near End Cross-talk and Signal Attenuation complying with EIA/TIA 568-A.
4. Test each termination Optical Fibre in both directions, recording all results of the calibrated optical power. Make sure in all cases that measurements are within those provided in the specification. The documentation required at the completion of the installation phases shall contain all of the following information, together with any other information the installer has acquired during the installation.

1. "As-Built" documentation, showing total cabling and connection installed, utilizing floor space plans and cable record sheets. This documentation shall show all cables and outlets incorporating the full numbering and marking convention supplied.

2. All test results and certification information, identified by cable, connection and numbering convention, necessary for all Optical Fibre and copper cables.

All components of the Structured Cabling should be sourced from one manufacturer to ensure minimal impedance mismatch and best possible NEXT performance and to

guarantee the Category-6a performance from end to end.

The Structured Cabling System should operate without introducing or being affected by electromagnetic radiation from other sources. Maintaining segregation from other services or screening are to be ensured to achieve acceptable immunity.

SECTION – 13 FIRE ALARM

13.1 SCOPE

Furnish a complete 24V DC analogue addressable, electrically supervised, zone annunciated, fire detection and alarm system as specified herein and indicated on the drawings. The system shall include but not be limited to, a control panel or panels with integral power supply to provide the 24V DC, signal initiating devices, audible and visual alarm devices, and all accessories required to provide a complete and operating system.

The fire alarm system shall be wired as 2 core signal loops. 24V DC power wiring shallbe installed to alarm sounders via addressable sounder modules or via conventional monitored sounder outputs within the control panel.

Loop powered sounders shall be connected directly to the signal loops..

13.2 MATERIALS

Codes and Standards

The following codes and standards shall apply to work of this section.

EN54-2 and EN54-4	-	Fire Alarm CIE and PSE
ISO9001	-	Quality control
BS 5839:part 1	-	Fire Detection and Alarm Systems for Buildings

Qualifications of Manufacturers

Manufacturers of the products supplied for the fire alarm system shall have been in the business of manufacturing Fire Alarm products for at least five years. They shall confirm compliance to the above codes and standards.

Fire Alarm Control Panel (FACP)

A. Functional Description

The fire alarm control panel (FACP) shall be the central processing unit of the system, receiving and analyzing signals from fire sensors, providing audible and visual information to the user, initiating automatic alarm response sequences and providing the means by which the user interacts with the system.

The FACP shall be certified as meeting the requirements of EN54-2 and EN54-4

by a suitable, notified body. A certificate and test report shall be made available for inspection as evidence of certification.

The FACP shall be easily configurable to meet the exact detection zone and output mapping requirements of the building.

The FACP shall be microprocessor based and operate under a multitasking software program. Operating programs and configuration data shall be contained in re-configurable non-volatile memory. Retention of the memory shall not rely on any form of battery or capacitor back-up device. The FACP shall incorporate separate processors for loop processing and central processing.

Provision shall be made for each addressable loop to be sub- divided into geographical zones. The section of wiring corresponding to each zone circuit shall be protected from faults in other sections by line isolator modules.

In order to facilitate re-configuration and system extension, the allocation of addresses to devices shall be independent of their physical arrangement on the loops.

Up to 240 individually addressed standard devices shall be configured on each addressable loop. Loop powered sounders and beacons incorporated as sensor bases shall be available.

The FACP shall have the capability to support sub-addressing of addressable modules.

It shall be possible to fit a 40-column printer to the FACP which will print system events automatically and logged data upon request.

The FACP shall incorporate a real time clock to enable events to be referenced against time and date.

B. Additional Components

It shall be possible to fit the FACP with a network board to allow up to sixty-four control panels to communicate with each other. The network shall be fully fault tolerant and shall continue to function normally under any single fault condition.It shall be possible to fit the FACP with a modem board to allow remote interrogation and monitoring of a network of control panels.

It shall be possible to fit up to thirty-two, sixteen way input/output modules,eight way relay modules, six way sounder modules or four way conventional

zone modules or any combination thereof to each control panel. Modules shall connect to a separate serial bus but shall be programmable in the same manner as devices connected to the addressable loops.

C. Configuration

It shall be possible to perform configuration updates on site using a portable personal computer and a Windows ® based configuration utility. This facility

shallallow the following parameters to be set: -

D. System

a) Produce a configuration file which contains data for up to 64 control panels connected together as a network.
b) Set cause and effect tables for any device to operate devices or functions on any panel or panels connected to the network.
c) Upload and view graphically the configuration from a single panel or entire network of panels.

E. Control panel

a) Panel name (network identity, fifteen characters minimum)
b) Panel text (comfort message or service company forty characters minimum)
c) Change code numbers for access levels two and three.
d) Select sounder ringing mode as common, zonal or two stage
e) Select first and second stage delay times for each sounder output to between zero and five minutes.
f) Set number of loops on panel as one, two or four
g) Set number of zones on panel as 0,16, 48 or 96
h) Set loop sounder volume globally
i) Set start and end times for day night mode for each day of the week

F. Detectors

a) Allocate a zone
b) Set a delay before the panel responds to a fire signal
c) Indicate pre-alarm
d) Set day sensitivity and night sensitivity separately
e) Address loop powered base sounders
f) Allocate a forty character location text message

G. Call points

a) Allocate a zone
b) Allocate a forty character location text message

H. Switch units (input)

a) Allocate a zone for each input and the device itself
b) Define input action as fire, fault, pre-alarm, technical alarm, evacuate, alert, security alarm, silence alarm, reset, transparent, disablement or test mode.
c) Change the input action message from the default to any one of the above or to any one of a user defined library of 10 additional action messages.
d) Set a delay before the panel responds to a fire signal
e) Select whether the input requires the control panel to be reset or is self clearing upon removal of the input
f) Allocate a forty character location text message

I. Relay or sounder units (output)

a) Allocate a zone for each input and the device itself

b) Define whether the device responds to evacuate inputs, as a sounder (default ringing), is silenceable, needs to be reset or produces a single pulsed operation of between one and five seconds (programmable)

c) Has a delay before operating (zero to five minutes)

d) Allocate a forty character location text message

J. Loop powered sounders and beacons

a) Allocate a zone

b) Define whether the device responds to evacuate inputs, as a sounder (default ringing), is silenceable or needs to be reset.

c) Has a delay before operating (zero to five minutes)

d) Allocate a forty character location text message

K. Panel Construction

The housing containing the FACP shall be of metal construction and shall be capable of being surface or semi-flush mounted. It shall be complete with cable knocks-outs in sufficient quantity to accommodate all likely cabling requirements.

The housing shall afford a minimum ingress protection to IP30 and it shall not be possible to open the FACP without the use of a special tool or key.

L. Panel Indications

The FACP shall monitor the status of all devices on the addressable loops for fire, short-circuit fault, open-circuit fault, incorrect addressing, unauthorized device removal or exchange, pre-alarm condition and contaminated detector condition.

The FACP shall also monitor the status of internal connections and interfaces including charger and batteries.

The FACP shall provide the following discrete visual indications:

a)	POWER ON	green LED indicator
b)	FIRE ALARM	red LED indicator
c)	PRE-ALARM	yellow LED indicator
d)	ON TEST	yellow LED indicator
e)	BUZZER SILENCED	yellow LED indicator
f)	DELAY ACTIVE	yellow LED indicator
g)	MORE EVENTS	yellow LED indicator
h)	GENERAL DISABLEMENT	yellow LED indicator
i)	GENERAL FAULT	yellow LED indicator
j)	POWER FAULT	yellow LED indicator
k)	SYSTEM FAULT	yellow LED indicator
l)	SOUNDER FAULT/DISABLED	yellow LED indicator

M. Display

In addition to the indications above, the FACP shall have an integral 240 x 64-pixel graphic LCD display.

The display shall incorporate a backlight which will illuminate upon any event (excluding mains failure) or button press.

The display shall be capable of simultaneously indicating the number of outstanding events and their types as well as the current event.

N. Panel Controls

The panel shall be provided with at least the following manual controls: -

a) SILENCE BUZZER
b) ACKNOWLEDGE ALARM
c) RE-SOUND ALARM
d) RESET
e) LAMP TEST
f) FUNCTION 1
g) MORE FIRES
h) MORE EVENTS
i) HELP
j) MENU NAVIGATION PAD (UP,DOWN,LEFT,RIGHT,ENTER,EXIT)

O. Remote Monitoring Signals

The FACP shall contain at least three programmable inputs to allow interconnection to other systems.

The FACP shall contain at least two programmable outputs to allow interconnection to other systems.

The FACP shall be capable of monitoring and controlling remote site devices, such as relays for the control of plant and dampers directly from the addressable loops.

The FACP shall be capable of monitoring fire doors such that, in the event of a fire alarm condition, an event is generated to warn of the failure of a fire door to close.

P. Software

The FACP shall have, as a standard software enhancement, the ability to annunciate a pre-alarm condition designed to give the earliest possible warning of potential fire condition without raising the full alarm condition.

The FACP shall have as a standard software enhancement the ability to automatically adjust the alarm threshold levels to compensate for changes in detector sensitivity due to contamination over a period of time.

The FACP shall have, as a standard software enhancement, the ability to provide an indication that a detector is nearing a level of contamination, which requires that it be replaced or serviced.

The FACP shall have, as a standard software enhancement, the ability to provide automatic warning that a detector has reached a level of contamination, which requires that it be replaced or serviced.

The FACP shall have, as a standard software enhancement, the ability to synchronize loop data transmission to eliminate the possibility of data corruption due to cross-talk or similar effects.

The FACP shall have, as a standard software enhancement, extensive, context sensitive help screens to offer additional information on system status at all times.

FAS. 1 Sounders

The FACP shall provide the necessary outputs to separately operate a minimum of two monitored circuits of common system sounders. Each output shall be capable of driving a sounder load of up to 1A.

The FACP shall also be able to monitor the integrity of and control standard sounder circuits, via a suitable addressable module.

The FACP shall be capable of providing a two-stage alarm sounder facility thatcan be programmed, either on a zonal basis or common system basis, to meet the requirements of the fire authority. Sounder outputs shall be available as follows:

- Alert, intermittent pulsed tone
- Evacuate, continuous tone

The FACP shall have the facility to change, on a per sounder zone basis, the sound output dependent upon whether the source of alarm is:

- an automatic detector, e.g. smoke, heat,
- a manual call point.

The FACP shall have the facility to generate a slow pulsed output to all sounder circuits in response to a security alert input.

FAS. 2 Fault Reporting

The FACP shall monitor all critical system components and interconnections, internal and external, such that a failure, which would prevent the correct operation of the alarm functions, causes the FAULT indicator to light and a message to be given on the alphanumeric display within 60 seconds of occurrence. The following faults shall be reported in the manner described above:
-Loop Sort Circuit

a. Loop Open Circuit
b. Un-configured Device
c. Device missing
d. Addressable Device Failure
e. Incorrectly Configured Device
f. System fault (processor)
g. Low battery
h. Charger failure
i. Earth fault monitoring
j. Battery Fault
k. Mains Failure
l. Sounder Wiring Open Circuit (per circuit)

m. Sounder Wiring Short Circuit (per circuit)

To help fault finding and repair, the FACP shall provide text messages to indicate the location of where a fault has occurred in the system.

FAS. 3 System Management

The FACP shall incorporate the following system management facilities:

a. Isolate/re-connect individual outputs or inputs of addressable points
b. Isolate/re-connect individual zones
c. Isolate/re-connect individual loops
d. Isolate/re-connect all or individual sounder circuits
e. Isolate/re-connect all volt-free contacts individually
f. Isolate/re-connect panel inputs
g. Walk-test of a selected zone to verify detectors and sounders
h. View system status
i. Print event log
j. Print point status.
k. Set time
l. View contamination status

Access to the facilities describe above shall be restricted to user Engineer level or above.

The FACP shall have an event log capable of storing the last 500 events that have occurred. It shall be possible to view the content of the log via the alphanumeric display. Events shall be displayed in chronological order with the newest events first. It shall be possible to scroll through the events.

The FACP shall be designed so that, for each type of analogue addressable detector, the overall response time including the sensor, the signal transmission system and the fire decision algorithm, meets the requirement of European Standards.

The FACP shall be capable of isolating a group of selected detectors in areas of the building where maintenance work is carried out.

FAS. 4 Automatic Fire Detectors (General)

A. General

The manufacturer shall have available the following types of analogue addressable automatic sensors, for direct connection to the system addressable loops:

- Ionisation smoke sensors
- Photoelectric smoke sensors
- Heat sensors
- Multi-sensors

B. Addressable Units

The manufacturer shall be capable of offering two-state addressable versions of the following units, taking only one address from the loop:

- Ionisation smoke detectors
- Photoelectric smoke detectors
- Heat detectors
- Photoelectric beam smoke detectors
- Ultra-violet flame detectors
- Conventional detector interface module
- Addressable sounder modules
- Addressable relay interface modules
- Addressable switch monitoring modules
- Short circuit isolator modules (no address required)
- Loop powered sounders
- Manual call points for indoor use
- Manual call points for outdoor use
- Multiple inputs/outputs
- Radio interfaces to detectors and call points

C. Conventional Units

The manufacturer shall have available the following types of conventional automatic detectors, manual call points and ancillary units for connection to the system via suitable interfaces:

- Ionisation smoke detectors
- Photoelectric smoke detectors
- Photoelectric beam smoke detectors
- Ultra-violet flame detectors
- Heat detectors
- Manual call points for indoor use
- Manual call points for outdoor use
- Remote indicator units
- Sounders

Analogue Addressable and addressable detectors and modules must be able to transmit to the FACP an address to be used in the system configuration.

It must be possible to connect and mix automatic detectors, addressable manual call points and addressable modules within the same zone sub-division of an addressable loop.

All equipment connected to the system addressable loop, either directly or via interfaces, shall be proofed against electrical noise, high frequency pulses and electromagnetic influences from other equipment.

The manufacturer shall have available suitable equipment to test and remove or exchange all three main types of automatic point-type detectors when installed.

D. Ionization Smoke Detectors

The Ionization smoke detectors shall be capable of detecting visible and invisible

combustion gases emanating from fires, using a dual Ionization chamber in which the air is ionized by a single radioactive source.

The radioactive source used shall be AM 241 of one microcurie or less.

The Ionization smoke detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimize the effect of radiated and conducted electrical interference.

The Ionization smoke detectors shall be suitable for operation in air speeds of up to 10m/s and shall incorporate screens to minimize the effects of small insects.

The manufacturer shall have available the following versions of the Ionization smoke detector to meet different applications:

- Analogue addressable
- Conventional

The Ionization smoke detector shall incorporate LED's, clearly visible from the outside, to provide indication of alarm actuation.

In locations where the detector is not readily visible, remote indicator units shall be provided.

E. Photoelectric Smoke Detectors

The photoelectric smoke detectors shall be capable of detecting visible combustion gases emanating from fires and shall employ the forward light- scatter principle.

The point-type photoelectric smoke detectors shall be equally sensitive to a wide range of combustible materials.

The design of the point-type photoelectric smoke detector sensing chamber shall be optimized to minimize the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.

The point-type photoelectric smoke detectors shall incorporate screens designedto prevent all but the very smallest of insects from entering the sensing chamber, (50 holes per square centimeter or more).

The photoelectric smoke detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimize the effect of radiated and conducted electrical interference.

The manufacturer shall have available the following versions of the point type photoelectric smoke detector to meet different applications:

- Analogue addressable
- Conventional - normal sensitivity
- Conventional – normal sensitivity – delayed response
- Conventional – normal sensitivity – Intrinsically Safe

The photoelectric smoke detector shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm actuation.

In locations where the detector is not readily visible, remote indicator units shall be provided.

F. Multi-Sensors – Analogue Addressable

The multi-sensor should be capable of monitoring two different sensing elements:

1) Photoelectric
2) Thermal

The design of the point-type multi-sensor photoelectric smoke detector sensing chamber shall be optimized to minimize the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.

The point-type multi- sensors shall incorporate screens designed to prevent all but the very smallest of insects from entering the sensing chamber, (50 holes per square centimeter or more).

The multi-sensors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimize the effect of radiated and conducted electrical interference.

The sensor should be able to operate in the following modes:

G. Combination Mode

The sensor should be able to operate as a photoelectric sensor but when the ambient temperature reaches 40^{o} C or above, the thermal elements should be capable of sensing the 'Rate of Rise' and adjust the sensitivity of the photoelectric element automatically. The sensitivity of the photoelectric should be increased via an internal algorithm.

H. Photoelectric mode

The sensor should be able to return the analogue value for the photoelectric element during a normal polling sequence.

The sensor should also be able to signal to the FACP if the thermal sensing element exceeds a fixed temperature threshold.

I. Thermal mode

The sensor should be able to return the analogue value for the thermal element during a normal polling sequence. The sensor should also be able to signal to the FACP if the photoelectric sensing element exceeds a pre-defined threshold.

The multi-sensor shall incorporate LED's, clearly visible from the outside, to provide indication of alarm actuation. The LED's should be controlled from the FACP if the LED's flash during the normal polling sequence.

The modes of the multi-sensor should be controlled by the FACP, when the FACP changes from one mode to another the FACP should re-calibrate the multi-sensor.

In locations where the detector is not readily visible, remote indicator units shall be provided.

The multi-sensor should have the capability of monitoring both sensing elements, if either or both of the elements fail it should be reported and displayed at the FACP.

J. Duct smoke detectors

The manufacturer shall produce standard equipment for the installation of smoke detectors in air ducts. This equipment shall be designed to accommodate the manufacturer's standard smoke detectors and bases: Analogue addressable, Addressable and conventional.

K. Heat detectors

The heat detectors shall be capable of detecting rapid rise in temperature and/or fixed absolute temperatures.

The heat detectors shall employ two heat-sensing elements with different thermal characteristics to provide a rate of rise dependent response.

The heat detectors shall include RFI screening to minimize the effect of radiated and conducted electrical interference.

The manufacturer shall have available the following versions of heat detectors tomeet different applications:

- Analogue addressable – grade 1, 2 or 3.
- Two state addressable – grade 1
- Two state addressable – grade 2
- Conventional – grade 1
- Conventional – grade 2
- Conventional – range 1
- Conventional – static 60 C
- Conventional – static 90 C

The heat detectors shall incorporate LED's, clearly visible from the outside, to provide an indication of alarm actuation.

In locations where the detector is not readily visible, remote indicator units shall be provided.

L. Detector Base

The automatic point-type fire detectors shall be fixed to the installation by mean of plug-in bases. Analogue addressable bases, sounder bases and conventional detector bases shall be available.

The three types of bases specified above shall incorporate the optional featureof being able to lock the detectors in place once plugged in. Termination facilities shall be available for earthing.

Standard conventional and Analogue Addressable bases shall not contain any electronic circuitry. This shall enable insulation and continuity checks to be completed on the wiring with the detector heads removed. FAS5A.

Other devices

Addressable Manual Call points

The addressable manual call points shall monitor and signal to the FACP the status of a switch operated by a "break glass" assembly. They shall be red in colour and suitable for surface or flush mounting. The addressable call points shall be provided with an integral red LED to indicate activation.

One version of the addressable call point shall be available mounted in a weatherproof housing, affording protection to IP 66.

The addressable call points shall be capable of operating by means of thumb pressure and not require a hammer. They shall be capable of being tested usinga special 'key' without the need for shattering the glass.

The addressable call points shall incorporate a mechanism to interrupt the normal addressable loop scan to provide an alarm response within 3 secondsand shall be field programmable to trigger either an alert or an evacuate response from the FACP.

B. Addressable Sounder Module

The addressable sounder module shall be capable of monitoring and controllingtwo independent circuits of alarm sounders using a single loop address.

24 V DC power to drive the sounders shall be derived independently from the FACP.

The addressable sounder module shall be capable of operating both sets of sounders in a pulsing or continuous mode as determined on the module. Each circuit shall be individually programmable. Sounder circuits shall be capable of synchronization.

The addressable sounder module shall provide the facility to monitor the wiring to the sounders for open or short-circuit and transmit the necessary fault signal to the FACP. Each sounder circuit shall be separately fused.

The addressable sounder module shall provide the facility to monitor for failure of the power supply for the sounders and transmit the necessary fault signal to FACP.

The addressable sounder module shall provide a green LED indication when the FACP is polling it.

C. Conventional detector interface module

The conventional detector interface module shall be capable of monitoring two independent zones, each of up to 30 conventional detectors using a single loop address.

24 V DC power to power the conventional detectors shall be derived independently from the FACP

The conventional detector interface module shall provide the facility to monitor the detector zones for open or short-circuit and transmit the necessary fault signal to the FACP.

The conventional detector interface module shall provide a remote LED facility to indicate detectors in alarm and shall provide a red LED indication when the FACP is polling it.

D. Addressable relay interface module

The addressable relay interface module shall be capable of switching two independent relays; either normally open or normally closed, each rated at 30V, 1Amp.

A single input shall provide open and short circuit monitoring facilities, set locally at the unit.

The addressable relay interface module shall use a single loop address.

The unit shall be powered directly from the addressable loop.

The addressable relay interface module shall provide an LED indication when the FACP is polling it.

E. Addressable switch monitoring module

The addressable switch monitoring module shall be capable of monitoring two independent voltage free contacts, each either normally open or normally closed, using a single loop address.

The unit shall be powered directly from the addressable loop.

The addressable switch-monitoring module shall provide a red LED indication when the FACP is polling it. The LED shall be continuously lit when either input is active.

F. Short Circuit Isolator Module

The short circuit isolator module shall provide protection on the addressable loop by automatically disconnecting the section of wiring between two modules where a short circuit has occurred.

The short circuit isolator module shall derive power directly from the addressable loop and shall provide an LED indication that the module has tripped. A base mounted version is available.

G. Loop powered sounders

Addressable electronic sounders shall be connected directly to the detection loops where required. These shall be incorporated in a suitable mounting baseso that an analogue smoke or heat sensor may also be connected to the base, if required. Loop powered sounders shall be ceiling or wall mountable. A cover plate shall be fitted when a sensor is not to be fitted on the sounder.

H. Photoelectric beam smoke detectors

The photoelectric beam smoke detectors shall be capable of detecting visible combustion gases emanating from fires and shall utilize the light obscuration principle. The emitter shall project a near infra red beam to the receiver.

Two types are acceptable:

1. The photoelectric beam smoke detectors shall consist of an emitter and a receiver pair. The detectors shall operate over a 5 – 100 metre range.
2. A Photoelectric reflective beam smoke detector consisting of a combined control unit and a separate reflector. The detector shall operate over a 5-30 metre range.

The photoelectric beam smoke detectors shall have automatic recalibration in order to adjust for contamination.

The photoelectric beam smoke detectors shall be designed to have high resistance to corrosion and shall include RFI screening to minimize the effect of radiated and conducted electrical interference.

The photoelectric beam smoke detectors shall incorporate two LED's, clearly visible from the outside and below, to provide indication of alarm actuation and fault.

I. Ultra-violet flame detectors

The flame detector shall be of a point-type. It shall be mounted on its base usinga simple twist action for ease of installation and removal.

The flame detector shall be able to detect weak ultra-violet rays in a 120 cone of vision, in a direct line of sight.

J. Remote Indicator Unit

The remote indicator unit shall provide a remote indication for any detector thatmay be located in an enclosed or locked compartment.

The remote indicator unit shall be driven directly from its associated local detector. It shall be either flush or surface mountable.

FAS.6 Sounders

Two types of Electronic sounders shall be acceptable: loop-powered addressable sounders (see above) and stand-alone versions. Stand-alone versions shall powered by 24 Volts DC from the FACP.

Non loop-powered versions shall be flush or surface mountable, red in colour. They shall have a minimum sound output of 95 dB (A) at 1 meter distance and shall have a maximum current consumption at 24V DC of 100 mA.

FAS. 7 Alarm Bells

Fire alarm bells shall be under dome type with a high resonance pressed alloy-steel gong to ensure a load clear-tone ring. They shall be fully suppressed and polarized.

The operating mechanism shall be fully enclosed and the gong shall be red stove enameled for long life.

Alarm bells shall have a minimum sound output of 95 dB (A) at 1 metre distance, and shall have a maximum current consumption at 24V DC of 30 mA.

SECTION – 14 CABLE TRAY SYSTEM

14.1 SCOPE

The metal tray system shall generally be routed under the ceiling slabs and only above the false ceiling and / or passages not normally open to public access. The sub-contractor shall supply all labour, material and accessories for the completion of this installation strictly in accordance with the specifications laid as under, illustrated on drawings and shown in the Schedule / Schedule of values.

The work consists of necessary cable tray systems as shown in the drawings.

Cable tray systems are defined to include, but are not limited to straight sections of cable trays, bends, tees, elbows, drop-outs, supports and accessories.

14.2 SUBMITTALS

A. Submittal Drawings: Submit drawings of cable trays and accessories including, but not limited to, clamps, brackets, hanger rods, splice plate connectors, expansion joints assemblies, dropouts and fittings, showing accurately scaled components.

B. Product Data: Submit manufacture's data on cable tray including, but not limited to, types materials, finishes, rung spacings, inside depths and fitting radii.

14.3 MATERIALS

The cable tray system shall be designed on the standardized modular system and comprise of basic modules of trays, fittings and accessories. Each modular shall be fabricated from sheet steel and then hot dip galvanized of 60 microns . Modular of 90 degree Elbows, T joints and double T joints shall be used for horizontal changes in the direction of cable runs while hinged connectors shall be used for vertical branch offs. The branch-off joints should be such as to allow for angle connections to be easily bolted to them (joints) by means of button-head screws. End plates shall be used to close off unevenly cut faces of the cable trays and protect the cables from damage. Where required barriers shall be used to permit power cables and cables of all modules shall be subject to the prior approval of the Engineer before mass production is taken in hand . The cable tray shall have standard lengths of 3000 mm.

The following standard sizes shall be used:

	Width	Height	Approx. Wt. Each.
Cable Trays	150mm	35mm	1.41 Kg.p.meter.
300mm	35mm	2.25 Kg.p.meter.	
450mm	60mm	4.00 Kg.p.meter.	
Barriers.	-	35mm	0.44 Kg.p.meter.
-	60mm	0.64 Kg.p.meter.	
Elbows.	150mm	35mm	0.43 Kg.p.meter.
300mm	35mm	1.12 Kg.p.meter.	

450mm	60mm	2.31 Kg.p.meter.	
T-Joints.	150mm	35mm	0.51 Kg.p.meter.
300mm	35mm	1.45 Kg.p.meter.	
450mm	60mm	2.83 Kg.p.meter.	
Double	150mm	35mm	0.75 Kg.p.meter.
T-Joints.	300mm	35mm	1.53 Kg.p.meter.
450mm	60mm	2.87 Kg.p.meter.	
Hinged	-	35mm	0.11 Kg.p.meter.
Connectors.	-	60mm	0.24 Kg.p.meter.
Connectors.	-	35mm	0.11 Kg.p.meter.
	-	60mm	0.18 Kg.p.meter.
Angle	-	35mm	0.07 Kg.p.meter.
Connectors.	-	60mm	0.11 Kg.p.meter.

Width Height Approx.Wt.Each.

Wall Bracket.	150mm	-	0.31 Kg.p.meter.
300mm		-	0.50 Kg.p.meter.
450mm		-	0.89 Kg.p.meter.
Pandant	150mm	-	0.20 Kg.p.meter.
Brackets for	300mm	-	0.41 Kg.p.meter.

Pendants	450mm	-	0.69 Kg.p.meter.
Pandant	300mm	-	0.70 Kg.p.meter.
with Head Plates.	450mm	-	0.91 Kg.p.meter.
End plates.	150mm	-	0.06 Kg.p.meter.
300mm		-	0.14 Kg.p.meter.
450mm		-	0.21 Kg.p.meter.

14.4 EXECUTION

The cables tray shall be installed on ceiling / wall as required in perfect line and plumb. The clearance between fixing points shall be 1 meter. The cable tray shall be solidly earthed with 1"x1/8" copper tapes on both sides. All cables shall be clipped with PVC strap to the tray at every interval of 1 meter.

Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

Proceed with installation only after unsatisfactory conditions have been corrected.

14.5 INSTALLATION

A. Install a complete cable tray system. There shall be no gaps, missing accessories. All accessories must be from same manufacturer of cable tray. Do not make field modification of accessories.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports securely to building

D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independently of fittings. Do not carry weight of cable tray on equipment enclosure.

E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed 27 m.

F. Make changes in direction and elevation using standard fittings.

G. Make cable tray connections using standard fittings.

H. Locate cable tray above piping unless accessibility to cable tray is required or unless otherwise indicated.

I. Seal penetrations through fire and smoke barriers

J. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

K. Workspace: Install cable trays with sufficient space to permit access for installing cables.

L. Install covers after installation of cable is completed.

M. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

N. Expansion splices shall allow for 25 mm of thermal expansion and contraction.

O. Ground cable trays according to manufacturer's written instructions. All metal components of the tray and fittings shall be electrically continuous.

14.6 QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing cable trays and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform the following electrical test and visual and mechanical inspections:

a. Visually inspect each cable tray joint and each ground connection for mechanical continuity.

b. Measure ground resistance of each system of cable tray from the most remote element to the point where connection is made to service disconnect enclosure grounding terminal to demonstrate compliance with specified maximum grounding resistance. Record resistance in ohms. See NFPA 70B, Chapter 18, for

testing and test methods.

3. Report results in writing.

14.7 PROTECTION

Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure cable tray is without damage or deterioration at time of Substantial Completion.

Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.

14.8 QUALITY ASSURANCE

Source Limitations: Obtain cable tray components through one source from a single manufacturer.

Do not install damaged equipment.

Store cable trays and accessories in original cartons and in a clean, dry space. Protect from weather and construction traffic. Wet materials should be unpacked and dried before storage.

SECTION – 15 POWER FACTOR IMPROVEMENT PLANT

15.1 SCOPE

This Section includes power and automatic power factor correction equipment rated 600 V and less. The power factor improvement plant Auto cum Manual shall be indoor type, free standing , floor mounting, sheet steel clad, totally enclosed, completely dust proof, fabricated from 3mm thick mild steel sheet suitably ventilated with vermin proof louvers, supplied fully assembled, readily wired, as one integral unit and capable of alignment to Main L.T. Switchboard . The use of mechanical forced ventilation is allowed. The plant shall be designed to house all delicate components e.g. p.f. meter, sensing relay, Main and auxiliary contactors, Auto/Manual Switch, ON/OFF push buttons, indicator lights, and control fuses with bases etc. in dust proof enclosures.

The fabricated plant housing shall be completely cleaned, degreased and derusted, before applying one coat of antirust primer and two coats of battleship gray enamel.

The plant shall be designed to meet the service condition at site and provide reasonable assurance of performance in mechanical and electrical adjustments. The plant shall be suitable for use on 415V, 50Hz, 3 Phase 4 wire, A.C. supply.

15.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions, operating characteristics of multiple capacitor cells or elements, and data on features, ratings, and performance.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, method of field assembly, components, and location and size of each field connection. Show access and workspace requirements and required clearances.
1. Wiring Diagrams: Power, signal, and control wiring.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals. Include the following:
1. Lists of spare parts and replacement components recommended for storage at Project site.
2. Detailed instructions covering operation under both normal and abnormal conditions

15.3 MATERIALS

COMPONENTS.

2.1 Each capacitor shall have rating of not more than 12.50/25/50 KVAR and shall conform to B.S. 1650/1971. Full capacitance of the plant as specified shall be capable of being switched in 10 equal steps. The capacitors shall be rated 525 V. The capacitor bank shall consist of single phase capacitors arranged in star formation with solidly grounded neutral.

2.2 A 12 stage sensing relay with time delay characteristics shall be provided for carrying out all switching operations automatically.
2.3 A manual control switch shall be provided to carry out manual switching if and when required.
2.4 Magnetic contactors suitable for 380/420 volts operation shall be provided in sufficient numbers to carry out automatic switching operations. The sub-contractor shall conform to B.S. 775/latest.
2.5 Suitable discharge resistors and hoods shall be provided.
2.6 A 6" x 6" dia. flush mounted power factor meter shall be supplied.
2.7 The PFI plant shall be manufactured by any of the approved manufacturer.
2.8 FACTORY FINISH
A. Manufacturer's standard enamel over corrosion-resistant treatment or primer coat.

15.4 EXECUTION

A. install freestanding equipment on concrete bases
B. Comply with mounting and anchoring requirements
C. Maintain minimum workspace according to manufacturer's written instructions.
D. Connect remote monitoring communication module to electrical power monitoring and control data network through appropriate network interface unit.

E. Identify components according to Division 26 Section: “Identification for Electrical Systems."

15.5 QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each power factor correction capacitor element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect capacitors, wiring, components, connections, and equipment installation.
2. Assist in field testing of equipment including pretesting and adjusting of automatic power factor correction units.
3. Report results in writing.

C. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Perform the following field tests and inspections and prepare test reports:

a. The capacitors shall be charged by application of full voltage for a period of one minute and then discharged through resistors. This will constitute one cycle and the tests shall be carried out for 5 such cycles.
b. The sensing relay shall be tested in accordance with tests specified in B.S. 142.
c. All small wiring shall be subjected to a high voltage test at 2000 volts for one minute.
d. The plant as a whole shall be tested by the application of inductive load.
e. Six copies of complete specification of each components along with six copies for test certificates shall be furnished by the sub-contractor.
f. The owner may require his Engineer to witness all or any test at manufacturer’s works and the Sub-contractor shall cause such tests to be performed without any extra cost to the Owner.
g. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
h. Adjust for optimum automatic power factor correction.

SECTION – 16 EARTHING

16.1 SCOPE

The sub-contractor shall be under obligation to supply all material and labor for the completion of the Earthing system as shown on drawings, listed in the schedule / Schedule of values and conforming to specifications laid down, hereinafter. The completed installation shall, in general, conform to British Code of Practice CP 1013/1965 and regulations of Pakistan Electricity Act. In the case of any conflict, specifications laid down hereinafter shall be followed. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

16.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features
1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.
5. Grounding for sensitive electronic equipment.
C. Qualification Data: For testing agency and testing agency's field supervisor.
D. Field quality-control test reports.

16.3 MATERIALS

CIRCUIT PROTECTIVE CONDUCTOR.

The Circuit Protective Conductors and earthing leads shall be solid hard drawn, insulated electrolytic copper wires of sizes given on the drawings and Schedule of values. All fixing accessories such as saddles, copper bolts, nuts, and washers shall be provided. The size of conductor above 19/.083 shall be of 1-1/8" flat copper strip or as specified.

EARTH POINT.

It shall comprised of 1" dia & 10 ft long steel rod with 1mm copper conductor sleeve of 99.97% imported copper as earth electrode 100ft below ground level including cost of boring and lowering the rod 100ft down, complete with clamp and appropriate size of stranded copper conductor from rod to ground surface in 1½" dia G.I. pipe (length 20' only) with tee on top having watering cap, earth access hole comprising of 8" dia, 12" deep 16-SWG M.S. cylinder with 12-SWG M.S. cover, both hot dipped galvanized, as perdetail shown in drawings.

EARTH CONNECTING POINT.

The earth connecting point in switch room or sub-station shall comprise 300mmx50mmx5mm (1'x2"x1/4") electrolytic copper bar having as many terminals of 3/8" dia. copper bolts, nuts, and washers as are required. The earth bar shall be fixed on bus bar insulators of appropriate size. The fixing bolts shall be galvanized and provided for fixing the bar on the wall. The bar shall be tinned for protection against corrosion. Copper tapes from various equipment and earth point shall be terminatedon this bar.

EARTH ELECTRODE.

For the earthing of poles or any devices or equipment rates less than 15 KW, earth assembly as shown on the drawing shall be installed.

MANHOLE.

Cast concrete inspection manhole covers shall be provided on each earth point, as

shown on drawings.

16.4 EXECUTION

a. The circuit protective conductor (CPC) shall be run, inside, all along the conduit installation. The CPC shall be insulated as specified elsewhere.

b. The C.P.C. or copper strip shall be laid all along the length of perforated metal tray or walls of masonry ducts, fixed at 3' intervals. At terminations the CPC or traps shall be bolted firmly to the equipment as per standard practice. Copper tape at straight through joints shall be brazed or cad welded. Joints between standard CPC shall be avoided or cad welded.

16.5 QUALITY CONTROL

A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

B. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each building electric service entrance, electric/telecom rooms, generator system, buildings and lightning protection system where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Tests at each ground rod before any conductors are connected are not required if a clamp-on ground tester is used. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven andtheir depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results. Maximum value of acceptable system ground resistance is 1 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, drive additional ground rods until resistance meets specified values.

SECTION – 17 LIGHTENING PROTECTION SYSTEM

17.1 SCOPE

This Section includes lightning protection for all buildings on the site. The Sub-contractor shall be under obligation to supply all labour and material for the completion of this installation to specification laid hereinafter, as shown on drawings and listed in the Schedule of values. The installation shall in general conform to British Standard 6651.

17.2 SUBMITTALS

A. Product Data: For air terminals and mounting accessories.

B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met

C. Field inspection reports indicating compliance with specified requirements.

17.3 MATERIALS

a. The Lightning Protection System shall comprise of lightning capturing devices fixed individually of a GI mast having arrangements for connection of conductor for diverting lightning current to ground system.

b. The lightning streamer shall be based on the principal of collection volume and shall comprise of elements to avoid corona charge from affecting its performance adversely. All mounting accessories for fixing the pipe to the roof including guy wires, base for pipe, etc. shall be provided.

c. There shall be at least two down conductors of soft drawn copper conductors which shall follow the most direct path between air terminal and the earth point through the down conductor.

d. Care must be given to ensure that when the conductor is fixed there shall be no sharp bend and absolutely no upturns. Joints should be made with square clamps. These joints must be kept to minimum number. Test clamps should be provided for each down conductor near ground level. No joint in conductor should be made below the test clamp, except at the earth terminal. The earth resistance for the entire lightning protection system, in no case, should exceed ten ohm.

e. When a metallic water pipe buried in the ground is available it should be bonded to the earth in compliance with the regulations of the Institute of Electrical Engineers. Group of electrodes, if used, should be capable of isolation for test purposes. Pipes carrying inflammable liquids or gas should not be used as a conductor or earth terminal. Earth rods should be at least 10 feet long and distance between the driven rods should be equal to their driven depth. Earth conductor should be burried 18" deep and in straight lines of radial formation.

f. All reinforcement steel of columns and slabs, where possible, shall be connected with the protective system. Metal pipes and other metal building componentsof structure, within 6 feet of down conductor should be bonded at the top and bottom, and also at intermediate position if directed at site.

g. The lightning arrestor should be mounted at the highest level and as close to the centers marked as possible. The Conductor shall be fixed to the roof with copper saddles by wood screws and nylon plugs.

h. All the instructions and safety measure should be adhered to at site. The Project Manager should be consulted at site if any changes due to site conditions are required to be made.

17.4 EXECUTION

A. Install lightning protection components and systems according to NFPA 780. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.

B. Conductors Concealment:

1. Conceal the following conductor:

a. System conductors.

b. Down conductors.

c. Interior conductors.

d. Conductors within normal view from exterior locations at grade within 60 m of building.

2. Do not embed conductors in concrete surrounding PCC as indicated on drawing details.

3. Notify Project Director/COR at least 48 hours in advance of inspection before concealing lightning protection components.

C. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.

D. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 18-m intervals.

E. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

F. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

SECTION – 18 PUBLIC ADDRESS MUSIC PAGING

18.1 SCOPE

The extent of works shown on the drawing does not indicate the exact position of conduits and pipes. The sub-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 conduit system shall be co-ordinate with manufacture's recommended accessories.

The quality and material for the accessories of conduits and pipes such as sockets, end cap, elbows, bushings, bends inspection/pull boxes, round boxes, etc., necessary for the complete installation shall be similar to that of conduits or pipes. All the accessories shall be supplied by the Sub-contractor without any extra cost and deemed to have been included in the price of conduits/pipes.

The Work under this section consist of supplying, Supplying, installing and commissioning of all material and services of the complete Conduits and Pipe as specified herein and/or shown on Tender Drawings and stated in the Schedule ofvalues.

The sub-contractor shall discuss the Public Address System layout with the Engineer and co-ordinate at Site with other services of exact route, location and position of the conduits and pipes.

The conduits and pipes with accessories shall also comply with the General Specifications for Electrical Works, Section-8001 and with other relevant provisions of the Tender Document

The public address system shall be used for paging within the building or specified area. The system shall include the entire component and installing methods/materials required ensuring full compliance to the code of the practice and applicable part of BS standard.

18.2 MATERIALS

All equipment supplied shall confirm as a minimum to the following protection classes.

Ip-40

Ip-

54

Ip-

65

18.2.1. SYSTEM OPERATION

The suggested system shall be operated through a central Control System. The system based on its amplifier, which will drive and handle all the speakers, fitted in the building.

The characteristic of some of the equipment in brief is given below; however sub-contractor / supplier shall provide the catalogue of each item for future details.

18.2.2. DETAIL OF EQUIPMENT

a. Voice Alarm Controller
b. Voice Alarm Router
c. Booster Amplifier
d. Ceiling Speaker
e. WALL Speaker
f. Column Speaker
g. Power Amplifier
h. Back Ground Music Unit
i. Call Station

A. VOICE ALARM CONTROLLER:-

Voice Alarm Controller should have following features:-

1. Compliant with standards for emergency sound systems (IEC60849).
2. 6 – Zone System Controller.
3. Built-in 240 W Booster Amplifier.
4. 12 Business and emergency control inputs and outputs.
5. Line output for monitor or recording.

The Controller should have two BGM source inputs and a mic/line input with configurable priority, speech filter, phantom power and selectable VOX activation. A total of 16 priority levels can be specified for microphone, call stations and trigger inputs for optimum system flexibility.

The powerful 240W output section should be have six transformer isolated 100V constant voltage outputs for driving 100V loud speakers in six separate zones. All zones may be individually selected from the front panel, and the BGM output level in each zone can be individually set in 6 steps. The BGM output is connected to the 70 V line, so it is possible to connect a total load of 480 Watts in a two-channel system combined with a 480 Watts

The output of the Booster should also available as a separate output o 100 V and 70 V.

A separate 100 V call only output should be provided for addressing and area where BGM is not is not required but where priority announcements are. Six configurable volume override output contacts should available for overriding local volume controls during priority calls. A LED VU – meter should monitors the output up to 255 messages can be stored in the internal 16 MB flash ROM, without a need for battery backup

Technical Specifications

Electrical

Mains Voltage	230 / 115 VAC, ±10%, 50 / 60 Hz
Main Power Consumption	60 VA
Max/Rated output Power	360 W / 240 W
Battery Current	24 VDC, +20% / -10%
Max Mains Inrush Current	8A @ 230 VAC / 16A @ 115 VAC

Power Consumption

Mains Current	
System Idle	0.26 A = 60 VA
System Idle with Pilot Tone	0.6 A = 136 VA
Maximum Load8*)	3.6 A = 380 VA
24 V Current	
System Idle	0.9 A
Maximum Load*	14 A

Performance

Frequency Response	60 Hz – 18 kHz (+1/-3 dB,
	@ - 10 dB ref. rated output)
Distortion	<1% @ rated output, 1 kHz
Bass Control	-8/+8 dB @ 100 Hz
Treble Control	-8/+8 dB @ 10 Hz

Inputs Mic /

Line

Input Type	XLR, 6.3 mm jack
Sensitivity	1 mV / 1V
S/N	63 dB (flat at max volume)
S/N	75 dB (flat at min volume/muted)
Headroom	25 dB
Speech Filter	-3 dB @ 315 Hz, high-pass, 6 dB/oct
Phantom Power Supply	12 V
VOX Trigger Level	-20 dB (100 µV mic / 100 mV line)or via input contact
Limiter	Automatic

Electrical

BGM and PC Call Station	
Input Type	Cinch stereo (converted to mono)
Input level	200mV – 2 V
Impedance	22 k Ohm
S/N	70 dB (flat at max volume)
S/N	75 dB (flat at min volume/muted)
Headroom	25 dB
Trigger Inputs	6 EMG, 6 business
Type	MC1,5/14-ST-3,5
Activation	Programmable
Supervision	on EMG inputs, Programmable
Supervision method	Series / Parallel resistor
100 V input	MSTB 2,5 /16-ST
Power Handling Capacity	480 Watts

Approvals and Compliance

Certifications and Approvals	
EMC emission	acc. to EN 55103-1
EVAC compliance	acc. to IEC 60849
EMC immunity	acc. to EN 55103-2
Safety	acc. to EN 60065

B. VOICE ALARM ROUTER:-

Voice Alarm Controller should have following features:-

1. 6 EMG in put contacts
2. 6 Business input contacts
3. 6 Volume Override output contacts
4. Supervision within the Voice Alarm System (compliant to IEC60849)

The Voice Alarm Router should be an expansion unit adding 6 zones as well as 12inputs- and 8 output contacts to the Voice Alarm System.

It must be able to use the built-in booster of the Voice alarm Controller, it should also provides output and inputs for one or two boosters in a multi amplifier one-or two-channel system. It should provide dual channel operation for calls and BGM simultaneously to a maximum of six different zones.

Technical Specification

Electrical

Main Voltage	230 VAC / 115 VAC,
	± 15%, 50 / 60 Hz
Max Mains Power	50 VAC
Consumption	
Battery Voltage	20-26.5 V
Max Battery Current	1.8 A
Max Mains Inrush Current	1.5 A @ 230 CAC / 3A @ 115 VAC

Power Consumption

Mains Current

System Idle	0.2 A
Maximum Load	0.3 A

24 V Current

System Idle	0.51 A
Maximum Load 24 V Output	1.5 A
Trigger Inputs	6 EMG, 6 business
Type	MC1, 5/12-ST-3, 5
Activation	Programmable
Supervision	On EMG inputs, programmable
Supervision Method	Series / parallel resistor
100 V Inputs	MSTB 2,5 /16-ST
Booster 1	100 V / 70 V/0V
Booster 2	100 V / 0 V
Power Handling Capacity	1000 Watts

Outputs

100 V/70 V Output	MSTB 2,5 / 16-ST, floating
100 V Outputs	1000 W rated per zone
Volume Override Type	3 wire, 4 wire (24 V),
	4 wire failsafe

Output Contacts

All Contacts	
Connector Type	MC1,5/12-ST-3,5
Rating	250 V 7A voltage free
General Purpose Relays (2x)	NO / COM

Environmental

Operating Temperature	$+5^0$C to $+55^0$C
Storage Temperature	-25^0C to + 55^0C
Relative Humidity	<95%
Dimensions	88x430 x 260 mm

Booster Amplifier

Booster / power amplifier should have following

features:Performance

Frequency Response	50 Hz – 20 kHz (+1/-3 dB,
	@ - 10 dB ref. rated output)
	<1%@rated output power, 1 kHz

Inputs

Line input (3-pin XLR, 6.3mm phone jack,

balanced)Sensitivity	1 V
Impedance	20 kOhm
CMRR	>25 dB (50 Hz – 20 kHz)

Line Input 1,2 (3-pin XLR,

balanced)LBB 1938/00

Sensitivity	1 V
Impedance	20 kOhm
CMRR	>25 dB (50 Hz – 20 kHz)

100 V Input (Screw, unbalanced)

Sensitivity	100 V
Impedance	330 kOhm

Outputs

Line Loop-through Output 1,2 (3-pin XLR, 6.3mm phone jack,

balancedNominal Level 1 V

Impedance Direct Connection

to line inputLine loop-through Output 1,2 (3-pin XLR,

balanced)

LBB 1938/00

Normal Level 1 V

Impedance Direct connection to line input

Loudspeaker Outputs (Screw, floating)

Output Power @ 24 V

Battery Operation -1 dB ref. rated power

Approvals and Compliance

EMC emission acc. to EN 55103-1

EMC immunity acc. to EN 55103-2

CEILING SPEAKER:-

C. Ceiling Speakers should have following features:-

Features

. Compact yet powerful

. Very wide opening angle

. Installation friendly

. Comply with international installation and safety regulations

Approval and Compliance

All plastic parts are manufactured from self-extinguishing high-impact ABS material(according to UL 94VO).

Safety	EN 60065
Water protected	acc. to EN 60529 IP x4

Technical Specifications

Max. Power	9 W
Rated Power (PHC)	6 W (6-3-1.5-0.75 W)
Sound Pressure Level at 6 W/1 W	
(at 1 kHz, 1 m)	96/88 dB (SPL)
Effective Frequency Range	60 Hz to 18 kHz(-10 dB)
Opening Angle	170^0 / 90^0 (at 1 kHz/4 kHz, -6 dB)
Rated Voltage	100 V
Rated Impedance	1667 ohm

Mechanical

Speaker Size	101.6 mm (4 in)
Magnet Weight	3.57 oz
Connection	2-pole push connector

Dimensions

Diameter	160 mm (6.30 inch)
Max. Depth	95 mm (3.74 inch)
Ceiling Thickness	9 to 25 mm (0.35 to 0.98 inch)
Mounting Cut-Out	145 mm (5.71 inch)
Color	off-white (RAL 9010)
Weight	690 g (1.52 lb)

Environmental

Ambient Temperature	-25^0C to +55 ^{0}C (-13 to 131 ^{0}F)

D. WALL SPEAKER:-

Cabinet Speaker should have following features:-

1. Good speech intelligibility and background music reproduction
2. Finished in white or black
3. MDB Construction
4. Available with or without integral volume control

5. Complies with international installation and safety regulations

Technical Specification:-

Electrical

Maximum Power	9 W
Rated Power	6 W (6-3-1.5 W)
Sound Pressure Level at Rated Power/1 W	
(at 1 kHz, 1 m)	99/ 91 dB (SPL)
Effective Frequency Range	180 Hz to 20 kHz (-10 dB)
Opening Angle	
(at 1 kHz / 4 kHz, - 6 dB)	165^0 / 95^0
Horizontal	190^0 / 88^0
Rated input Voltage	100 V
Rated Impedance	1667 ohm

Environmental

Ambient Temperature	- 15^0C to + 55^0C

*) Technical performance data acc. to ICE 60268-5

COLUMN SPEAKER:-

Column Speaker should have following features:

1. For sound Beaming in difficult reverberant conditions
2. Excellent speech and music reproduction
3. Adjustable bracket mounting
4. MDF Construction
5. Comply with international and safety regulations

Technical Specification:-

Electrical

Max. Power	36 W
Rated Power	24 W (24-12-6 W)
Sound Pressure Level at Rated Power/1 W	
(at 1 kHz, 1 m)	110/96 dB (SPL)

Effective Frequency Range	165 Hz to 16 kHz (-10 dB)
Opening Angle	
(at 1 kHz / 4 kHz, - 6 dB)	
Horizontal	190^0 / 88^0
Vertical	30^0 / 8^0
Rated input Voltage	100 V
Rated Impedance	417 ohm

Environmental

Ambient Temperature	- 15^0C to + 55^0C

E. POWER AMPLIFIER

The main function of the power amplifier is the amplification of audio signals for the signals. It shall be possible to select the output voltage between 100V, 70V, 50V, by changing jumpers. The unit shall be certified to be complaint to IEC 60 849 and compliant to other relevant local standards. Should have the following Features

Mains voltage	115 Vac/230 VAC,
	±10%, 50/60 Hz

Performance

Frequency Response	50 Hz – 20 kHz (+1/-3 dB,
	@ - 10 dB ref. rated output power,
Distortion	<1% @ rated output power
	kHz
Bass Control	-8/+ dB @ 100 Hz
Treble Control	-8/+8 dB @ 10 kHz

Inputs

Input 1(5-pin DIN, balanced with phantom power,

6.3 mm phone jack)

Input 2 (3-pin XLR, balanced with phantom power,
6.3 mm phone jack)

Sensitivity	1 m V
Impedance	>1 kOhm

S/N (flat at max volume)	63 dB
S/N (flat at min volume/muted)	>75 dB
CMRR	>40 dB (50Hz-20kHz)
Headroom	>25dB
Speech Filter	-3 dB @ 315 Hz, high-pass,6dB/oct
Phantom Power Supply	16 V via 1.2 kOhm
VOX (input 1 only)	attack time 150 ms Release time 2 s

Input 3,4 (3-pin XLR, balanced with phantom power
6.3 mm phone jack)

Sensitivity	1 mV (microphone), 200 mV (line)
Impedance	>1 kOhm (microphone), >5 kOhm (line)
Dynamic Range	100 dB
S/N (flat at max volume)	>63 dB (microphone), >70 dB (line)
S/N (flat at min volume/muted)	>75 dB
CMRR	>40 dB @ (50 Hz-20 kHz)
Headroom	>25 dB
Speech Filter	-3 dB @ 315 Hz, high-pass,6dB/oct
Phantom Power Supply	16 V via 1.2 kOhm

(microphone)Music Input (Cinch, stereo converted to mono)

Sensitivity	200 mV

Electrical

Impedance	22 KOhm
S/N (flat at max volume)	>70 dB
S/N (flat at min volume/muted	>75 dB
Headroom	>25 dB
Emergency/telephone (Screw, balanced)	
Sensitivity	100 m V – 1 V adjustable
Impedance	>10 kOhm
VOX	threshold 50 mV Attack time 150 ms
	Release time 2 s
S/N (flat at max volume)	>65
dBInterconnection (Cinch)	
Nominal Level	1 V
Impedance	>10 kOhm

Outputs

Master output (3-pin XLR, balanced)	
Nominal Level	1 V
Impedance	‹100 ohm
Tape Output (Cinch, 2x mono)	
Nominal Level	350 mV
Impedance	1.5 kOhm
Interconnection (Cinch)	

Nominal Level	1 V
Impedance	‹100 ohm
Loudspeaker outputs (Screw, floating)	

Environmental

Operating Temperatue	-10 ^{o}C to +45
^{o}CStorage Temperature	-40 ^{o}C to +70 ^{o}C
Relative Humidity	‹95%
Acoustic Noise Level of Fan	‹40 dB SPL @ 1m

F. BACK GROUND MUSIC & PAGING UNIT:-

Back ground music & Paging unit should have the following features:-

1. All-in-one solution for back ground music & paging.
2. CD player for Audio and MP3 CD/CD – R.
3. FM/AM Tuner with 15 presets and Digital Control.
4. Dual Zone 120W Mixer Amplifier with volume control per zone.
5. Selectable priority and vox switching on microphone input.
6. The powerful 120W out put section has two transformer isolated 100V Constant

Voltage out puts for driving 100V Loud Speakers in two separate zones.

1. The announcement part of the unit has 3 microphone input

Approvals and Compliance

Safety	acc. to EN 60065
Immunity	acc. to EN 55103-2
Emission	acc. to EN 55103-1

Technical Specifications

Mains power supply

Voltage	230/115 VAC, ±15%, 50/60 Hz

Max power consumption	25 VA

DVD/CD-Player

Frequency response	2 Hz to 20 kHz (+ 1/-3 dB)
Distortion	<0.1%
S/N	>96dB

MP3

MP3 bit rates	CBR 32 to 320 kbps and VBR, mono andStereo
Data buffer shock protection	32 MB
Lifetime	>10,000 play cycles

Tuner

Frequency response	30 Hz to 15 kHz (+1/-3dB, FM)
Distortion	<1%

Mains power supply

S/N	>63 dB (1mV, FM)

DVD/CD player outputs 2x

Connector	Cinch, (RCA) stereo
Nominal level	500 mV
Optical output	To Slink (PCM, multi channel)
Supported formats	DVD, CD (re-) writableMP3, MP4, JPEG

Mixed output 1x

Connector	Cinch, (RCA) stereo

Nominal level	200 mV

Video outputs

Component connectors	3 x cinch
Composite connector	1 x cinch
S-Video connector	1 x mini-DIN

Tuner frequency range

Range		FM 87.5 – 108 MHz (Europe, 50 kHz) 87.5 – 108 MHz (Asia/America, 100 kHz)AM 531 – 1602 kHz (Europe, 9 kHz) 530 – 1610 kHz (Asia/America, 10 kHz)
Sensitivity		
	FM	2µV (26 dB S/N)
	AM	30µV (20 dB S/N)

Environmental

Operating temperature	-10 ^{0}C to +55 ^{0}C (14 ^{0}F to + 131 ^{0}F)
Storage temperature	-40 ^{0}C to +70 ^{0}C (-40^{0}F to + 131 ^{0}F)

Relative humidity	<95%

G. CALL STATION:-

The call station is used for making a manual or pre recorded call to any pre-assigned zones or executing a pre-defined action. The Call station should have the Following Features.

Features

. Stylish 6-zone call station, intended for LBB 1990/00

voiceAlarm System Controller

. Six zone selection keys, all-call key and momentary PTT-

keyfor calls

. Selectable gain, speech filter and limiter for improved

. intelligibility

. LED indications for zone selection, fault and emergency state

. Call station extension provides 7 additional zone and zone group keys

Technical Specification

Power supply

Voltage Range	18 – 24 V
	24 V by
	LBB 1990/00
	Or external power supply
Current Consumption	<30 mA Call Station
	<15 mA key Pad

Performance

Nominal Sensitivity	85 dB SPL (gain preset o dB)
Nominal Output Level	700 mV
Maximum Input Sound Level	110 dB SPL

Gain Preset	+6/0/-15 dB
Limiter Threshold	2 V
Compression Ratio Limiter	20 : 1
Distortion	<0.6% (maximum input)
Equivalent Input Noise Level	25 dB SPLA
Frequency Response	100 Hz – 16 kHz
Speech Filter	-3 dB @ 315 Hz, high-pass, 6 dB / oct
Output Impedance	200 ohms
Selections	

Environmental

Operating Temperature	-10 °C to +55 °C
Storage Temperature	-40 °C to +70 °C
Relative Humidity	<95%

Conduiting and Wiring Installation Work

Galvanized Iron (G.I) Pipes and Accessories

Galvanized iron pipes shall be used on surface or underground installation wherever specified and required at entry into manholes and as shown on drawings.

The underground G.I. pipes and accessories shall be provided with one thick coat of bituminous paints on the outer surface prior to installation.

PVC Conduit and Accessories for Indoor

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 shall have minimum dimensions of 63 mm diameter and depth. Wall junction boxes shall have minimum dimensions of 63 mm deep. Round junction boxes means of brass screws

Pull and Adaptable Boxes

Inspection/Pull boxes and 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 inspection/pull boxes or adaptable boxes. However, these shall be as per Engineer's approval.

Cable for Public Address Systems

The cables shall be PVC insulated, PVC sheathed twisted pair screened cooper conductor conforming to IEC

The PVC insulation shall comply with BS 6746. The conductor shall be tinned sold high conductivity soft annealed copper complying with 6360. The insulation of conductors shall be colour coded as per above-mentioned publications.

All wires and cables shall be color-coded tagged and checked for open short or ground terminals blocs of proper size and type for the services involved cable joints shall only be allowed on speaker and

Rack

Suitable mounting rack for head and equipment with adequate ventilation to fixing of all controlling equipment .

Testing & Commissioning

On completion of the work and before commissioning of the equipment. The entire PA

/sound system including wiring shall be tested and commission by the supplier / sub-contractor engineer and test performance result to be submitted to client / user and system commission report.

Maintenance & Warranty

The supplier / sub-contractor shall be responsible for all equipment by him and warranty the time for a period of twelve month from the date of commissioning certificate.

Training

The supplier / sub-contractor shall provide

SECTION – 19 CCTV SYSTEM

19.1 SCOPE OF WORK

The work under this section consists of, installation, testing and commissioning a complete closed circuit television (CCTV) system as stated herein and as per SCHEDULE OF VALUES..

All equipment provided under this section shall conform to relevant European / American standard i.e. CE & UL listed..

19.2 MATERIALS

The system shall provide color CCTV surveillance of specified areas by means of color CCD cameras. The Control Contain the color monitor with Digital Video Recorder.

A. Camera.

Compact rugged, 1/3 inch image format digital color CCD cameras having a resolution of 752 (horizontal) by 582 (vertical) pixels is specified. The Camera shall conform to the CCIR – standard. The camera shall be of compact ragged design, high sensitivity advance digital signal processing high resolution with outstanding picture quality extended sensitivity with night sense.

The camera shall require only 1.0 lux for useable video. All the control shall be concealed. Other standard features shall be back light compensation, automatic shutter, selectable electronic shutter, digital adjustment control, automatic white balance and insulation installation.

The camera shall be line locked to the power line zero crossing to ensure roll free vertical interval video switching and recording.' A vertical phase adjustment potentiometer shall be accessible through an opening in the side *of* camera to allow for camera synchronization in multi phase power installation.

The rated voltage shall 12VDC, 24VAC, 50 Hz. The operating temperature shall be

-20 to 50 degrees Celsius. Humidity shall be 5 to 93 % non-condensing. Shock resistance shall be minimum 50 gm.

Signal-to-Noise Ratio: 50 db with AGC : 21 dB (Max.)

Electronic Shutter: Automatic, 1/50 to 1/125,000 – sec.

White Balance: Automatic Sensing, (2500 – 9000 K)

Video Output Composite video 1.0 Vpp, 75 ohms)

The camera should have an on-screen menu with following controls.

Video Level

AGC: : On / Off

BLC : On / Off

ATW : On / Hold

Shutter : AES/ off / Flicker

less.R – Offset

B – Offset

V – Phase Adjustment: 0 –358 Degrees

B. Auto Dome Camera.

The camera should consist an imager *of* 1/3" IT CCD with a resolution *of* (752 x 582 " PAL) / (768 x 494 NTSC). Having a lens *of* 25 x zoom (2.4 -:- 60 mm) F 1.6 to F 27. It ' should consist an automatic with manual override. Focus and iris adjustment with a field of view *of2.0* degree to 45 degree.

The camera should be operational between -40 degree C to 50 degree C under 100% relative condensing humidity, the ingress protection should be less than IP 66 (NEMA 4X)

The camera should be able to PAN 360 degree continues and tilt from horizontal plane 5 degree to 90 degree during a guard tour the camera speed should be 360 degree per second, ISO accuracy and having a variable speed *of* 120 degree per second.

The camera should be capable *of* creating 16 independent sector with 16-character title. The camera should be remotely controlled through either biphase or via RS-232. Pre position should be at least 99 each with 16-character title.

The camera can create two types of tours one recorded tour with totally 15 min during both and the preset tour that consist up to 99 scenes consecutively. The camera should be able to fast addressing or 4 digit thumb wheel.

The camera must have the following specification.

Video output : 1.0 Vp-p ; 75

ohms

Gain control : off / auto (with adjustable limit)

Synchronization : line lock (-120 to 120 degree vertical

phase adjust) or internal crystal

Aperture Correction : horizontal and vertical

Digital zoom : 12 X

Horizontal resolution : 470 TVL (NTSC) / 460 TVL

(PAL)Sensitivity (usable video)

Day mode w/slow shutter off	0.2 fc / 2.0 Lx
Night mode w/slow shutter on	0.025 fc / 0.25 Lx
Day mode w/slow shutter on	0.013 fc / 0.13 Lx
Night mode w/slow shutter off	0.0016 fc / 0.016 Lx

C. AUTO DOME CONTROLLER:

Auto Dome Controllers provide complete Control of the Auto Dome System features is as:

- Operates upto 8 Controllable Cameras in daisy -Chain Configuration.
- Controls All Dome system features including Auto play back
- Ergonomic layout for single-handed Control.
- Full pan/tilt/zoom operation
- 22, key control unit with integral vector solving 'pan/title/zoom/joy stick, interface box and appropriate power supply.

D. CCTV MONITOR

Color Monitor is multi standard compatibility with a Built - in loud speaker and in puts able to accept NTSC, PAL and S-video standards in 450 TV line of Horizontal resolution is housed in a compact, space-saving metal cabinet for, rugged reliability.

E. Digital Video Recorder:

- Digital video recorder should have the following features. ~ Combined multiplexer & digital video recorder.
- 240 fps recording (PAL/NTSC)
- Simultaneous recording & play back.
- Remote operation via the control center.
- Intuitive user face.
- Storage capacity of upto 7 day recording

F. VIDEO CABLE

The Low loss video cable RG - 6 are 75 ohms coaxial cables suitable for use in close circuit television system. The specifications adopting such design is mentioned below.

- The conductor shall be copper.
- The insulation comprises of foamed polyethylene resulting in low attenuation.
- Cable is then provided with screen and overall covered with black PVCcompound.

G. POWER CABLE

PVC insulated PVC sheathed unarmored multicore 600 '/ 1000 volts grade with

standard copper conductors according to latest standard specification.

H. LENSES

Lenses shall be of C and CS mount and following types.

1. 4 or 8 mm fixed focal length and manual iris lens.
2. 3.5 - 8 mm varifocal auto iris lens.

I. RACK.

The rack shall house monitors, Digital Video Recorder. It shall be of 19" standard mounting system, all material casing with front glass Door. All racks shall be supplied with lock & key arrangement.

19.3 TESTING & COMMISSIONING.

All of the normal test as recommended by the manufacturer shall be carried out on the system. The system shall be commissioned by the authorized personnel only.

SECTION – 20 M.A.T.V SYSTEM

20.1 SCOPE

The Sub-contractor shall supply, install, test, Commissioning, guarantee and maintain a modern Master Antenna Television (SMATV) system for the distribution of combined IF- RF signals. The system shall be capable of receiving and distributing the present Television and Radio transmission with sufficient allowances made to include any future transmissions within the foreseeable future, without degrading of the system parameters.

The system shall receive the off sir VHF and UHF channels and shall process and distribute them to TV/FM outlets. The system shall include, but not limited to dishes, antennas, antennas mast, head-end cabinet, amplifiers, convertors, combiners, filters, distribution equipment, cables, connectors, tap-offs, splitters, TV outlets, etc.

The system shall be from an approved manufacturer, supplied and installed by a specialist Sub-contractor, who shall have trained staff to undertake the work.

The sub-contractor shall submit a complete proposal with schematic drawings with signal level calculations, list of materials and originals detailed catalogues of the equipment for approval before starting the work.

A pre planning site survey will be performed to assess the signal strength and also takein to account the site related factors for performance of system.

20.2 SUBMITTALS

- Signal survey report.
- Data of system/components with complete technical literature
- Shop drawings.
- Certificate of Country of Origin

20.3 MATERIALS

TECHNICAL REQUIREMENTS

A. System Description

The system design shall meet and fully comply with the following performance and operational requirements.

a. The system shall consist of a Centralized MATV system suitable for receiving TV and FM channels and also transmitting in-house videos over the same network. The system shall be designed to operate on 24/7 basis.
b. The system shall be for a range of up to 1000 MHz with a signal strength of 60-80 dB micro-volts at user outlet.
c. The signal to noise ratio shall be 40 dB for the TV signals. A difference of 3 dB shall be maintained between adjacent channels.
d. Channel convertors shall be provided to avoid interference from terrestrial TV signals.
e. The selection of channel separation shall be made to avoid any interference and quality of signal.
f. All outputs of devices shall be provided with a termination resistor as recommended by the system manufacturer.
g. Connectors shall be F type.
h. The system shall be powered by regulated DC power supply operating on 220-volt, 1 phase ac supply from a UPS source.

SYSTEM COMPONENTS

The principal characteristics of the system equipment are stated in following sections. However it shall be the responsibility of MATV system supplier to select equipment that will provide best performance, for which consultant approval will be obtained.

A. Satellite Dishes

The dishes shall be of aluminium provided with supports to sustain a wind velocity of 160 KPH. The dishes shall be of specified diameters. These will be provided with suitable LNBs; selection of satellites shall be done during execution stage.

B. Antenna

The antenna shall receive the UHF/VHF and FM signals and installed to sustain a wind load at a velocity of 160 KPH. The antenna shall have a BALUN for the required output level. The antenna shall have the following features:

- Number of UHF channels - 36
- Return Loss - 10 dB minimum
- F/B ratio - As appropriate for VHF and UHF signals
- Material - Aluminium with Saccessories**Amplifier**

3.3.1 The power amplifiers shall have the following characteristics.

- Output level - 40 dBmV for 36 channels
- Slope control range - 0-8 dB
- Gain control - 10 dB

3.3.2 Cascading of amplifiers shall be considered where required by the signal level.

3.3.3 Amplifiers shall have surge protection.

3.3.4 One amplifier shall be installed as spare.

D. Pre-Amplifiers, Convertors, Filters, Modulators

These components of the system shall be selected based on the recommendations of system manufacturers for best possible performance of thesystem. Details shall be submitted with supporting calculations/justifications for approval of consultant.

E. Splitter

The splitter unit shall be in a shielded metal housing and provide multiple isolated outed from a single input and vice versa. The splitter shall comply with the following:

- Slitter loss - Maximum 12 dB for 8 way, 7.5 dB for 4-way

F. Receiver Wall Outlets

- The outlet shall be combined for receiving TV and FM signals.
- Outlets shall screw on cable connectors.
- The outlets shall have the same design and finishes as the other electrical wiring accessories. A metallic box shall be provided for flush mounting of the outlet.
- Where required, termination device shall be provided with outlets.

G. Cable

- Cable shall be RG6 double shielded type with jacket.
- Conductor - 18 AWG
- Di-electric - Foam
- Return Loss - 28 dB
- Suitable for the entire frequency range of the system.

INSTALLATION, TESTING & COMMISSIONING

a. Power supply for the system shall be Alternating Current at 230V 50Hz, and connected to the building UPS. It shall automatically switch on to batteries in case of mains power failure before the essential power line's generator kick-in to supply power. The standby battery supply shall provide sufficient power and enable the fully loaded system, announcement at the maximum level, to continue operating without

interruption for a minimum duration of 1/2 hour should mains power fail.

b. All equipment shall be mounted into a 19" EIA standard equipment rack.

c. The sub-contractor shall submit a detailed testing and commissioningplan and procedures and checklist, which shall be designed to verify the full compliance of the installed system with these specifications. The T&C plan and procedures shall be submitted to the Consultant for approval.

d. Functional test on the system shall be performed following the completion of the installation. The functional tests shall include signal measurements at outlets and actual quality of reception.

e. The sub-contractor shall provide all facilities/test measurement equipments. Records, chart, etc. of the T&C shall be documented as part of the installation documentation.

SECTION – 21 UNINTERRUPTABLE POWER SUPPLY (UPS)

21.1 SCOPE

This specification describes as three-phase, on-line, continuous operation, solid-state uninterruptible power supply (UPS). The UPS shall operate as an active power control system, working in conjunction with the building electrical system to provide power conditioning and on-line power protection for the critical loads.

21.2 SUBMITTALS

A. Product Data: Include data on features, components, ratings, and performance for each UPS component indicated.

B. Shop Drawings: Detail assemblies of equipment indicating dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.

a. Wiring Diagrams: Power, signal, and control wiring.

C. Factory Test Reports: Demonstrating compliance with specified requirements.

D. Field Quality-Control and Performance Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.

E. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals including the following:

a. Lists of spare parts and replacement components recommended being stored at Project site for ready access.

b. Detailed operating instructions covering operation under both normal and abnormal conditions.

F. Special Battery Warranties: Written warranty, signed by manufacturer and Installer agreeing to replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.

1. Warranted Cycle Life for Premium Sealed Lead-Acid Batteries: Equal or greater than that represented in manufacturer's published table, including figures corresponding to the values in Table 1.8, "Warranted Battery Cycle Life," based on annual average battery temperature of 25 deg C:
2. Special Warranty Period: Five years from date of installation/power-up.

21.3 MATERIALS

Standards

A. Safety: EN/IEC 62040-1.

B. EMC/IEC 62040-2 (Class C2 and C3).

C. Performance: EN/IEC 62040.

Classification

A. Classification according to EN/IEC 62040-3.

Submittals

A. **Product data**: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

1. Bill of materials for the proposed system.
2. Product catalogue sheets or equipment brochures.
3. Product guide specifications.
4. System single-line operation diagram.
5. Floor layout/footprints.
6. Installation guide.
7. Drawings for requested optional accessories.

B. Operation and Maintenance Data

Submit operation and maintenance data to include in operation and maintenance manuals specified in (division 01-GENERAL REQUIREMENTS) (Division 1-GENERAL REQUIREMENTS), including, but not limited to, safe and correct operation of Ups function.

1. Submit an installation manual, which shall include, but shall not be limited to, instructions for storage, handling, examination, preparation, installation, and start-up of all systems.
2. Submit an operation and maintenance manual, which shall include, but shall not be limited to, operating instructions.
3. Submit equipment drawings, dimensions and schematics.

Description

The UPS shall consist of the following easy to repair modular rectifier/inverter sections and easy to install internal and external modular battery units.

a. The UPS shall be provided with separate fees for rectifier/inverter section and the static bypass switch.

b. Modes of operation: The UPS shall operate as an on-line system in the following modes:

1. **Normal:** The inverter and the rectifier shall operate in an on-line manner to continuously regulate the power to the critical load. The rectifier shall derive power form the AC input source and supply DC power to float charge thebattery.
2. **Battery:** Upon failure of the AC input source, the critical load shall continue being supplied by the inverter without any switching. The inverter shall obtain its power from the battery. There shall be no interruption in power to thecritical load upon failure or restoration of the AC input source.
3. **Recharge:** Upon restoration of the AC input source, the UPS shall simultaneously recharge the battery and regulate the power to the critical load
4. **Static Bypass:** The static bypass switch shall be used for transferring the critical load to input supply without interruption. Automatic re-transfer to normal operation shall also be accomplished with no interruption in power to the critical load. The static bypass switch shall be fully rated and shall be capable of manual operation. The UPS shall be able to recharge the batteries while supplying full power to the load via the static bypass switch.
5. **Internal maintenance bypass:** The UPS shall be provided with an internal manualbypass to simplify the installation and shall be used for supplying the load directly from the mains supply, while the UPS is taken out for maintenance.

Static UPS

A. **General:** The UPS shall be housed in a freestanding enclosure. The enclosure shall be designed to blend into an IT environment. The cabinet shall be equipped for fork truck lifting. The UPS cabinet shall be painted with the manufacturer's standard color. All service access shall be from the front. Installation access shall be from the lower backside of the system.

1. The UPS shall be in a self contained cabinet and comprise of two 20 kVA power sections; Bypass Static Switch; Battery for standard run time and interface LCD display all mounted in a separate cabinet. The UPS shall permit user installable and removable battery units.

The power section shall be of the Double Conversion On-Line topology with power factor corrected inputs.

a. The UPS battery shall be sized for desired kVA Ratings at a power factor of 0.8for 10 minutes (minimum).

2. The UPS shall have a short circuit withstand capability of 30 KA.

Component Description

A. Rectifier

1. Each UPS power module shall include an active power factor corrected, insulated Gated Bipolar Transistor (IGBT) rectifier.
2. The input current limiter must be design to support 100% load, charge batteries at 10% of the UPS output rating, and provide regulation with mains deviation of up/down to +/-15% of the nominal input voltage. During an overload condition the input current must be limited to maximum 125% of the nominal output current.

3. The battery charging shall keep the DC bus float voltage of +/-216 x 2.30V = 497V

4. DC ripple voltage shall be less than ±1% of nominal with no battery connected.

5. Input power factor shall be 0.99(min.) 0.7/0.8 lagging to 0.8 leading without de-rating
6. Rectifier shall employ electronic waveform control technology to maintain the current sinusoidal
7. Pulse Width Modulation (PWM) current control shall be used. Digital Signal Processors (DSP) shall be used for all monitoring and control tasks. Analog control is not acceptable.
8. Reflected input current Total Harmonic Distortion <5% THDi (Linear load condition at rated input current)
9. Typical battery re-charges time as per IEEE 485.

B. Batteries

1. Standard battery technology shall be Dry Sealed Maintenance Free.
2. Batteries shall be housed in the same rack as the power section. Batteries shall be modular on pull out shelves for quick replacement and servicing.
3. Battery voltage shall be Battery Temperature Compensated as outlined in the rectifier section above.
4. End of discharge: 378 to 360.72 Configurable VDC.
5. For longer runtimes, external battery frames in the same design may be offered.
6. Battery Charge Current Limit: The UPS shall be capable of limiting the energy sourced from the mains for purposes of battery charging. As a default setting, the battery charge energy will be set to 100% of its nominal value. UPS must be able to sensing circuitry and an innovative three stage charging technique that extends the useful service life of UPS batteries while optimizing battery rechargetime. It should also provide advance notice of the end of useful battery service life to allow you ample time to hot-swap batteries without ever having to shut down connected equipment.
7. The battery charging circuit shall remain active when in Static Bypass and in Normal Operation.
8. The batteries charger shall allow cyclic charging when system is running in normal operation and batteries are full charged to extend the battery life. This operation shall be selectable in the display. Cyclic charge should be 10 hours on and 48 hours off. The Cyclic charge shall end if UPS is overloaded, switch to battery operation, battery voltage drops below 200V or are deactivated by user.

C. Inverter

1. The inverter shall consist of fast switching IGBT power module.
2. Inverter shall be PWM controlled using DSP logic. Analog control shall not be acceptable.
3. The inverter modules shall be rated for an output power factor at 0.8.
4. Nominal output voltage shall be 1x230 V and adjustable for 1x220 V or 1x240 V, 50 Hz, L1,N, PE.

5. **Efficiency of each module at full load:** not less than 92% (minimum).

6. Output Voltage Total Harmonic Distortion at full load:

a. Less than 1.5% for 100% resistive load.
b. Less than 3.5% for computer load as defined by EN50091-3/IEC 62040-3.

7. Output voltage regulation:

a. **Static:** Less than 1% at full linear load.
b. **Dynamic:** 5% at 100% step load.
8. Output frequency: 50 Hz free running.
9. **Crest factor:** Unlimited but regulates it down to 2.7.
a. Remote Emergency Power Off (EPO) shall be standard (wall switch and wiring shall be provided by the electrical sub-contractor).

D. Static Bypass Switch

1. The static switch shall consist of fully rated Silicon Controlled Rectifiers (SCRs). Part rated SCRs with a wrap around contactor are not acceptable.
2. The static bypass switch shall be automatically transfer the critical load to bypass input supply without interruption after the logic senses one of the following conditions:
a. Inverter overload beyond rating.
b. Battery runtime expired and bypass available.
c. Inverter failure.
d. Fatal error in control system.
3. The static bypass switch shall automatically retransfer from bypass to the inverter, when one of the following conditions occurs:
a. After an instantaneous overload-induced transfer has occurred and the loadcurrent has returned to less than 100% of the system rating.
b. The inverter is active (on).
4. The static bypass switch shall be equipped with a manual means of transferring the load to bypass and back to inverter.
5. If more than 10 transfers from and to inverter occur in a 1 minutes period, the load shall be locked on static bypass. An alarm communicating this condition shall be annunciated.

E. Mechanical

1. The UPS power section, Static Bypass Switch, internal manual bypass switch and the DRY SEALED MAINTENANCE FREE batteries (for standard runtimes) shall be housed in a freestanding enclosure. The enclosure shall be designed to blend into an IT environment. The UPS cabinet shall be painted with the manufacturer's standard color. All service access shall be from the front. The enclosure shall have the following specifications.
a. Heavy-duty design with an all-metal construction

b. Caster fitted for mobility. Leveling feet shall be supplied as standard.
c. Electrostatic applied paint.
d. The cable entry shall be from the bottom on the back of the UPS.
e. The UPS enclosure shall meet an ingress level of min. IP52.

f. The UPS should be fitted with dust filter in the air inlet to filter dust, molds and spores with particles larger than 3 m.

System Controls and Indicators

A. **General:** A microprocessor controlled display unit shall be located on the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.

1. The following metered data, shall be available on the alphanumeric display but shall not limited to:

a. Time record of occurring events.
b. Input AC voltage.
c. Output AC voltage.
d. Output Ac current.
e. Input frequency.
f. Battery voltage.
g. Highest internal battery temperature.

2. The display unit shall allow the user to display an event log of all active alarms and of the 50 most recent status and alarm events (minimum).

3. For purposes of remote communications with the UPS the following shall be available and contained within the UPS on a removable, “hot swappable” “smart slot” interface card:

a) RJ-45 Interface port for remote communications with a network via web browser or SNMP.

b) Environmental monitoring feature, capable of locally monitoring temperature and humidity as well as two additional generic set of user determined dry contacts capable of taking an input signal from any third party on/off signal, such as water detection, smoke detection, motion, or fire detection.

Battery

A. The UPS battery shall be of modular construction made up of user replaceable, hot swappable, fused, battery modules. Each battery module shall be monitoredto determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

B. The battery blocks housed within each removable battery module shall be of the Dry Sealed Maintenance Free type.

Accessories

A. Extended runtime (XR) option

1. For purposes of extending the UPS battery runtime, external extended runtime options shall be available. The extended runtime option shall be housed in “line up and match” type enclosures and shall contain necessary hardware and cablesto connect to the UPS, or between enclosures. Each XR enclosure shall be equipped with removable, hot swappable, battery units housed in draw-out cartridges.

2. The extended runtime system shall have a 250 V DC rated, thermal magnetic trip molded case circuit breaker. Each circuit breaker shall be equipped with shunt trip mechanisms and 1A/1B auxiliary contacts. The circuit breakers are to be equipped as part of a line-up-and match type battery enclosure.

B. Software and connectivity

1. The Ethernet Web/SNMP Adaptor shall allow one of more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and UNIX formats. The SNMP interface adaptor shall be connected to the UPS via the RS232 serial port on the standard communication interface board.
2. The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems during when the UPS is on reserve mode.
3. The Ups shall also be capable of using an RS232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during an on battery situation.

C. **Remote UPS monitoring:** The following three methods of remote UPS monitoring shall be available.

1. Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explore.
2. RS232 monitoring: Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.
3. Simple Network Management Protocol (SNMP): Remote UPS Monitoring shall bepossible through a standard MIB II complaint platform.

D. Software compatibility: The UPS manufacturer shall have available software to support graceful shutdown and or remote monitoring for the maximum prevailing operating system.

21.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.

B. Store equipment in spaces with environments controlled within manufacturers' ambient temperature and humidity tolerances for non-operating equipment.

21.5 Quality Assurance

A. **Qualifications:**

1. **Manufacturer Qualifications:** Manufacturer shall be a firm engaged in the manufacture of solid state UPS of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years.

a. The manufacturer shall be ISO 9001 & 14001 certified and shall be designed to internationally accepted standards.

Manufactures

A. Basis of Design: Items specified are to establish a standard of quality for design, function, materials, and appearance. Only the products from the approved manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent. Examples of modifications include, but are not limited to the following:

1. Structural reinforcement to accommodate heavier equipment.
2. Increased sizes of circuit breakers, raceways and wiring.
3. Larger back-up generators (including upgraded accessories and wiring) to avoid instability caused by most double conversion UPS system.

4. Larger HVAC equipment (including duct work and wiring) to accommodate increased heat dissipation of less efficient UPS systems.
5. Filters to prevent input distortion, avoid upstream equipment malfunction and failure of power factor equipment.
6. Source Limitations: Obtain UPS and associated components specified in this Section from single manufacturer with responsibility for entire UPS installation.

SECTION – 22 TESTING AND COMMISSIONING

22.1 SCOPE

Upon completion of the installation the sub-contractor shall perform field tests on all equipment, material and systems. All tests shall be conducted in the presence of the Engineer for the purpose of demonstration equipment or system compliance with specifications.

The sub-contractor shall furnish, install and maintain all tools, instruments, test equipment, material, connections, etc., and furnish all personnel including supervision and 'Stand by" labor required for the testing, setting and adjustment of all electrical facilities and their component parts, including putting the same into operation.

All tests shall be made with the proper regard for the protection of the equipment, and the sub-contractor shall be responsible for adequate protection to all personnel during such tests.

The sub-contractor shall record all test values of the tests made by him on all equipment, giving both "as found" and 'as left" conditions. Three (3) copies of all test data shall be given to the Engineer for record purposes.

The witnessing of any test by the Engineer do not relieve the sub-contractor of his guarantees for materials, equipment and workmanship as specified in the Conditions of Contract.

This Section includes general requirements for field testing and inspection of electrical systems. More detailed requirements are specified in each Section listed in the “Related Sections” paragraph. General requirements include the following:

1. Qualifications of testing agencies and their personnel.
2. Suitability of test equipment.
3. Calibration of test instruments.
4. Coordination requirements for testing and inspecting.
5. Reporting requirements for testing and inspecting.

22.2 TYPE OF TESTS

T.1 INSULATION TESTS.

Insulation resistance tests shall be made on all electrical equipment, using a self-contained instrument such as the direct indicating ohm-meter of the generator type direct current potentials shall be used in these tests shall be as follows :-

Circuit under 230 volts - 500 volts test.

circuit 230 volts to 400 volts-1000 volts

test.he minimum acceptable insulation

resistance value will be 5 Megaohms.

The test equipment for insulation testing will

be furnished by the sub-contractor.

Before making connections at the ends of each cable run, the insulation resistance test of each cable shall be made. Each conductor of a multicore cable shall be tested individually to each other conductor of the group and also to earth. If insulation resistance test readings are found to be less than the specified minimum in any conductor, the entire cable shall be replaced and the new cable tested.

All transformers, switchgear shall be given an insulation resistance measurement test to ground after installation but before any wiring is energized. 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 that specified above, the cause of the low reading shall be determined and removed. Corrective measure shall include dry out procedure by means of heaters if equipment is found to contain moisture. Where corrective measures have been necessary and the insulation resistance reading taken after the correction has been made it should satisfy the requirements specified herein. Repeated insulation resistance maintenance test shall be made twice and at least 12 hours apart. The maximum range for each reading on the 3 successive tests shall not exceed 20% of the average value. After all tests have been made successfully , the equipment shall be reconnected.

T.2 EARTH RESISTANCE TESTS

Earth resistance tests shall be made by the sub-contractor on the earthing system, separating and re-connecting 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 ECP 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.

T.3 TRANSFORMER & SWITCHGEAR.

In addition to the insulation resistance tests on the transformer , a polarity or phase rotation test shall also be made. Auxiliary devices , breather, bucholz relay etc. shall be tested for satisfactory operation.

Each air circuit breaker shall be operated electrically and mechanically , ascertaining that handle mechanisms are operating . All interlock control circuit shall be checked out for proper connections in accordance with the wiring diagrams given by the manufacturer.

The sub-contractor shall identify the phase of all switchgear and power cables by stenciling the switchgear and tagging the cables so that the phases can be identified for connections to give proper phase sequence.

Series over current trip elements shall be checked against rating of equipment served. Also to checked for correct size, function of fuses disconnect switches, number of inter locks indicating lights, alarms and remote control devices. Name plates shall be checked for proper designation of equipment served.

T.4 OPERATING TESTS.

Current load measurement shall be made on equipment and on all power and lighting feeders.

The current reading shall be taken in each phase wire and in each neutral wire while the circuit or equipment is operating under actual load conditions. Clip-on ammeters may be used to take current readings. All light fittings shall be tested electrically and mechanically to check whether they comply with the standard ofspecifications. Fluorescent light fittings shall be tested so that when functioningproperly no flickering is observed or choke noise is heard.

The lightning protection system shall be tested for earth resistance and for electrical and mechanical joints. The combined resistance to earth to the whole lightning protection system shall not exceed 5 ohms.

The alarm system, telephone system, sound distribution system shall be checked and tested as per manufacturer's instructions and in the presence of the Engineer or his representative.

After any equipment has been tested , checked for operation etc., and is accepted by the Owner's representative the sub-contractor shall be responsible for the proper protection of such equipment for assurance that subsequenttesting of other equipment of system do not disturb the completed work.

22.3 GENERAL TESTS AND INSPECTIONS

A. Testing Preparation: Prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for Independent Testing Agency testing. Include the

following minimum preparations as appropriate:

1. Perform insulation-resistance tests.
2. Perform continuity tests.
3. Perform rotation test (for motors to be tested).
4. Provide a stable source of electrical power for test instrumentation at each test location.

B. Field Test and Inspection Reporting: In addition to requirements specified in Related Sections, ensure that each test and inspection report includes the following:

1. Manufacturer's written testing and inspecting instructions.
2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
3. Tabulation of expected measurement results made before measurements.
4. Tabulation of "as-found" and "as-left" measurement and observation results.

CONSTRUCTION OF SEED BUILDING

AT UNIVERSITY OF AGRICULTURE, FAISALABAD

TENDER DOCUMENTS (VOLUME-III)

TECHNICAL SPECIFICATIONS (PUBLIC HEALTH WORKS)
FOR
SEED BUILDING
AT
UNIVERSITY OF AGRICULTURE FAISALABAD

(JUNE 05, 2023)

ONSULTING SERVICES (Pvt.) Ltd.
34- A, Mian Gulberg, Lahore

TECHNICAL SPECIFICATIONS
PUBLIC HEALTH WORKS

CONTENTS **PAGE NO.**

TECHNICAL SPECIFICATIONS

1. PLUMBING, FITTINGS AND FIXTURES

1.1. SCOPE

The work under this section consists of providing all material and equipment and performing all the work necessary for the complete execution (jointing, clamping, cleaning, painting etc. both above and underground and embedded in walls) and completion, including testing and commissioning of all systems of plumbing works as shown on the Drawings and/or as specified herein and/or as directed by the Engineer. The system includes plumbing works as follows:

a. Cold and Hot Water Supply
b. Building Drainage
c. Rain Water Drainage
d. Storm water Drainage

All the above named systems shall be completed in all respects including extension of these internal systems up to the specified limits outside the building as indicated on the drawings. All hookup systems are also included in scope of work like water supply connections to existing line, connection of sewer to existing manhole etc.

1.2. APPLICABLE STANDARDS

G. I. Pipes	BS- 1387
Polypropylene Random (PPR) pipes	DIN 8077-8078
UPVC Pipes	ISO- 3633 (Type B), EN1329 & BS- 4514/ 5255 (Class B)
MS Pipe	ASTM106GB

1.3. SUBMITTALS & SHOP DRAWINGS

1.3.1. All the materials and equipment shall be of the specifications mentioned herein and the SUB-Contractor shall submit the sample, necessary catalogues, sketches, the name of manufacturer and guarantee if necessary, before installation. The system shall be installed after the approval of Engineer Incharge. All material and equipment shall be new, approved and unused.

1.3.2. It is specifically intended and must be agreed to by each SUB-Contractor submitting a bid, that any material or labor which is usually furnished as a part of such equipment and which is necessary for its proper completion and best operation shall be furnished as a part of this Contract without any additional

cost whether or not shown in detail on the drawings or described in detail, in the specifications.

1.3.3. Approval of material and equipment by the Engineer shall not absolve the SUB-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.

1.3.4. Prior to commencement of works on site and at least 3 weeks in advance of all the drawing being required for actual execution the SUB-Contractor shall submit on larger scale as approved by Engineer, shop drawings in triplicate for approval to the Engineer. The Engineer shall review the drawing and (1) approve the drawing or, (ii) approve the drawing with comments or, (Hi), disapproved the drawings with comments for rectification/revision of the drawing and resubmit 3 copies to the Consultant for approval. On a drawing being approved, the SUB-Contractor shall submit 6 copies for formal approval and distribution to relevant offices.

1.3.5. All drawings shall have plan and section and with sufficient details to clearly reflect the installation of the system. All material specifications shall be provided on the drawings. All information required for preparing suitable foundation, for providing suitable access to the system, for making openings in building structure, for coordination with electrical, air-conditioning and other-discipline etc., shall be clearly provided.

1.3.6. Installation shall not be allowed to commence unless approved shop drawings are in possession of the SUB-Contractor, for which purpose shop drawings shall be submitted by the SUB-Contractor to the Engineer sufficiently in advance of actual requirements to allow for ample time in checking and approval and no claim for extension of the contract time will be considered by reason of the SUB-Contractor's failure to submit the shop drawings on time.

1.3.7. Each shop drawing submitted by the SUB-Contractor shall include a certificate by the SUB-Contractor that all related conditions. on site relevant to that particular installation have been checked and that no conflict exists.

1.3.8. Any expenses resulting from an error mistake or omission in or delay in delivery of the drawings and information mentioned above shall be borne by the SUB-Contractor.

1.3.9. Drawings approved shall not be departed from except on the instructions of the Engineer.

1.3.10. The approval by the Engineer for any submitted data, working drawings, performance curves, test certificates for any items, arrangements and/or layout shall not relieve the SUB-Contractor from any responsibility regarding the performance of the Contract. Such approval shall not also relieve the SUB-

Contractor from responsibility of any error in the submitted data and workings, brought to light at any time subsequent to any approvals.

1.3.11. Relevant specified imported item, model cuts will be available with the authority concern for execution of work for SUB-Contractor to check the models for fabrication or import.

1.4. MATERIAL & EQUIPMENT

1.4.1. G.I. COLD, HOT WATER PIPES AND FITTINGS

The galvanized pipes shall be of medium grade and conform to British Standard Specifications 1387 for "Steel Tubes and Tubular suitable for screwing to BS 21 pipe threads".

All screwed tubes and sockets shall have BS pipes thread in accordance with BS

21. -In order to prevent damage to the leading thread, the ends of the sockets shall be chamfered internally.

A complete and uniform adherent coating of zinc will be provided for galvanized pipes.

Every tube shall be tested at the manufacturer's works to a hydraulic test pressure of 4.90 MPa and shall be maintained at the test pressure sufficiently long for proof and inspection.

Tubes which are bundled shall be secured together by rope or soft iron or other suitable material.

The threads of all tubes shall be effectively covered with good quality grease or other suitable compound, and each tube above 50 mm nominal bore shall have a protecting ring affixed to the un socketed screwed end.

All pipe fittings upto 75 mm dia. shall conform to BS 21 and shall be of malleable cast iron. Pipe fittings above 75 mm dia. shall be of approved material and specifications as decided by the Engineer.

1.4.2. POLYPROPYLENE RANDOM (PPR) PIPES AND FITTINGS

Polypropylene Random Pipes and fittings shall conform to the following standards:-

DIN	8078	Resistible to all chemical elements
DIN	16961	Smooth inner surface
DIN	19560	Usability for hot water all levels
DIN	4279	Durable to inner pressure
DIN	16962	Conforms to connections by welding process

1.4.3. VALVES

Generally, all valves of the same type shall be of the same manufacturer. All gate, globe, angle, and swing check valves as a group shall be of the same manufacturer. All valves 50 mm and smaller shall be threaded and have bronze bodies.

All valves 65 mm and larger shall be Cast iron type and shall be flanged (or

grooved for grooved coupling joints).

For PPR piping use PPR Coated valves of the same piping material and manufacturer.

Each valve shall be marked (engraved, stamped, or cast on each valve or metal tag, permanently attached to the valve) at the factory with the following minimum information

a. Manufacturer's Name.
b. Catalogue or Figure No. Size and Pressure Class.

Arrows to indicate direction of flow on check, globe, angle, non-return, and eccentric plug valves.

1.4.4. GATE VALVES

[Size 50 mm and Smaller]. Furnish bronze valves with screwed-in bonnet, non-rising stem, solid wedge disc, and threaded ends. Pressure rating N20.

[Size 65 mm and Larger]. Furnish Iron Body Bronze Mounted (IBBM) valves, i.e. cast iron body bronze trim valves, with bolted bonnet, non-rising stem, solid wedge disc, flanged ends, and renewable seat rings.

1.4.5. GLOBE VALVES

[Size 50mm and Smaller]. Furnish valves designed for minimum PN20 working pressures.

[Size 65 mm and Larger]. Furnish valves designed for minimum PN16 working pressure.

1.4.6. CHECK VALVES

[50 mm and smaller]. Furnish swing valves designed for minimum PN20 non-shock working pressures. Valves shall have renewable discs and side plugs, integral seats.

[Size 65 mm and Larger Water Check Valves]. Valves shall be silent type spring loaded of the double door or wafer style. Valves shall be designed for minimum PN16 non shock water working pressure.

1.4.7. RELIEF VALVES

Domestic Water Temperature and Pressure Relief Valve.

On hot water storage tanks provide an ASME rated thermostatic, self-closing, temperature and pressure relief valve, located in the relief valve openings of tanks.

Valve shall have a minimum thermal discharge capacity equal to the input capacity of the heater standard pressure setting of 600 kPa and standard temperature setting of100 - 140 degrees C. Relief valve pipe to discharge to floor drain.

1.4.8. BALL VALVES

[Size 50 mm and Smaller]. Valves shall be standard port, 2-piece construction with screwed ends. Valves shall be designed for minimum PN25. Valves shall have bronze or brass body, stainless steel ball, steel handle with vinyl grip.

[Size 65 mm and Larger].Valves shall be standard port, BS 5159 with flanged

ends. Valves shall be designed for minimum PN16 working pressure. Valves shall have steel body, chrome or nickel plated steel or stainless steel ball.

1.4.9. FLOAT VALVES

Float valves shall be installed as indicated in the drawings to provide consistent level control in reserve supply water storage tanks. The valve shall meet the requirements of the Water Byelaws for air gaps and shall be constructed throughout in approved materials and shall prevent back siphoning. Bronze equilibrium float valves 80 and above shall be flanged end, flat faced and drilled to suit BS4504 PN16.

Bronze equilibrium float valves upto 50 shall be screwed end BS2779 parallel and shall be provided complete with back nut.

Floats for valve sizes 80mm and above shall be of copper.

1.4.10. SOIL, WASTE, VENT & RAIN WATER DRAINAGE PIPES & PIPE FITTINGS (C. I. & uPVC)

1.4.11. UPVC Pipes

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.

1.4.12. PIPES

There are two types of pipes and fittings (type A and type B) as per ISO 3633 for drainage systems.

Type A, which shall be used only for primary and secondary ventilation pipe work and internal rainwater applications.

Type B, which shall be used for soil and waste discharge systems and may also be used for any type A application.

Unplasticised polyvinyl chloride (PVC-U) pipes and fittings for soil and waste discharge (low and 'high temperature) systems inside the buildings shall confirm to ISO: 3633: (1991(E)) type B.

1.4.13. FITTINGS

There are two types of fittings available as per ISO 3633:

UPVC fittings with Solvent Cement (SC) socket joint conforming to ISO 3633:1991.

UPVC fittings with rubber ring socket joint conforming to DIN 19560, which is compatible with ISO 3633/PS 3214.

1.4.14. RUBBER RINGS

The rubber rings may either be Synthetic or natural conforming to PS 1915:1987 & ISO 4633/1983 (E).UPVC pipes shall be used for domestic installation inside the buildings for soil and waste discharge, ventilation and drainage of rain water.

The material shall consist substantially of poly-vinyl chloride (PVC) to which may be added only those additives that are needed to facilitate the manufacture of pipes and fittings having good mechanical strength and opacity.

The pipes and fittings shall be tested mechanically and physically in accordance with the relevant Standards as and when directed by the Engineer, before and during installation.

1.5. PLUMBING FIXTURES

1.5.1. General Requirements

Materials shall conform to the latest referenced standard specifications and other provisions stipulated herein and shall be new and unused. All fixtures shall be of the best quality and finish.

1.5.2. Prior to procurement of the materials, the SUB-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.

1.5.3. 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.

1.5.4. Plumbing fixtures shall have smooth impervious surfaces, be free from defects and concealed fouling surface. They shall be true to line, angles, curves and colour etc. Normally they shall be of local make and of the best quality available, provided.

1.5.5. All taps and cocks to be installed with plumbing fixtures shall be chrome plated (CP) and shall be of appropriate class to work without damage or leakage on the specified pressure of potable water system, which is 0.88 MPa (128 psi). The taps and cocks shall be of the best quality locally manufactured.

1.5.6. When any fixture is provided with an overflow, the waste shall be so arranged that the standing water in the fixture cannot rise in the over flow when the stopper is closed or remain in the overflow when the fixture is empty.

1.5.7. 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.

1.5.8. 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.

1.5.9. Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet shall be set closer than 400 mm from its centre to any side wall. No urinal shall be set closer than 300 mm from its centre to any side wall or partition nor closer than 600 mm centre to centre. The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow. All cuttings, making holes etc. and making it good shall be included in the work.

Other physical/chemical properties of the fixtures are as below:

S. No.	Physical / Chemical Properties	Pakistan Standards	European Standards
1.	Water absorption	Less than 0.50%	Maximum 0.5%
2.	Scratch Resistance	Maximum 5.5 MOH's scale	Maximum 5 MOH's scale
3.	Resistance to Chemicals	Resistant to acids, alkalies, bases & other household cleaning chemicals	Resistant to chemicals.
4.	Crazing Resistance	Crazing *NIL*	Crazing *NIL*
5.	Warpage	Maximum 5.5-6mm	Maximum 6mm
6.	Strength against	More than 700 kg/cm	450kg/cm – 700
	bending		kg/cm
7.	Thermal shock	More than 10 cycles of thermal shock from hot to cold water 15^{O} C-200^{O} C	More than 2 cycles of thermal shock from hot to cold water 20^{O} C-110^{O} C
8.	Durability	Permanently durable	Durable for ever

1.5.10. COUNTER TOP LAVATORIES/WALL HUNG LAVATORY

White vitreous china 302, SS self-rimming, min. dimension of 19" wide x 17" front to rear with supply openings for use with top mounted centre set faucets, furnished template and mounting kit by lavatory manufacturer. Mount counter with the top surface 34" above floor and with 29" min. clearance from bottom of the counter face to floor. Provide top mounted washer-less centre-set lavatory faucet.

1.5.11. FLUSH TANK WATER CLOSET/WALL HUNG WATER CLOSET

White Vitreous China, 302 SS, Siphon Jet, Round Bowl, Pressure Assisted, Floor-mounted, Floor Outlet. Top of Toilet Seat Height above floor shall be 14 to 15 inches, except for 17 to 19 inches for wheel chair WC's. Provide wax bowl ring including plastic sleeve. Water flushing of the WC shall not exceed 6 litres per Flush. Provide a dual flush toilet with a second flushing option that shall not exceed 4 litres per flush. Provide white solid plastic round closed front seat with cover.

1.5.12. WATER CLOSETS (ORISSA)

Floor mounted Indian type commode with all allied accessories, color to match floor tiles, complete installation as shown on drawings and as directed by the Engineer.

1.5.13. URINALS

White vitreous china SS wall mounted wall outlet, Siphon Jet integral trap and extended side sheets. Provide Urinal with the rim 17" above the water flushing volume of the urinal.

1.6. MISCELLANEOUS ITEMS

1.6.1. KITCHEN SINK

Provide 42" single-deep bowl, single tray finish to be brushed stainless steel.

1.6.2. BATHROOM FAUCET

Provide bathroom faucet with push-button function. Finish to be chrome plated.

1.6.3. HANDICAP BATHROOM FAUCET

Provide handicap compliant goose neck faucet with two lever handles finish to be chrome-plated.

1.6.4. KITCHEN FAUCET

Provide wall mounted goose neck faucet with two lever handle finish to be chrome plated.

1.6.5. MUSLIM SHOWER

Provide Muslim Shower with adjustable pressure for jet-spray. Provide all accessories including wall hanging brackets, Fixing, steel hose finish being mirror chrome.

1.6.6. LOOKING MIRROR

Provide imported mirror with bevelled/polished edges, mirror to be fixed with SS clamps of the sizes mentioned in the Schedule of values.

1.6.7. TOILET PAPER HOLDER

Furnish Type-II surface mounted toilet tissue holder with two rolls of standard tissues, mounted horizontally. Provide SS satin finish.

1.6.8. SOAP DISPENSER

Provide soap dispenser surface mounted liquid type consisting of a tank with holding capacity of 1.2 litres with a corrosion resistant al purpose wall that dispenses liquid soap lotions, detergents and antiseptic soaps.

1.6.9. ROBE HOOK

Provide Robe Hooks with concealed fastenings with maximum projection of 4", Provide one hook for every toilet compartment door, mounting at 5' above the finish floor, Robe Hooks are SS with satin finish.

1.6.10. GRAB BAR

Provide an 18 Gauge 1.25" grab bar of type 304 SS, Provide form and length for grab bars as indicate on drawings. Provide concealed mounting flange, provide grab bar with satin finish, furnish installed bars capable of

withstanding 2.225 KN vertical load without coming loose from the fastening and without obvious permanent deformation, allow 1.5" space between wall and grab bars.

1.6.11. ELECTRIC WATER HEATER

Electric Water Heater thermally efficient and having stainless steel tank of capacity 15 litres and 50 litres as shown on drawings shall be supplied and installed. Electric water heater shall be storage type. All heaters, after installation, shall be subjected to an operation test to determine the efficient working of the recovery side, thermostat, etc. to the satisfaction of the Engineer. The Engineer prior to supply and installation shall approve all heaters. The authorities having jurisdiction and any other governing regulationsshall approve all heaters.

1.6.12. INSTANT GAS WATER HEATER

The instant gas water geyser must be thermally efficient and user friendly. The capacity of Instant Gas Water Heater should be 12 litres per minute. Being the tank-less water geyser, it heats the water instantaneously. The outer casing of the geyser is made of mild steel sheet painted with anti- corrosive powder. The inner body is made of copper. Both the bodies are thermally insulated from each other. These heaters must have a safety system which automatically shuts off the instant water heater if the temperature goes beyond safety limits.

1.6.13. MOP SINK

MOP Sink to be installed where shown on the drawings, Terrazzo shall be of marble chips cast in white Portland cement to produce 25 MPA minimum compressive strength 7 days after casting, provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

1.6.14. FLOOR TRAP/DRAIN

Floor trap/drain shall be of UPVC or of other anti-corrosive material, compatible with the material of pipe. They shall have minimum water seal of 40 mm and shall be provided with removable metal/uPVC strainers. The traps shall be of self-clearing type. The open area of the strainer shall be greater than the cross section area of the drain line to which it connects. Floor traps shall be well set in position so that there is no leakage at the joint between trap and the floor.

1.6.15. ROOF DRAINS

Roof drains shall be of bitumen coated cast iron/ brass or UPVC or of other anti-corrosive material, compatible with the material of pipe. They shall have strainers extending at least 15 mm above the roof surface immediately adjacent to them, when installed on flat part. Bottom of strainer shall be flush with the roof surface, when installed on vertical part. Strainer shall have an available inlet area, above roof level, of not less than 1-1/2 times the area of the down-pipe to which the drain is connected.

The connection between roof and roof drain shall be made watertight by the use of proper flashing material.

1.6.16. CLEANOUTS

Cleanout shall be of the same nominal size as that of the pipe on which it is installed. Cast iron Cleanout shall consist of tapped heavy duty cast iron ferrule caulked into cast iron fitting and heavy duty brass tapered even plug. UPVC cleanout shill consist of either two 45° bends or one long radius bend both with an removable end cap and other necessary fittings/material for complete installation in floor Cleanouts shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of cleanout shall be flush with the floor by means of finished metal plate secured in position and screwed firmly to the plug. Cleanout shall be so installed that there is a clearance of at least 300 mm for pipes less than 75 mm diameter and at least 457 mm for pipes of 75 mm and larger diameter, for the purpose of roding.

Pipe used with cleanout shall be measured and paid under pipe item. All other work of ferrule, plug, concrete work, frame and cover etc. shall be measured and paid under cleanout item.

1.6.17. GULLY TRAP

Gully trap shall be of cast iron with specified size outlet. The inlet shall be provided with cast iron, medium duty grating. The open area of the grating shall be at least 1-1/2 times the area of the outlet. The trap shall be of P-Type with a minimum water seal of 50 mm.

1.6.18. CAST IRON GRATING

Cast iron grating shall be of the specified size. The specified size shall mean the clear span. Cast iron grating shall be complete with frame. They shall be of Light/medium duty type to resist normal traffic loads, the casting shall be sound and free from all defects. The frame shall be set in place at the time of pouring of concrete. Openings in grating shall be in approved pattern.

1.6.19. ELECTRIC WATER COOLER

Cabinet shall be of heavy gauge mild steel construction painted with non- corrosive paint from inside and with special hammer finish paint from outside.

Push button type water taps shall be chrome plated. Drain pot shall be made of hard plastic with stain-less steel tray. Back panel shall be easily remove-able for cleaning and servicing top cover shall be of scratch proof Formica.

Water storage tank shall be either of stainless steel or copper alloy, tinned inside and outside with present insulation to maintain water temperature, with special arrangement for cleaning the tank.

Condensing unit shall be heavy duty, -hermetically sealed with thermal overload protection for refrigerant F-12 and capillary expansion with valves for easy gas charging. Thermostat and other control necessary for proper functioning of the unit shall be provided. The thermostat shall control the temperature of cooled water between + 11°C & + 20°C.

1.6.20. WATER FILTERS

Water filters shall be installed on wall near the water coolers. They shall be of best quality local/foreign make. Each filter shall have a crystal housing of a durable material. The flow rate shall be 2 to 6 gpm with a maximum pressure of 70psi and a temperature of 35°F to 100°F.

Stage 1:- Stage 1 shall use a "poly propylene Yarn ln depth Sediment filter cartridge", for removal of dust, rust, silt, scale and unseen suspended particles. It shall have a filtration rating of 5-micron.

Seed building at UAF

Stage 2:- In this stage a "Granular Activated Carbon (GAC) cartridge" equipped with a post-filter of 1-micron is recommended, for removal of chemicals and unpleasant taste and odor.

Stage 3:- This stage must provide 30,000 MW.sec/sq.cm energy to guarantee '100% sterilization and ensure effective control of microbiological contamination.

1.7. EXECUTION

GENERAL

1.7.1. The SUB-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.

1.7.2. 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.

1.7.3. All metal fixture trimmings shall be thoroughly covered with non-corrosive grease which shall be maintained until all work is completed. Upon the completion of work, all fixtures and trimmings shall be thoroughly cleaned polished and left in first class condition. Before erection, all pipes, valves, fittings, etc. shall be thoroughly cleaned of oil, grease or other material.

1.7.4. All special tools for proper operation and maintenance of the equipment provided under this Contract shall be delivered at no additional cost. The SUB-Contractor shall allow in his bid for cost of all cutting, making holes and subsequent making it good to the desired finish as per approval of the Engineer. No separate payment shall be made for this item.

1.7.5. The SUB-Contractor shall allow in his bid for the cost of providing protective painting or coating as specified in the relevant sections and no claim shall be entertained for this item.

1.7.6. 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 bythe Engineer.

1.7.7. The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings. The Engineer reserves the right to change the location etc. Special precautions shall be taken for the installation of concealed pipes as shown on the drawings and/or as required. Should it be necessary to correct piping so installed, the SUB-Contractor shall be held liable for any injury caused to other works in the correction of piping. The SUB-Contractor shall closely coordinate with other works during the entire stage of execution.

1.7.8. A minimum distance between different services shall be maintained as shown on the Drawings and/or as approved by the Engineer.

1.7.9. 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.

1.7.10. 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.

1.7.11. When the roughing-in is completed, the plumbing system shall be subjected to test prior to concealing the roughing-in, in order to ascertain that all threads and connections are water tight. Cast iron soil and drainage fittings for change in direction shall be used as follows:-

a. *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.
b. *Horizontal to vertical: quarter bend or short turn.

1.7.12. All fittings with hubs shall be aligned so that the hub faces upstream. No drainage or vent piping shall be drilled.

1.7.13. 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.

1.7.14. Joints at the roof, around vent pipes, shall be made water-tight by the use ()Head, copper, galvanized iron, or other approved flashing or flashing material. Exterior wall openings shall be made watertight.

1.7.15. Each length of pipe & each pipe fitting, trap, fixture, & device used in a plumbing system shall have cast, stamped or indelibly marked on it the maker's mark or name, the weight, type & classes of the product, when such marking is required by the approved standard that applies. Where different sizes of pipes, or pipes

and fittings are to be connected, the proper size increasers or reducers or reduced fittings shall beused between the two sizes.

1.7.16. Any fitting or connection which has an enlargement, chamber, or recess with a ledge, shoulder, or reduction of pipe area that offers an obstruction to flow through the drain pipe is prohibited. The vertical distance from the fixture outlet to the trap weir shall not exceed 600 mm: Each fixture trap shall have a water seal of not less than 50 mm and not more than 100 mm.

1.7.17. Full S, bell, crown vented traps and traps/depending for their seal upon the action of movable parts are prohibited. No fixture shall be double trapped. Where fixture comes in contact with wall and floors, the joint shall be water-tight. Piping in ground shall be laid on a firm bed for its entire length.

1.7.18. 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 SUB-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.

1.7.19. The run and arrangement of all pipes shall be as shown on the Drawings and as directed during installation. All vertical pipes shall be erected plumb and shall be parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls. If required to change the location etc. during the currency of the work, the SUB-Contractor will do so at no additional cost. Screwed joints in G.I. pipes shall be made perfectly tight, without the use of any filler except approved jointing compound or tape. Wherever required to make flanged joints, they shall conform to BS 10 Table D.

1.7.20. Furnish and install all pipes passing through floors and walls with sleeves of G.I. sheet, 18 gauges, the inside dia. of which shall be at least 1/2" greater than the outside dia of the pipe passing through it. Sleeves in exterior walls and pits shall have anchor flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

1.7.21. All embedded water supply piping shall be wrapped with approved anti-corrosion polyethylene tape. All exposed piping shall be painted with two coats of enamel paint over a coat of red oxide:-

1.7.22. Insulation

All hot water supply and return piping shall be insulated as specified herein. Prior to insulation thepipes shall be hydraulically tested and cleaned.

Nominal Pipe Dia. (mm)	Thickness of per-form Fiber glass pipe insulation. (mm)
15 (1/2")	25
20 (3/4")	25
25 (1")	25
32 (1-1/4")	25
38 (1-1/4”)	
50 (2”)	

1.7.23. Insulation shall consist of pre-formed fiberglass pipe insulation, with factory applied reinforced aluminum vapor barrier, single layer in semi-circular halves, consisting of long, fine glass fibers, bonded with a temperature resistant binder, free from shot or coarse fibers, damage resistant, light in weight, easy to handle, cut and fit. The product shall comply with the requirements of B.S. 3958: Part 4. The insulation shall be rot proof, odorless, non-hygroscopic, and shall not sustain vermin. The fiberglass insulation shall be covered with a layer of approved polyethylene tape in the field. Further reinforcement shall be provided by the use of 20 mm wide soft aluminum bands, generally spaced at 457 mm and on either side of elbows and tees. All butt joints shall be se -d with

self-adhesive type of approved quality adhesive tape.

1.7.24. All trimmed sections shall be secured by wrapping of approved type of self-adhesive tape to form a complete waterproof seal. All work shall be done in a neat and workmanlike manner, and should reflect recommended practice.

All Hot water and Hot water return lines concealed in walls only, shall be provided with Glass wool blanket insulation.

1.7.25. Pipe work Supports

All supports, clips, steel rods and hangers shall be of mild steel painted with two coats of approved metallic zinc prime(All clips and brackets shall be equipped with 9 mm sectional rubber liners (shore-hardness A 40+5°).

Pipe work supports shall be installed in order to allow free movement due to expansions and contraction. Supports shall be arranged adjacent to joints, changes of direction and branches. Each support shall carry the overall weight of pipe work and water to be borne by it. The intervals between pipe supports shall not exceed the following:

Maximum interval between supports (metres)

Nominal Dia mm	Steel pipes	
	Horizontal.	Vertical
10	1.7	1.7
15	2.0	2.0
20	2.4	2.4
25	2.7	2.7
32	2.7	2.7
40	3.0	3.5
50	3.4	3.9
65	3.7	4.3
80	3.7	4.3

Dimensions of Support Materials

Nominal Dia mm	Flat iron bands mm	Support rods mm	U-bolts mm
10	25 x 3	6	6
15	25 x 3	6	6
20	25 x 3	6	6
25	25 x 3	6	6
32	40 x 5	10	10
40	40 x 5	10	10
50	40 x 5	10	10
65	50 x 6	12	12
80	50 x 6	12	12

1.7.26. Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle from shall be fitted to the underside of slab by two hangers and the pipes shall be supported from the channel iron by rod hangers and flat iron hands.

1.7.27. All hanger rods shall have double nuts and beveled washers to allow the hanger rod to swing. Multiple pipe runs along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

1.7.28. 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.

1.7.29. Pipes shall be individually supported. Pipes shall not hung from other pipes. Points at which pipes pass through Walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes. Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means-of support for the riser. Vibration isolators to be provided with the hangers as approved by the Engineer.

1.8. POLYPROPYLENE RANDOM PIPES & Jointing

1.8.1. Jointing Techniques

The surfaces of the pipes and fittings must be clean and without impurities. Pipe ends must be clean, cut at right angles. It is recommended to cut 1cm from the pipe ends in order to prevent possible micro-cracking due to incautious handling.

1.8.2. Before carrying out the welding, check that the poly-fusion device operates correctly and that it reaches the required welding temperature (260°C ± 5).Jointing is done by heat fusion (welding) by means of welding machine. Welding is carried out by means of heating simultaneously the male and female parts to be joined together, once the welding temperature is reached the joint is made and held for cooling time. (see table I below)

a. Welding Instructions using socket welding machine
b. Check whether the welding tool corresponds to the size you need to join.
c. The welding tool/device has reached the necessary operating temperature of 260°C ± 10
d. Cut the pipe at right angles to the pipe axis by using cutter or a hack saw.
e. Clean the pipe from burrs, cutting and chips
f. Mark the welding depths at the end or pipe
g. Push the end of pipe up to the marked welding, depths in the welding tool, at the same time push the fitting, into the welding tool.

1.8.3. After the stipulated heating time quickly remove pipe and fitting from the welding tools and join them immediately, forcing the pipe into the fitting until the marked welding depth is covered by the bead of Polypropylene from the fitting. The joint elements have to be fixed and aligned within the specified assembly time.

1.8.4. After the cooling time the fused joint is ready for use. The heating time starts when pipe and fitting have been pushed to the correct welding depth in the welding tool

Est. Diameter (mm)	Welding. Depth (mm)	Heating Time DVS 2207(sc.)	*	Heating Time (sc.)	Cooling Time (min.)
20	14.0	5	8	4	2
25	15.0	7	11	4-	2
32	16.5	8	12	6	4
40	18.0	12	18	6	4
50	20.0	18	27	6	4
63	24.0	24	36	8	6

The heating time have to be increased 50% if average temperature is under + 5°C

Welding of PPR Pipes

Cutting of pipe at right angle with a cutter

Marking of welding depth on the pipe end

Simultaneous heating of both pipe and fittings according to required heating time (as per given data).

Pushing of pipe end into the fitting and alignment of the assembly within specified time period

1.8.5. Finish joint / Installation Principles

Fastening technique for open installation

The selection of fastening material and its application have to be determined as:-

Fixed Point

Sliding

Point

Pipe clamps are such as to meet all requirements and- ensure that no mechanical damage on the pipe surface can occur.

1.8.6. Fixed Point

Valves and connections resisting to bending stresses have to be fastened by means of points. In particular cases the fixed points are to be positioned closed

to branches or wall passages. The axial expansion will be compensated between two points. The assess the resistance of the fixed points one has to take into account the stresses to which they will be subjected, caused by linear expansion, weight of the piping and weight of the transportation fluid. Fixed points should be delimited on both sides of the clamp, availing oneself of the rim fittings or valves.

1.8.7. Sliding Point

The sliding points must keep the system aligned and support it, and allow the axial sliding of the piping as well. The sliding are to be firmly mounted in order to prevent vibration and transmission of noise.

Distance between the support points in cm.

Pipe diameter	Temperature in °C		
	20	50	80
20mm	85	70	60
25mm	85	80	70
32mm	100	85	85
40mm	110	100	90
50mm	125	110	90
65mm	140	125	105

1.9. SOIL, WASTE, VENT & RAIN WATER DRAINAGE PIPES & PIPE FITTINGS (C.I. & uPVC)

1.9.1. 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 meter centres or a minimum of one hanger per each length of pipe whichever is smaller. Where excessive numbers of fittings are installed, additional clamps will be provided.

1.9.2. All steel clamps, hangers and support etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint. Materials for painting shall be high quality product. of well-known manufacturer and will be approved by the Engineer before using. The instructions of the manufacturer regarding all painting work shall strictly be adhered to Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. AU vent pipes to be installed in the system shall be provided with approved cowl and will rise at least 0.70 meter above the roof.

1.9.3. Special requirements for uPVC Dines and fittings are as under:

Maximum Interval between Supports (m)

(Support centers for uPVC pipe work systems)*

Nominal Diameter, d_e	PIPEWORKS Horizontal ($10xd_e$)	Vertical
(mm)	(m)	(m)
40	0.40	1.2
50	0.50	1.5
75	0.75	2.0
110	1.10	2.0

* The values shown are for general installations only. Attention is drawn to special requirements that may be needed in more demanding applications. All steel clamps, hangers, supports etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint.

1.9.4. *PRECAUTIONS*

Following points describe how an uPVC must be cared of:

The depth of concrete cover above uPVC pipe depends on the pipe gradient. However, a minimum of 1 (one) inch concrete cover must be provided.

When using cemented joints, the adhesive should be given sufficient opportunity to harden before the pipe is concreted in.

Horizontal lines that are concreted-in should be anchored against upward movement and should be adequately secured while the concrete is being poured.

During the pouring and setting of concrete, necessary care shall be taken to prevent physical damage to the pipes.

When using heated concrete or when steaming the concrete, the sensitivity of uPVC material to temperature changes should be borne in mind.

Concrete mortar that is used before .concreting7in shall include no sharp-edged material.

1. Avoid excessive misalignment of the pipes.
2. Avoid excessive tightness of joints.

Provide sufficient expansion joints to allow thermal movement or regression.

Use only allowed cleaning & descaling techniques for different situations & locations (as described in ISOTTR 7024-1985E) when a pipeline gets choked or blocked.

1.9.5. *DELIVERY CONDITIONS*

The internal and external surfaces of pipes and fittings shall be smooth and free from grooving, blistering and any other surface defect. The materials shall not contain visible impurities or pores. Pipe ends shall be cleanly cut, and the ends of pipes and fittings shall be square with the axis of the pipe

1.9.6. *MARKINGS*

Pipes, fittings and sealing rings shall be marked clearly. and indelibly so that legibility is maintained for the life of products under normal conditions of storage, weather and use.

The markings may be integral with the product or on a label. The markings shall not damage the product.

1.9.7. *PIPES*

Pipes shall be marked with at least the following information:

Manufacturer's name or trade mark;

Pipe material;

Nominal diameter of pipe;

Nominal wall thickness of

pipe

Manufacturing information, in plain text or in code, providing tractability of the production period to within the year and month and the production site if the manufacturer is producing at several national or international sites.

The number of this International Standard.

Fittings

Fittings shall be marked with at least the following information:

Manufacturer's name or trade mark;

Fitting material (may be given on packing only in the case of PVC, provided this information is not required on each article by national authorities);

Nominal diameter of fitting;

Classification (where applicable).

Values of angles, if any;

Manufacturing information, in plain text or in code, providing tractability of the production period to within the year and month and the production site if the manufacturer is producing at several national or international sites (May be given on packing only, provided this information is not required on each article by national authorities);

The number of this International Standard (may be given on packing only,

provided this information is not required on each article by national authorities).

Sealing Rings

Sealing rings shall be marked with at least the following information:

Manufacturer's name or trade mark;

Nominal diameter of ring;

Manufacturing information, in plain text or in code, providing traceability of the production period to within the year and month and the production site if the manufacturer is producing at several national or international sites.

1.10. TESTING AND COMMISSIONING

1.10.1. GI& PPR WATER PIPES

All water distribution system shall be tested whole or in part to 2 times the working pressure with a minimum test pressure of 90psi. The SUB-Contractor shall pay for all device, materials, supplies, labor and power required for the test. The test will be run for two hours at the specified pressure and there should be no leakage in the system. Defects revealed by the test shall be repaired and the whole test rerun until the system proves to be satisfactory.

1.10.2. After all the pipes and fixtures have been properly laid and tested, they shall be flushed with clean water and then disinfected with water solution of chlorine of at least 50 ppm strength for a contact period of 6 hours. The system will be finally flushed with clean water.

1.11. SOIL, WASTE, VENT & RAIN WATER DRAINAGE PIPES & PIPE FITTINGS (C. I. &uPVC)

1.11.1. The entire system of drains, waste, and vent piping inside the building shall be tested by this SUB-Contractor under a water test. Every portion of the system shall be tested to a hydrostatic pressure-equivalent to at least 3-meter head of water. After filling this SUB-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.

1.11.2. The SUB-Contractor shall furnish and pay for all devices, materials, supplies, labor and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

1.11.3. The SUB-Contractor shall also be responsible for the repair of this work & other trades work that may be damaged or disturbed by the tests. Defects disclosed by the tests repaired. Work shall be replaced with new work without extra cost to the Employer. Tests shall be repeated as directed, until all work is proven satisfactory. All fixtures shall be tested for soundness, stability, support and satisfactory operation.

2. FIRE PROTECTION

2.1. SCOPE

The work to be done under this section of the Specifications includes furnishing all plant, labor, equipment, appliances and .materials and in performing all operations required in connection with the supply and installation of galvanized steel pipes and fittings for firefighting system, portable fire extinguishers, fire hose rack cabinets and landing valves as shown on the Drawings, as specified herein and/or as directed by the Engineer.

2.2. APPLICABLE STANDARDS

MS Pipe (Schedule 40)	ASTM A106 Grade B
Portable Fire Extinguishers	BS- 5423
HDPE Pipe	PN-16/SDR-11 DIN 8074/8075

Portable fire extinguishers shall conform to NFPA (National Fire Protection Association) of USA or F.O.C. (Fire Offices Committee) of U.K. and B.S. 5423.

2.3. SUBMITTALS

The SUB-Contractor shall submit technical brochures and samples of all the items mentioned in the Specifications from approved manufactures or as directed by the Engineer.

2.4. MATERIAL

2.4.1. Pipes

(A) MS Pipes (Seamless)

The MS Pipes shall conform to ASTM A160 Grade B schedule 40. Every tube shall be tested at manufacturer's works to specified hydraulic test pressure 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.

A tube shall be effectively covered with good quality grease or other suitable compound, and each tube above 50mm nominal bore shall have a protecting ring affixed to the un-socketed screwed end.

(B) PE Pipes (HDPE)

The PE pipes shall the conforming to DIN 8074 specification. Sizes will be 110 & 160mm – PN16.

2.4.2. PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers shall contain specified quantities and types of extinguishing agents. Extinguishers shall be classified according- to type of extinguishing agents and the Class of fire types for which it is intended to be used. The extinguisher container/vessel shall be of anticorrosive material or otherwise lined internally with corrosion-resistant material. The outside surfaces

of the container/vessel shall be painted with at least two coats of anti-corrosive paint.

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.

a. 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.

When operated the discharge time for 10 lbs. carbon dioxide extinguisher shall not be less than 9 seconds.

b. 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. When operated the discharge time of 10 lbs. dry powder extinguisher shall not be less than 9 seconds.

c. Water Extinguisher

Water extinguisher shall contain specific quantity of water. The extinguisher shall have a knob or a lever operated valve, a short length of hose and a nozzle at the end. The valve shall have a 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. When operated the throw for 2 gallons water extinguisher shall not be less than 6 metres. The discharge time shall not be less than 10 seconds.

2.4.3. FIRE HOSE CABINET

Fire Hose Cabinet shall consist of rubber hose of specified diameter and length as shown on the applicable drawings. The hose shall have polished brass valved nozzle at one end. The reel shall turn full 180 degrees. Hose and reel shall be placed in a steel or concrete fire box with glazed steel door. The door shall open

full 180 degrees and shall be provided with locking arrangement. The locking arrangement will be such that the cabinet can be opened either by breaking the front glass and turning, the handle from inside or with key from outside without breaking the .front glass. The exposed front face of fire hose cabinet shall be painted with signal red enamel paint over a prime coat of anti-corrosive paint. Instructions for opening of fire hose cabinets and operation of hose reel shall be inscribed in signal red on the inside face of the glass such that the instructions can be read from outside.

The hose shall be rated for a working pressure of 16 kg/cm2 and test pressure of 25 kg/cm2.

2.5. DELIVERY & STORAGE

Portable fire extinguishers shall be delivered and stored as per manufacturer's directions or as directed by the Engineer while observing all necessary precautions.

2.6. EXECUTION

2.6.1. PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers shall be installed at one 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.

Portable Fire extinguishers shall be painted with color code according to British Standard specifications. On the body of the extinguishers shall be marked/imprinted the following information:

a. Instructions on how to use the extinguisher.
b. Name of the extinguishing agent.
c. Weight/volume .of the extinguishing agent.
d. Gross weight of the extinguisher.
e. Filling pressure of the extinguishing agent.
f. Classes of fires for which the extinguishing agents may be effectively used.
g. Name of the manufacturer and the year of manufacture
h. Validity/ expiry date

2.6.2. Fire Hose cabinet

Fire Hose Cabinet shall be installed at one meter height above finished floor level. The fire hose shall be connected to fire/or potable water system as the case may be, through a Hydrant valve. The valve shall be rated for a working pressure of 16 kg/cm2.

If the pressure at the valve exceeds 6 kg/cm2 then an orifice plate shall be installed between the gate valve and the fire hose so that the water pressure in the hose shall not exceed 6 kg/crn2 under any condition.

2.7. TESTING & COMMISSIONING

The fire water line shall be tested at 1.5 times the working pressure but at a pressure not less than (20 to 150PSI).

3. PUMPING MACHINERY

3.1. SCOPE

The work to be done under this section of the specifications includes furnishing all plant, labor, equipment, appliances and materials and performing all operations required in connection with the installation of pumping machinery including all accessories as specified herein or shown on the Drawings or as directed by the Engineer.

3.2. 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, material and equipment will be of the same manufacturers. In all other cases the SUB-Contractor shall submit the names and addresses of the Manufacturers and trade names of the materials and equipment that he intends to buy. Other information such as diagram, drawing and descriptive data will be supplied if so desired by the Engineer. Approval of materials and all the machinery under this provision shall not be construed as authorizing any deviations from the specifications. The approval of machinery of manufacturer other than specified will be purely on the discretion of the Engineer. The Engineer will fully ascertain the facts and satisfy himself as to the performance of the machinery offered by the SUB-Contractor.

3.3. SPECIAL REQUIREMENTS OF PUMPS

The SUB-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.

The pumps shall stable throttling curves and be suitable for unrestricted parallel operation.

The pumps and their drives shall not overload or trip when operating against zero pressure. The design, construction and materials shall be such that damage as a result of cavitation is completely eliminated.

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. Pumps shall be tested at site before their final acceptance.

Pumps shall be installed at positions shown on the Drawings and/or as directed by the Engineer.

Pumps and their drives shall be in perfect alignment when installed in position.

3.4. PUMP AND MOTOR

3.4.1. POTABLE WATER PUMP & MOTOR

3.4.1.1. Specifications

The pump sets will consist of close coupled, horizontal, centrifugal pumps of specified capacity and head and duty and shall be horizontally mounted totally enclosed, fan cooled, squirrel cage induction motors of specified power

Pump material shall be as under:

Body : Fine grained grey cast iron

Impeller : Bronze

Shaft : Bronze or stainless steel

Pumps shall nave mechanical seal. The suction and discharge flanges shall be rated for a working pressure of 10 kg/cm2 for potable water pumps. The flanges shall be drilled to BS 19 (Table 'D' or 'E') or BS 4504.

Motors shall run on 3-phase, 400 volts ÷ 10%, 50 c/s NC power motors shall be protected from low voltage, overload, overheating and phase failure.

3.4.1.2. Installation

Potable water pumps and motors shall be installed on concrete foundation with anchor bolts.

3.4.1.3. Operation

For potable water pumps, one pump shall be duty and one shall be standby. Duty shall however change between the pumps on each start/stop/cycle of the pump.

Operation of potable water pumps shall be controlled by water level indicators provided on the roof tank of the building.

Duty pumps shall automatically start, when the water levelreaches the low water level (L.W.L).

Duty pumps shall automatically stop when the water level reaches high water level (H.W.L).

Duty pumps shall automatically stop when the water level in the underground tank reaches the low water level (L.W.L).

In case the duty pumps fail to start, the stand by pump shall start automatically. In case the stand by pump also fails to start, the emergency alarm will be automatically sounded.

3.4.2. FIRE WATER PUMP & MOTOR

The pump sets will consist of close coupled, horizontal, centrifugal pumps of specified capacity and head and duty and shall be horizontally mounted, totally enclosed, fan cooled, squirrel cage induction motors of specified power. Pump materials shall be as under:

Body	:	Fine grained grey cost iron
Impeller	:	Bronze
Shaft	:	Stainless steel
Shaft Sleeve	:	Bronze or stainless steel

Pumps shall have mechanical seal. The suction and discharge flanges shall be rated for a working pressure of 16kg/cm2 for fire pumps. The flanges shall be drilled to BS 10 (Table 'D' or 'E') or BS 4504.

Motors shall run on 3-phase, 400 volts + 10% 50 c/s A/C power motors shall be protected from low voltage, overload, and overheating and phase failure.

3.4.2.1. Installation

Fire water pumps and motors shall be installed on skid land connects will be concrete foundation with anchor bolts.

The motor control panel shall be located in the pump house in a painted steel cabinet with locking arrangement. The panel shall be wired to each pump by water proof power cable.

3.4.2.2. Operation

For main fire water-pumps, one pump shall be duty and one shall be standby. Duty shall however change between the pumps on each start/stop/cycle of the pump.

There shall also be a jockey pump installed in the system which shall start automatically before main fire water pumps, to account for any accidental use of FMC or leakage in the system. This jockey pump shall have the capacity to turn off automatically when accidental fault is over and the desired pressure is achieved. Main pumps shall operate automatically only at indicated pressures when demands are more to fight a fire in reality. However, main pumps shall stop manually when the fire is over.

3.4.3. Submersible Drainage Pump with electric motor

Pump shall be submersible centrifugal type with horizontal or vertical discharge port designed for free standing installation or installation by means of an auto-coupling guide rail system or for pit installation. The pump housing shall be stainless or cast iron steel. The stainless steel pump sleeve shall be in one piece

and equipped with an insulated carrying handle. The suction strainer shall be clipped on to the pump housing so that it could easily be removed for maintenance. The stainless steel pump housingshall be fitted with an internal riser pipe ensuring that has a number of holes which enable efficient cooling of the motor during operation. The cable entry shall be of the socket and plug connection type.

The shaft shall be stainless steel which shall rotate in maintenance-free heavy duty pre-lubricated ball bearings. The impeller shall be of stainless steel. The impeller shall be semi-open type with L-shaped blades. The blades shall be curved backwards. The unit shall be equipped with at least 10m standard water-proof power cable. The operation of the pumps shall be controlled automatically by means of level switches. Pump shall be vertical, single entry, single or multi stage.

Pumps capacity and head shall be as specified in schedule of pumps. Pumps

shall be installed as shown on drawings.

Pumps shall be supplied and installed complete with Electric motor, starter, control panel, level switches, etc.

3.5. ACCESSORIES

3.5.1. PRESSURE GAUGE

Pressure gauge shall be of copper alloy, bourdon tube type with 100 mm diameter dial face. The dial shall be engraved in black on white background from zero to 6 bars or 1.5 times the working pressure whichever is larger. Gauge shall be installed socket welded to the pipeline with the isolating plug/ball valve. Gauge shall be installed no higher than 1.8 M above the finished floor. If the

pipeline installation is such that the above requirement cannot be met pressure gauge of remote reading type shall be installed.

3.5.2. Y-STRAINERS

Strainers shall be 'Y' types with bronze body and threaded ends upto 75mm diameter Screen shall be of 20 mesh monel. Strainers above 75 mm shall have Cast Iron body with flanged ends. Screen Cover shall be provided with blow off tapping. Screen shall be of perforated stainless steel, 36 holes per Sq.Cm., with

1.14 mm diameter and 0.5 mm thick. All strainers for water supply application shall be suitable for 10.5kg/Cm2 and 120 degree C. All strainers for fire protection service shall be suitable for 21 Kg/Cm2 and 120 degree C.

3.5.3. FOOT VALVE FOR PUMPS

Shall be installed on the suction Line of the pumps where required or indicated on the drawing: Foot valve shall be of brass, and shall be provided with integral

strainer. Foot valve shall be provided with a spring loaded vertical check disc with gasket fortight shut-off.

3.6. 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 +2HZ.

3.7. MOTOR CONTROL PANEL

Refer to relevant electrical specifications and drawings

3.8. MAINTENANCE MANUALS AND TOOLS

3.8.1. A book or books containing the complete information in connection with the assembly operation, lubrication, adjustment and repair of the pumping equipment, electric motor, together with the detailed part with the drawings or photographs shall be furnished in duplicate.

3.8.2. For the pumping station, special tools necessary for maintenance and repair of the pumps and electric motors including tools kits, grease guns etc. with accessories shall be furnished.

3.8.3. The equipment to be supplied for the pumping station shall be provided with spare parts necessary to the operational and maintenance for 1 year.

3.8.4. The manufacturer's recommended list of spare parts to be stocked by the Authority shall be submitted by the SUB-Contractor to the Engineer for approval. Such spare parts will also be furnished by the SUB-Contractor.

3.8.5. AU the maintenance manuals, tools, spare parts etc., shall be supplied by the SUB-Contractor at no cost of the Authority and all cost shall be deemedto be included by the SUB-Contractor in his bid against item of pumping set.

END OF THE SECTION

Summary of Cost

Construction of ISTA Seed Lab under the project "Quality Seed Production and Supply to the Farming Community for Ensuring Food Security in Pakistan" at University of Agriculture, Faisalabad

Sr. No.	Description	Amount (Rs.)
A)	**Civil Work**	
i)	Standardized Items	
ii)	Non Standardized Items	
B)	**Water Supply & Sewerage**	
i)	Standardized Items	
ii)	Non Standardized Items	
C)	**Electrification**	
i)	Standardized Items	
ii)	Non Standardized Items	
	TOTAL	
	Add 5% Punjab Sales Tax (PRA)	
	GRAND TOTAL	

Amount in words:-

Seed building at UAF

UNIVERSITY OF AGRICULTURE, FAISALABAD SEED BUILDING (SCHEDULE ITEMS)					
Sr.#	**Description**	**Quantity**	**Unit**	**Rate (Rs.)**	**Amount (Rs.)**
	Building Civil Works				
1	Excavation in foundation of building, bridges and other structure, including dagbelling, dressing, refilling, around the structure with excavated earth, watering and ramming lead up to one chain (30m) and lift up to 5 ft (1.5m).In ordinary soil. **MRS FSD 2023 (Chapter 3, Item 21 (b), P.30)**	17,968.94	1000 Cft		
2	Spraying termite proofing by using liquid FMC/ Biflex/ Terminex Exin/ Ms Hextar or equivalent @ specified suspension concenterate (SC), Mixing Ability-HEXTAR with Ratio (1:250) = 540 Sft or equivalent approved liquid applying with shower and certificate will be provided by the contractor for 10-years complete in all respect .as approved by the Engineer Incharge (**MRS FSD 2023 (Chapter 26, Item 43, P.214)**	17,717.02	P.Sft		
3	Cement concrete brick or stone ballast 1½ " to 2" (40 mm to 50 mm) gauge, in foundation and plinth:- (1:4:8) **MRS FSD 2023 (Chapter 6, Item 3 (b), P.41)**	5,011.71	% Cft		
4	Filling watering and ramming earth under floor. i) With surplus earth from foundation. **MRS FSD 2023 (Chapter 3, Item 15, P.29)**	7,884.94	1000 Cft		
5	Filling watering and ramming earth under floor. ii) With new earth excavated from out side lead upto one chain (30m)	1,000.00	1000 Cft		

Seed building at UAF

	MRS FSD2023 (Chapter 3, Item 15, P.29)				
6	Pacca brick work in foundation and plinth in cement sand mortar 1:5 **MRS FSD 2023 (Chapter 7, Item 4, P.52)**	1,482.03	% Cft		
7	Pacca brick work 1:5 c/s mortar in super structure (Ground Floor) **MRS FSD2023 (Chapter 7, Item 5, P.53)**	15,665.06	% Cft		
8	i) ---do--- in 1st Floor. **MRS FSD2023 (Chapter 7, Item 6, P.53)**	7,628.16	% Cft		
9	ii) ---do--- in 2nd Floor. **MRS FSD 2023 (Chapter 7, Item 6, P.53)**	408.75	% Cft		
10	Perforated pacca brick walling one brick thick, in ground Floor (1:3) **MRS FSD 2023 (Chapter 7, Item 18, P.55)**	4,466.77	% Sft		
11	i) ---do--- in 1st Floor. **MRS FSD 2023 (Chapter 7, Item 19, P.55)**	1,635.26	% Sft		
12	Providing and laying reinforced cement concrete (including prestressed concrete) using Ordinary portland Cement/ Sulphate resisting Cement / Slag Cement As may be, Required using coarse sand and screened graded and washed aggregate, in required shape and design, including forms, moulds, shuttering, lifting, compacting, curing, rendering and finishing exposed surface, complete but excluding the cost of steel reinforcement, its fabrication and placing in position, etc.):- (a)(ii) Reinforced cement concrete in slab of rafts / strip foundation, base slab of column and retaining walls; etc and other structural members other than those mentioned in 6(a) (i) above not requiring form work (i.e. horizontal shuttering) complete in all respects:-- Type C (nominal mix 1: 2: 4) **MRS FSD 2023 (Chapter 6, Item 6, P.42)**	5,565.56	P.Cft		

A	Providing and laying reinforced cement concrete (including prestressed concrete), using Ordinary portland Cement/ Sulphate resisting Cement / Slag Cement As may be Required coarse sand and screened graded and washed aggregate, in required shape and design, including forms, moulds, shuttering, lifting, compacting, curing, rendering and finishing exposed surface, complete but excluding the cost of steel reinforcement, its fabrication and placing in position, etc.):- (a)(i) Reinforced cement concrete in slab of rafts / strip foundation, base slab of column and retaining walls; etc and other structural members complete in all respects:- - Type B (nominal mix 1: 1.5: 3) **MRS FSD 2023 (Chapter 6, Item 6, P.42)**	3,216.00	P.Cft		
A	Providing and laying reinforced cement concrete (including prestressed concrete), using Ordinary portland Cement/ Sulphate resisting Cement / Slag Cement As may be Required coarse coarse sand and screened graded and washed aggregate, in required shape and design, including forms, moulds, shuttering, lifting, compacting, curing, rendering and finishing exposed surface, complete (but excluding the cost of steel reinforcement, its fabrication and placing in position, etc.):- (a) (i) Reinforced cement concrete in roof slab, beams, columns lintels, girders and other structural members laid in situ or precast laid in position, or prestressed members cast in situ, complete in all respects:- (3) Type B (nominal mix 1: 1.5: 3) **MRS FSD 2023 (Chapter 6, Item 6, P.42)**	18,921.11	P.Cft		
A	---do--- in 1st Floor. (Extra Labor) **MRS FSD 2023 (Chapter 6, Item 6 (d), P.42)**	8,185.77	P.Cft		
A	---do--- in 2nd Floor. (Extra Labor) **MRS FSD 2023(Chapter 6, Item 6 (d), P.42)**	2,097.20	P.Cft		

Seed building at UAF

13	Fabrication of mild steel reinforcement for cement concrete, including cutting, bending, laying in position, making joints and fastenings, including cost of binding wire and labor charges for binding of steel reinforcement (also includes removal of rust from bars):- (c) Deformed bars (Grade-60) **MRS FSD 2023 (Chapter 6, Item 12, P.45)**	68,425.35	% Kg		
14	Supplying and filling of sand under floors or plugging in wells. **MRS FSD 2023 (Chapter 7, Item 30, P.57)**	19,661.78	% Cft		
15	Providing, laying, watering and ramming brick ballast 1½" to 2"(40 mm to 50 mm) gauge mixed with 25% sand, for floor foundation, complete in all respects. **MRS FSD 2023 (Chapter 10, Item 3, P.68)**	2,671.98	% Cft		
16	Cement concrete plain i/c placing compacting finishing and curing complete (i/c screening and washing of stone aggregate) (f) Ratio 1:2:4. **MRS FSD 2023 (Chapter 6, Item 5, P.41)**	3,136.37	% Cft		
17	Cement plaster 3/8" (10 mm) thick under soffit of R.C.C. roof slabs only, upto 20' height. (b) Ratio 1:3 **MRS FSD 2023 (Chapter 11, Item 10, P.76)**	200.00	% Sft		
18	Cement sand plaster ratio (1:4) 3/4" thick on wall upto 20' height. **MRS FSD 2023 (Chapter 11, Item 9c, P.76)**	46,130.35	% Sft		
19	Providing and laying 4-1/2" thick fair face Special brick Cladding (9"x4-1/2"x3") laid in (1:3) cement / red posso mortar having 1/4" thick groovefinish i/c thecost of 8 SWG wirein shape of 8 placed horizontally and vertically at 36" and 18" c/c respectively i/c cutting charges as per approved drawing, complete in all respect as approved and directed by the Engineer Incharge **(MRS FSD 2023 (Chapter 7, Item 39, P.57**)	20,953.00	Per Sft		

20	Providing and laying Conglomerate flooring (two coat work) with top layer of ½"(13mm) thick wearing surface, one part of cement and 2 parts of stone chips passing 3/16"(6 mm) sieve, over bottom layer of cement concrete 1:3:6, including surface finishing and dividing in panels:- (2" thick) **MRS FSD 2023 (Chapter 10, Item 16, P.69)**	1,005.00	% Sft		
21	Providing and laying superb quality Ceramic tile floors of Master brand of specified size,Glossy/Matt/Texture of approved Color and Shade as per approved design with adhesive bond, over 3/4" thick (1;2) cement sand plaster i/c the cost of sealer for finishing the joints i/c cutting grinding complete in all respects and as approved and directed by the Engineer Incharge) 12"x18"/12"x24"/10"x24" /8"x24"/12"x36" (**MRS FSD 2023 (Chapter 10, Item 24, P.70)**	3,601.50	Per Sft		
22	Providing and laying superb quality Porcelain glazed tiles flooring of MASTER brand of specified size in approved design,Color and Shade with adhesive/bond over 3/4"thick (1:3) cement plaster i/c the cost of sealer for finishing the joints i/c cutting grinding complete in all respect as approved and directed by the Engineer Incharge(ii) 600mmx 600 mm. **(Full Body Glazed Tile)** **(MRS FSD 2023 (Chapter 10, Item 42, P.73)**	19,480.22	Per Sft		
23	Providing and laying superb quality Porcelain glazed tiles of Master brand, skirting/dado of specified size, Color and Shade with adhesive/ bond over 1/2"thick (1:2) cement plaster i/c the cost of and sealer for finishing the joints, cutting grinding complete in all respect as approved and directed by the Engineer Incharge **(ii) 600mmx 600 mm.** **(MRS FSD 2023 (Chapter 10, Item 43, P.73)**	1,178.55	Per Sft		

24	Providing and laying 3/4" thick full width Prepolished Marble slab for Vanities / Shelves / Treads/Window Cills , having Uniform texture (Spotless) with adhesive bond over 3/4" thick (1:2) cement sand mortor i/c the cost of matching sealer complete in all respects as approved and directed by the Engineer Incharge.) **(MRS FSD 2023 (Chapter 10, Item 47, P.74)**				
	China Verona	4,819.27	Per Sft		
25	Extra cost for making hole in Marble slab for fixtures, Sink,burners, basin Vanities i/c cost of bevelling of internal edge as approved and directed by the Engineer Incharge **(MRS FSD 2023 (Chapter 10, Item 49, P.74)**	45.00	Each		
26	Providing and fixing 2" wide MS/ GI Chowkat singel/double rebate made of 16 SWG MS sheet pressed/welded / supported with M.S. flat 1- 1/4"x1/8" i/c 6"long M.S. Flat 1"x1/8"hold fasts (6-Nos) welded/ screwed, punching of lock hole covered with MS Box,coating with antirust paint including filling with cement sand mortar (1:8) and embedding hold fast in cement concrete (1:2:4) ,complete in all respect as approved and directed by Engineer Incharge **(MRS FSD 2023 (Chapter 12, Item 17, P.84)**				
	(ii) 10.50 " wide	749.00	P.Sft		
	iii) 5.5 " wide	721.00	P.Sft		
27	Providing and laying 24 SWG aluminum kick plate 4" high, fixed with screws 4" (100 mm) centre to centre, on bottom rail of flush doors only of commercial ply **(MRS FSD 2023 (Chapter 12, Item 53, P.88)**	200.00	Per Rft.		

28	Providing and fixing auotomatic hydraulic operated door closer imported heavy duty complete in all respect as approved and directed by the Engineer Incharge. **(MRS FSD 2023 (Chapter 12, Item 67, P.91)**	20.00	Each		
29	P/F Iron door comprising of specified leaves made of 1-1/4”x1-1/4”x3/16" MS angle iron for leaf frame, diagonal and horizontal braces duly welded with MS. sheet 18-SWG i/c the cost of sliding bolt, tower bolt and painting 3-coats but excluding the cost of Chowkat complete in all respect as approved and directed by the Engineer incharge **MRS FSD 2023 (Chapter 25, Item 62, P.210)**				
I	Single Leaf	49.00	P.Sft		
II	Double Leaf	35.00	P.Sft		
30	Providing and laying roof insulation, comprising of single layer of tiles 9"x4½"x1½" (225x113x40 mm) grouted with cement sand mortar 1:3 laid over 2" (50 mm) thick earth (including mud plaster) over thermopore sheet, over polythene sheet 300 gauge over a layer of bitumen, complete in all respects: (**MRS FSD 2023 (Chapter 9, Item 35, P.64)**				
	iii) Thermopore sheet 1" (25 mm) thick	10,475.91	% Sft		
31	Khuras on roof 2'x2'x6" (600 x 600 x 150 mm) **MRS FSD 2023 (Chapter 9, Item 15, P.63)**	10.00	Each		
32	Providing and fixing ornamental wooden architrave 3"x(1-1/2" tapered to 1/4") all along the door frame complete in all respect. (b) Deodar wood architrave. **MRS FSD 2023 (Chapter 12, Item 58, P.89)**	517.50	P.Sft		

33	Providing and fixing 24" Deep Box type Wardrobe consisting of 3/4" thick UV coated MDF board(Medium density Fiber board) Sheet both side glazed shutters and box comprising of 3/4" thick laminated MDF sheet i/c thecost of 1mm thick PVC tapeduly hot pressed on all edgesof theshutters/ panels/ drawersetc., withmachinei/c thecost of self closing box type hinges, handles, screws, Glue and rawal plugs, Drawers & locking arrangement complete in all respect as approved and directed by Engineer Incharge **MRS FSD 2023 (Chapter 12, Item 63, P.90)**	100.00	P.sft		
34	Providing and fixing 1st class solid wood wrought joinery in panelled or panelled and glazed doors and windows of specified thickness with 1" thick solid wood panels with step and 1-1/2"x2-1/2" beadings all around the panels i/c the cost of Tower bolt and handles complete in all respect (Excluding the cost of sliding bolt,lock and chowkats (frame), etc.) as approved and directed by the Engineer Incharge **MRS FSD 2023 (Chapter 12, Item 7, P.81)**				
	a) Deodar wood Door				
	(i) 2" thick (50 mm)	1,365.00	P.Sft		
35	Providing and fixing Imported Mortise Lever Handle Lock with backplate (Machine,Cylinders,Lever Handles (Pair) and backplate(Pair))of approved quality,design & finish ,including the cost of all accessories to complete the job as show non drawing and as per specification ,complete in all respect, as approved and directed by the Engineer Incharge. **MRS FSD 2023 (Chapter 12, Item 69, P.91)**	80.00	Each		

Seed building at UAF

36	Providing and fixing all types of partly fixed and partly openable glazed anodised Powder Coated aluminium doors, using delux section (2mm thick) of M/s Al-Cop or Pakistan Cables, having chowkat frame of size 40 x 100 mm (1½" x 4") and leaf frame of 60x40mm (2½"x1½") wide sections including the cost of ¼" (5 mm) thick imported tinted glass with aluminium triangular gola and rubber gasket to support the glass and leaf edging, using approved standard fittings, locks, 3" (75 mm) wide long handles etc., and hardware any required as approved by the Engineer Incharge. **MRS FSD 2023 (Chapter 25, Item 51, P.208)**	37.50	P.Sft		
37	Providing and fitting all types of glazed aluminium windows of anodised/ powder coated partly fixedand partly sliding using delux sections of approved manufacturer section thickness is 1.2 mm. having frame size of 100 x 30 mm (4"x1-1/4") and leaf frame sections of 50 x 20 mm (2"x¾"), all of 1.6mm Thickness including 5mm imported tinted Glass with rubber gasket using approved standerd latches,hardware etc., as approved by the Engineer in-charg**e (MRS FSD 2023 (Chapter 25, Item 52, P.208)**	1,575.00	P.Sft		
38	Providing and fixing aluminium glazed partition of anodized / powder coated using section of M/s. Al-Cop/ Pakistan Cable having 2 mm thick Frame size D48-A , i/c 12 mm tinted TEMPERED glass with sand blasting and edge polishing i/c the cost of tear resistance film,rubber gasket and hardware etc. complete in all respect as approved and directed by the Engineer Incharge.(Floor hinge will be paid sapratly) **.(MRS FSD 2023 (Chapter 25, Item 57, P.209)**	70.00	P.Sft		

39	Providing and fixing false ceiling comprises of Gypsum board laminated sheet of size 2'x2'/2'x3'/ 3'x3'of specified design and thickness i/c cost of fixtures i.e galvanized angle 1" x 1" at wall sides, galvanized tee 1¼" x 1"and 1 ½" x 1" both at 4' c/c (made of Taiwan CKM or equivalent), hanging with G.I/Copper wire 16 SWG, G.I hook, Rawal Plug etc: complete in all respects as approved and directed by the Engineer Incharge **(MRS FSD 2023 (Chapter 9 Item 48, P.66)**				
	iv) 12 mm thick	17430.22	P.Sft		
40	P/L false ceiling comprising of 5/8" thick plaster of paris sheet of required size in approved design with one line of 6" wide niche all around , hanging with Copper wire (16 SWG) duly enriched with POPand flaxen i/c thecost of making space for rope light /screws/jute/making holes for lights and rawal plugs complete in all respects as approved and directed by the Incharge.(Measurement will be made as per carpet Area) **(MRS FSD 2023 (Chapter 9 Item 49, P.67)**	200.00	P.Sft		
41	Preparing surface and painting with emulsion paint **MRS FSD 2023 (Chapter 13, Item 31, P.96)**				
a	1st Coat	44,617.10	% Sft		
b)	2nd and Each subsequent Coat	44,617.10	% Sft		
42	Providing and applying weather shield paint of approved quality on external surface of building including preparation of surface, application of primer complete in all respect:- a) new surface: (**MRS FSD 2023 (Chapter 13, Item 33, P.97)**				
	1st Coat	1,375.00	% Sft		
	2nd Coat	1,375.00	% Sft		

43	Providing and laying Tuff pavers ,having 7000PSI ,crushing strength of approved manufacturer ,over 2" to 3" sand cushion i/c grouting with sand in joints i/c finishing to require slope . complete in all respect (50% Grey / 50% Coloured) **.MRS FSD 2023 (Chapter 10, Item 41, P.72)**				
b)	60mm Thick	250	Per Sft		
				TOTAL AMOUNT (Rs.) =	

Seed building at UAF

UNIVERSITY OF AGRICULTURE, FAISALABAD SEED BUILDING (NON-SCHEDULE ITEMS)					
NOTE: For Rate Analysis of NS Items; Input Material & Labor Rates of Faisalabad (2022-23) have been used.					
Sr.#	**Description**	**Quantity**	**Unit**	**Rate (Rs.)**	**Amount (Rs.)**
	Building Civil Works				
1	Clearing and grubbing of building area, dressing, compaction upto required modified AASHTO dry density and removal of trees, shrubs, roots etc. Including dismantling of existing one-storey structure old store room near the proposed building at the site. Including stacking or disposing off the surplus material out side the Project limit as per instructions of the Engineer Incharge. This includes all related civil works to be involved in demolishing.	1.00	Job		
2	Providing and fixing 2" diameter S.S pipe hand rail fixed to wall, complete in all respects as per specifications, as shown on drawings and as directed by the Engineer.	100.00	P.Rft		
3	Providing and fixing of 2" dia S.S stair railing with 1-1/2" dia S.S. vertical posts including SS brackets and bolts, including all fixing arrangements complete in all respects as per specifications, as details shown on drawings and as directed by the Engineer.	275.00	P.Rft		
4	Frosting of the glass of windows in bathrooms with sandblasting and making it completely obscure, with approved pattern and design, complete in all respects as per directions of the Engineer Incharge.	120.00	P.Sft		
				TOTAL AMOUNT (Rs.) =	

Seed building at UAF

UNIVERSITY OF AGRICULTURE, FAISALABAD					
Seed Building					
(SCHEDULE ITEMS)					
Sr.#	**Description**	**Unit**	**Total Quantity**	**Rate (Rs.)**	**Amount (Rs.)**
	Public Health Works				
1	Providing, fixing, testing and commissioning of µ-PVC (Unplasticized Polyvinyl Chloride) Nikasi/ waste pipe make of Dadex /Popular/Beta or equivalent, plain /socket ended conforming to code EN-1329 of specified SDR (Standard Dimension Ratio) including the cost of specials and Solvents complete in all respect as approved and directed by the EngineerIncharge **MRS 2023 (Chapter 19, Item 47, P.130)**				
	b) **Type (SDR 32.5/SN-8)**				
	(iii)2"(60 mm)	Per Rft	250.00		
	(iv)3"(85 mm)	Per Rft	800.00		
	(v)4"(110 mm)	Per Rft	1,000.0		
	(vi)6"(160 mm)	Per Rft	150.00		
	(vii)8"(200 mm)	Per Rft	80.00		
2	Providing, fixing, testing and commissioning of µ-PVC (Unplasticized polyvinyl Chloride) Nikasi/ waste pipe Fittings make of Dadex /Popular/Beta or equivalent, conforming to code EN-1329 including the cost of Solvents complete in all respect as approved and directed by the Engineer Incharge **..MRS 2023 (Chapter 19, Item 49a, P.131)**				
	a) **P-Trap**				
	(i) 4" dia	Each	15.00		

	(ii) 3" dia	Each	40.00		
	b) **Multi-Trap**				
	(i) 4" dia	Each	6.00		
	(ii) 3" dia	Each	4.00		
	c) **Vent Cowel**				
	(i) 4" dia	Each	20.00		
	(ii) 3" dia	Each	4.00		
	(iii) 2" dia	Each	15.00		
	d) **Clean Out**				
	(i) 4" dia	Each	8.00		
	(ii) 3" dia	Each	5.00		
3	Providing and fixing CP bath Room Set made of Sonex/Master/Faisal comprising of 3-No Tee stop cocks, lever type Basin Mixer, double Bib Cock, open wall shower, Muslim shower,waste coupling and bottle trap etc. complete in all respect as approved and directed by the Engineer incharge .**MRS 2023 (Chapter 19 Item 52, P.132)**				
	(i) 3 No Tee Stop Cock (set)	Each	64.00		
	(ii) Lever Type Basin Mixer	Each	6.00		
	(iii) Double Bib Cock	Each	7.00		
	(v) Muslim shower	Each	7.00		
	(vi) Waste Coupling	Each	44.00		
	(vii) Bottle Trap	Each	4.00		

4	Providing, laying, testing and commissioning of POLYPROPYLENE RANDOM COPOLYMER (PPRC) water supply pipe (**Dadex /Popular/ Beta or equivalent**) with specified pressure rating PN (PRESSURE NOMINAL)and conforming to DIN 8077-8078 code i/c cost of solvent, specials,making jharries complete in all respect as approved and directed by Engineer Incharge.(Internal/External Diameters mentioned) **MRS 2023 (Chapter 23, Item 47, P.160)**				
	b) **PN-20 pipe**				
	(ii)(3/4") 25 mm	Per Rft	3,500.00		
	(iii)(1") 32 mm	Per Rft	2,500.00		
	(iv) (1-1/4") 40 mm	Per Rft	900.00		
	(vi)(2") 63 mm	Per Rft	200.00		
	(vii)(2-1/4") 75 mm	Per Rft	150.00		
5	Providing and fixing, chromium plated mixing valve, for wash hand basin, sink or shower **MRS 2023 (Chapter19, Item 30, P.128)**	Each	34.00		
6	Providing and fixing gun metal peet/gate valve (screwed) **MRS 2022-23 (Chapter19, Item 31, P.128)**				
	ii) 40 mm(1½") dia	Each	5.00		
	iv) 65 mm(2½") dia	Each	3.00		
7	Providing and fixing chromium plated bottle trap with waste pipe, etc. complete:- ii) 4 cm (1½") **MRS 2023 (Chapter 19, Item 5, P.133)**	Each	4.00		

8	Providing and fitting 10cm (4") gully trap, including cement concrete , cost of pvc grating 15x15cm (6"x6") and masonry chamber 30x30cm (12"x12"). **MRS 2023 (Chapter 19, Item 36, P.129)**	Each	10.00		
9	Providing and fixing stainless steel sink with drain board, size 120x60 cm (48"x24") including bracket set, waste pipe and waste coupling **MRS 2022-23 (Chapter 19, Item 8, P.126)**	Each	38.00		
10	Providing and fitting glazed earthen ware wash hand basin /vanity 56 x40 cm (22"x16") including bracket set, waste pipe and waste coupling, etc.**MRS 2023 (Chapter 19, Item 7, P.125)**				
	i) white, with pedestal	Each	7.00		
	v) Under Counter Vanity Basin	Each	1.00		
11	Providing and fitting one piece Europeon Coupled set of Water Closet(WC) and flushing Cistern of PORTA brand (full size) i/c the cost of CP/rubber connection, thimble, normal seat cover andrawal boltscomplete in all respects as approved and directed by the Engineer Incharge **MRS 2023 (Chapter 19, Item 3, P.125)**	Each	10.00		
12	Providing and fitting glazed earthen ware water closet,squatter type (Orisa pattern), combined with foot rest. **MRS 2023 (Chapter 19, Item 4, P.125**)				
	i) White	Each	1.00		
13	Providing and fixing glazed earthen ware flat back urinal **MRS 2023 (Chapter 19, Item 11, P.126)**	Each	1.00		

14	Providing and fixing, chromium plated soap dish**.** **MRS 2023 (Chapter 19, Item 16, P.126)**	Each	43.00		
15	Providing and fixingchromium plated toilet paper holder. **MRS 2023 (Chapter 19, Item 18, P.127), .**	Each	10.00		
16	Providing and fixing, chromium plated towel rail: **-MRS 2023 (Chapter 19, Item 19, P.127),**				
	i) 60 cm (24") long, and 2 cm (¾") dia.	Each	7.00		
17	Providing and fixing looking glass 55x40 cm (22"x16") size, and 5 mm thick, first quality. **MRS 2023 (Chapter 19, Item 20, P.127)**	Each	8.00		
18	Providing and fixing chromium plated bib cock: **-MRS 2023 (Chapter 19, Item 27, P.128)**				
	i) 2 cm (¾")	Each	2.00		
	ii) 1.5 cm (½")	Each	2.00		
19	Providing/fixing Gas water heater (Geyser) of specified capacity,comprising of water tank made of 14 SWG steel sheet and cover with 20 SWG MS sheet, best quality of approved make of Corona/Ambassador / Super Asia/Canon i/c the cost of non return valve,imported thermostate,G.I. accessories, safety valve and making connection with existing water supply pipelinecompletein all respectsas approved and directed by the Engineer Incharge. **MRS 2023 (Chapter 19, Item 53, P.132)**				
	(i) 50 Gallons	Each	2.00		
				Total Amount (Rs.) =	

UNIVERSITY OF AGRICULTURE
AT FAISALABAD
SEED BUILDING
ELECTRICAL WORKS
COST ESTIMATE

A. SCHEDULE ITEMS

Sr. No.	Description	Qty	Unit	Rate	Amount
3/24	Supply and erection of PVC pipe for wiring recessed in walls, including inspection boxes, pull boxes, hooks, cutting jharries, and repairing surface, etc, complete with all specials.				
ii)	20mm i/d.	2250	Meter		
iii)	25mm i/d.	3530	Meter		
iv)	32mm i/d.	105	Meter		
v)	40mm i/d.	30	Meter		
vi)	50mm i/d.	20	Meter		
6/24	Supply and erection PVC pipe for recessed wiring (main and sub-main) purpose, including bends, specials, etc, in floor, wall or trenches.				
i)	100mm i/d.	50	Meter		
10/24	Supply and erection of single core PVC insulated copper conductor cables, in prelaid PVC pipe/M.S. conduit/G.I. pipe/wooden strip batten/wooden casing an capping/G.I.wire/trenches (rate for cables only):-				
a)	250/440 volts, PVC insulated.				
i)	3/0.74mm (3/0.029").	7950	Meter		
iii)	7/0.74mm (7/0.029").	1550	Meter		
iv)	7/0.91mm (7/0.036").	7180	Meter		
v)	7/1.12mm (7/0.044").	1120	Meter		

vi)	7/1.63mm (7/0.064").	130	Meter		
12/24	Supply and erection of single core PVC insulated, PVC sheathed copper conductor, 600/1000 volts grade cable, in prelaid G.I. pipe/M.S, conduits/PVC pipe/G.I. wire/trenches, etc (rate for cable only):-				
viii)	70mm (19/0.083").	75	Meter		
13/24 (c)	PVC insulated, PVC sheathed 4 core, 660/1100 volt non armored cable.				
v)	6mm (7/0.044").	60	Meter		
ix)	35mm (19/0.064").	130	Meter		
xvi)	240mm (37/0.114").	75	Meter		
14/24	Supply and erection of M.S. sheet box of 16 SWG, 10 cm (4") deep, with 4.75 mm thick (3/16") bakelite sheet top, for recessed wiring, including making holes for regulators, switches, plugs, etc.				
i)	10x10 cm (4"x4")	360	Each		
ii)	17.5 x 10 cm (7"x4")	30	Each		
49/24	Supply and erection of 3/8" (10 mm) dia M.S. bar fan hook, placed at the time of casting of slab.	60	Job		
90/24	P/F wall mounted DB (Distribution Board) made with 16SWG Sheet (Recessded/Surface mounted Type), Powder coated Paint, i/c the cost of Lock, Indication lights,Thimble, Copper Comb, Wiring, Netural & Earth Bar, Door Earthing, Digital Voltmeter, Digital Ammeter,Volt Selector Switch, Ammeter selector switch, Current Transformers and Controles Complete in all respect as approved and directed by the Engineer Incharge (Breakers will be Paid Separately).				
a)	**6" deep.**				
i)	20-60A.	9	P.Cft		
ii)	75-100A.	22	P.Cft		

91/24	P/F floor mounted Electric Panel board of required depth and size, fabricarted with 14SWG M.S sheet (Indoor/Outdoor Type),derusting, zinc Phosphated, finish with electro static powder coating in approved colour i/c the cost of Lock, Indication lights, Brass glands, Netural & Earth bar, Digital volt meter/ Amp meter, Slector switchs, Current Transformers, Controles, Channels, Copper bus bars of specified capacity, Door Earthing, complete in all respects as approved and directed by the Engineer				
	Incharge (Breakers will be Paid Separately).				
i)	**LT Switchboards**				
	a) 2.50 Ft deep				
i)	250~600A	92	P. Cft		
86/24	Suppling,Installation and comissioning of MCB (Miniature Circuit Breaker) of specified rating made of LEGRAND FRANCE/ GE U.S.A / SCHNEIDER GERMANY /SIEMEN GERMAN/TERASAKI JAPAN/ ABB SWITZERLAND in prelaid DBs and Panels i/c the cost of screwes,necessary wire complete in all respect as approved and directed by the Engineer Incharge.				
a)	**Single Pole**				
ii)	6-40 Amp (6KA)	174	Each		
87/24	Supplying, Installation and commissioning of MCCB (Moulded Case Circuit Breaker) of specified rating made of LEGRAND FRANCE/ GE U.S.A / SCHNEIDER GERMANY / TERASAKI JAPAN/SIEMEN/ABB SWITZERLAND (with fixed Thermal-Magnetic Trip) in prelaid DBs and Panels i/c the cost of screws, necessary wire complete in all respect as approved and directed by the Engineer Incharge.				
a)	**Tripple Pole**				
ii)	15-100Amp (10KA, 15KA)	16	Each		
iv)	125-250Amp (18KA)	1	Each		

x)	300-630Amp (36KA)	2	Each		
93/24	P/F PFI PLANT (Power Factor Improvement Plant) comprising of components of required ratitngs, in MS box of 14 SWG i/c the cost of 3mm thick Backlite sheet (Safety Sheet)Lock, thimbles i/c the cost of power capacitors, Magnetic contactors, HRC fuses, Power factor controllers, Indication lights, Copper comb, Wiring, Netural & Earth bar, Door earthing, brass glands, push buttons, CTS,				
	Controle MCB, Surge Suppressors, Auto/Manual Switches, Exhaust Fan, Temp regulators as per WAPDA standards complete in all respects as approved and directed by the Engineer Incharge.				
i)	62.5 KVAR	1	Each		
94/24	Providing and fixing DB/Panel accessories of required rating and size i/c copper screws of approved brand Complete in all respect as approved and directed by the Engineer Incharge.				
(i)	Selector Switch.	8	Each		
(ii)	Current Transformer Coil (Make: Metelx/Fico).	4	Each		
(iii)	Digital Voltmeter (0-600 Volt).	7	Each		
(iv)	Digital Ammeter (0-9999 Amp).	1	Each		
(v)	LED Phase Indicator.	24	Each		
(viii)	Control MCB S/P 6A (Make: Schneider/Terasaki/ABB).	24	Each		
(ix)	Surge Suppressors.	1	Each		
103/24	P/F PVC double layer Switch kit Face plate with specified switch holes i/c the cost of switches / sockets / dimmer made of Hi-Life / Bush / Schenider, screws complete as approved and directed by the Engineer Incharge.				
a)	**One way Gange Switch**				
	Small				
i)	01 Gange.	35	Each		
ii)	02 Gange.	12	Each		
iii)	03 Gange	5	Each		

iv)	Three pin light plug 10/13Amp.	245	Each		
vi)	Fan dimmer.	60	Each		
viii)	Three pin power plug 15-32Amp.	85	Each		
v)	Telephone/TV/data cable socket.	30	Each		
	Large				
i)	04 Gange.	6	Each		
ii)	05 Gange.	19	Each		
iii)	06 Gange.	3	Each		
b)	**Two way Gange Switch**				
	Small				
i)	01 Gange one way/two way.	4	Each		
102/24	Providing and fixing Copper winded Exhaust fan with louver and shutter made of Pak/Younas/G.F.C i/c the cost of necessary cable and hardware for connection from ceiling rose complete as approved and directed by Engineer Incharge.				
a)	**Plastic body.**				
ii)	12" dia	4	Each		
97/24	Providing and fixing 3" deep cable tray with straight flange fabricated with perforated G.I. Sheet of specified guage,size and depth duly wall supported/ceiling hung on painted brackets of MS angle iron of 1"x1"x1/8" and MS patti of 1-1/2"x3/16" size @ 5 ft C/C, hangers i/c the cost of hardwares as approved and directed by the Engineer Incharge.				
(a)	**16-SWG**				
i)	4"x3"	65	Meter		
ii)	6"x3"	45	Meter		
98/24	Providing and fixing 4" deep cable tray with straight flange fabricated with perforated G.I. Sheet of specified guage,size and depth duly wall supported/ceiling hung,supported on painted brackets of MS angle iron of 1- 1/2"x1-1/2"x3/16" and MS patti of 1-1/2"x3/16" size @ 5 ft C/C, hangers i/c the cost of hardwares				

	as approved and directed by the Engineer Incharge.				
(a)	**16-SWG**				
ii)	9"x4"	10	Meter		
100/24	Providing and fixing screwless cable tray cover fabricated with 18 SWG G.I. Sheet of required size i/c the cost of hardware as approved and directed by the Engineer Incharge.				
i)	4" wide.	65	Meter		
ii)	6" wide.	45	Meter		
iii)	9" wide.	10	Meter		
106/24	Supply, Installation and commissioning of wiring with 4-pair data Cable, 23 AWG UL/EN listed cable * Conforming to following standards: TIA/EIA 568 / ISO/IEC 11801, in prelaid conduit / cable tray from including all accessories, Manufacturer/OEM Authorization, Make: Schneider / i-connect UK/3M Corning USA/ D-Link/ Pollo Australian or equivalent complete in all respect as approved and directed by Engineer Incharge.				
a)	**UTP (Unshielded Twisted pair)**				
i)	CAT-6 (Min.1G @ 250MHz or higher).	3100	Per Meter		
131/24	Supply, Installation and commissioning of Simple type, Dual Shutter Face Plates having fully populated I/O:				
	Option 1:RJ-11 with RJ45/8P8C I/Os supporting either Cat6 or Cat6a cables as required by project.				
	Option 2: Two RJ45/8P8C I/Os supporting either Cat6 or Cat6a cables as required by project.				
i)	Single I/O.	60	Each		

Seed building at UAF

114/24	Supply and installation of Cable Metal Organizer, 19" Rack mounted with high graded epoxy powder coating and slideable top- UL Listed. Made of Schneider/i-Connect UK/3M Corning: Pollo Australia or equivalent as approved and directed by the Engineer Incharge.	3	Each		
115/24	Supply, Installation and commissioning of 19" Rack Mounted of specified, UTP Patch Panel with specified toolless support & Rear Cable Management, UL listed, Loaded with UTP of specified Keystone Jack Toolless Support , Made of Schneider / Norden /3M Corning/D-Link, Pollo Australia or equivalent or as Approved and Directed by Engineer Incharge.				
i)	CAT-6 (24 Port Patch Panel with Toolless Support 1-Gigabit).	3	Each		
111/24	Supply, Installation and Connection of Specified Ports Layer-2 PoE (Power Over Ethernet) data Network Switch specified ports x100 Mbps PoE, Min.2x1Gbps SFP UPLINK ports, made of Cisco USA/NOVAS Europe/Juniper USA / Huawei / H3C, Pollo Australia or equivalent as approved and directed by the Engineer Incharge.				
iii)	16 port, Min. 300 Watt PoE power.	1	Each		
iv)	24 port, Min. 365 Watt PoE power.	2	Each		
129/24	Supply , Installation of wall mounted CCTV Cabinet comprising of Powder Coated M.S frame, front glass & two side openings, 02 way fans for cooling, top & bottom entry, handle lock with 6 way PDU (Power Distribution Unit) with all necessary accessories/ materials, complete in all respects. Made of Bosch/ HP / Dell , Pollo Australia or equivalent or as approved and directed by Engineer Incharge.				
iii)	18U size (600x550x900mm)	1	Each		

109/24	Supply, Installation and commissioning of Cat-6, UTP Machine Made Patch Cord of Specified Length, Support 10 Giga, UL listed cable, with anti snag boots, Gold Over Nickel Plated, Manufacturer/OEM Authorization, confirming to manufacturer warranty, Made of Schneider / i-Connect UK /Panduit USA/D-Link/3M, Corning ,Pollo Australian or equivalent Approved and Directed by Engineer Incharge.				
i)	1 meter Patch Cord.	47	Each		
ii)	3 Meter Patch Cord.	32	Each		
122/24	Supply, installation & connecting IP based Camera of specified resolution, 1/3" Progressive scan, fixed lens 2.8 mm AF, Max resolution 2592 x 1920				
	mm, Codec H-265, Camera with 25 fps, day night (ICR), ONVIF, IP-66, Max IR distance 30 meter, WDR Smart Analytics, i/c the cost of mounting bracket, mounting accessories/ materials. Make: - Honey Well / Bosch / Norden, Pollo Australia or equivalent, as approved as directed by the Engineer Incharge.				
(a)	**2 Mega Pixel**				
i)	Fixed Bullet Type.	17	Each		
116/24	Supply & Installation of NVR (Network Video Recorder) for Real Time View of specified Channels, video and Audio channels,Supported protocoles: ONVIF,RTSP etc, Internal HDDs mount support:2/4/8 or higher as per site requirement,Monitor outputs,(HDMI,4K Ultra HD),VGA (Video Graphic array), Support Raid 5/6, Embeded OS, Data Encryption, Min. 1 x RJ-45 1000Mbps Ports, with PC Video Monitoring Software, Web Server, Embedded Server complete in all respect. made of AXIS Europe/NOVAS Europe/Avigilon by Motrola USA /Huawei, Pollo Australia or equivalent as approved and directed by the Engineer Incharge.				
iii)	32-Channel.	1	Each		

117/24	Supply, Installation and Connection of Surveillance Grade Hard Drives (HDD) of Specified Capacity for CCTV System Backup. made of Seagate / WD, Pollo Australia or equivalent, as approved and directed by Engineer Incharge.				
iii)	10 TB (Tera Bite).	1	Each		
				Total Rs:-	

UNIVERSITY OF AGRICULTURE
AT FAISALABAD
SEED BUILDING
COST ESTIMATE
ELECTRICAL WORKS

B. **NON SCHEDULE ITEMS**

Sr. No.	Description	Qty	Unit	Rate	Amount
1.0	**INDUSTRIAL SOCKET AND FLOOR BOX/TECHNOLOGY BOXES**				
1.01	Supply & Installation of 32A 5 pin industrial socket with matching plug.	2	Each		
1.02	Supply and Installation of adjustable 12 SWG die cast aluminum 12"x12"x4" **floor boxes** having base box of 16-SWG G.I. sheet **make POWER CONCERN** with 3 sets of 15A PVC connectors, including floor cutting as required as per drawings for following outlets and space of following outlets (excluding cost of socket/outlet).				
i)	1-Voice outlet.				
ii)	1-Data outlet.				
iii)	1-3 pin 13A international switch socket outlet.				
iv)	2-3 pin 13A flat switch socket outlets.	9	Each		
1.03	Supply and Installation of adjustable **18- SWG sheet steel with electrostatic painted technology box size 20"x4"x2½"**, **make Power Concern** including wall cutting as required as per drawing and space of following outlets (exceluding cost of socket/outlet).				
i)	1-Data outlet.				
ii)	1-Telephone outlet.				
iii)	1-3 Pin 13 Amp international switch socket outlet.				
iv)	2-3 Pin 13 Amp flat switch socket outlets.	20	Each		
	SUB TOTAL SECTION (1.0)				

2.0	**POWER CABLE AND CABLE CATCH PIT**				
2.01	Supply, Laying & Connecting up of 600/1000 volt grade single /4/3.5 core PVC insulated and PVC sheathed copper conductor cables as specified, **make FAST/NEWAGE/ PAKISTAN/FR/COPPER**				
	GAT Cable of following size **including copper thimble and one feet long heat shrinkable colour sleeve**.				
	Note:- Cables shall be purchased as per actual measurements at site.				
i)	4 core 6mm2 PVC/PVC flexible copper conductor cable.	48	Meter		
ii)	Single core 6mm2 PVC flexible copper conductor cable.	48	Meter		
2.02	Supply and Construction of following size internal size **cable catch pits (CCP)** including earth work 4" thick P.C.C 9" thick first class burnt brick work, in 1:5 cement sand mortar plaster inside in 1:5 cement sand, and 4" thick P.C.C slab with 12" dia C.I. manhole cover to **BS 497** double rubber seal material conforming to **BS 1452** grade 150 including 4" dia perforated PVC pipe of 4 meter length vertically installed after making a bore hole under manhole, complete in all respects as per details shown in drawing.				
i)	2'x2'x3'.	3	Each		
			SUB TOTAL SECTION (2.0)		
3.0	**LIGHTING FIXTURES AND FANS**				
3.01	Supply and Installation of LED/SMD light fittings**.The light fitting Make of NVC/ Sunlight/Get Technology/Envirogreen** or approved equivalent. All the light fixture have the efficacy of 100 lumens/Watt & have 3 yrs of standard replacment warranty. The power factor of the light fitting should >0.9 & have <15% THD. The color shifting of the LED Source should not be greater than 5 SDCM for indoor light. The driver should be Meanwell or approved equivalent and LED should be atleast 100 lumens/Watt.				
i)	Surface mounted 2'x2' SMD slim panel light (40Watt).	34	Each		
ii)	Surface mounted 25Watt SMD downlighter.	8	Each		
iii)	Surface mounted 18Watt SMD downlighter.	18	Each		
iv)	Surface mounted 4 feet long SMD light (36Watt).	118	Each		

v)	Surface mounted 2 feet long SMD light (9Watt).	7	Each		
vi)	Surface mounted 12Watt SMD down lighter.	128	Each		
vii)	Decorative wall bracket light with 12Watt SMD lamp.	2	Each		
viii)	Decorative weatherproof wall bracket light IP-65 with 12Watt SMD lamp.	2	Each		
3.02	Supply and Installation of LED exit light (3Watt) (wall/ceiling surface type) with exit pictogram with 3 hour battery back-up.	6	Each		
3.03	Supply and Installation of LED emergency light (3Watt) (wall/ceiling surface type) with 3 hour battery back-up.	53	Each		
3.04	Supply and Installation of 18" sweep wall bracket fan copper winding **make GFC/PAK/ROYAL FAN**, complete in all respects, as per specification.	1	Each		
3.05	Supply & Installation of ceiling fan 56" sweep copper winding DELUXE model make **ROYAL FAN/PAK FAN/GFC FAN,** including hanging rod as required as per site condition, complete in all respect.	60	Each		
	SUB TOTAL SECTION (3.0)				
4.0	**VOICE STRUCTURED CABLING SYSTEM**				
4.01	Supply, Installation & Connection up of following sizes **16-SWG sheet steel with electrostatic painted wall recessed/mounted type, hinged door, vermin & dust proof telephone junction box (TJB) make POWER CONCERN** with connecting modules and marking arrangements for following Nos. of pairs of cables.				
i)	40 pairs.	1	Each		
4.02	Supply, Laying & Connecting up of Telephone cables **make PONY/NORDEN/CLIPSAL/ PAKISTAN** 0.6mm solid conductor, polyethylene insulated, 2 insulated conductors twisted together and PVC sheathed laid in prelaid PVC pipe of following pairs.				
i)	20 pairs cable.	90	Meter		
	SUB TOTAL SECTION (4.0)				
5.0	**FIRE ALARM SYSTEM**				

5.01	Supply, Wiring and Connecting up of fire alarm system smoke detector/heat detector/sounder and manual call point wired with fire resistant cable 2 core1.5mm2 fire resistant silicon rubber insulated, aluminum tape screen over copper drain wire, thermoplastic low smoke, halogen free sheath cable (class PH30/PH120) coloured red **make NOROEN (UK)/2M KABLO/PRYSMIAN (UK)/RAMCRO (ITALY)** from FACP to device and device to device laid in prelaid PVC pipe, complete in all respects as per drawings and specifications.	760	Meter		
5.02	Supply and Installation of addressable 1 loop fire alarm control panel having indication, control & supervision of each detector & sounder circuit, key switch for general alarm, complete with battery and charger. **make MENVIER/Honeywell/Zeta** or approved equivalent, complete in all respect.	1	Each		
5.03	Supply and Installation of addressable smoke detector with base **make MENVIER/Honeywell/Zeta** or approved equivalent complete in all respects as per specifications & drawings.	47	Each		
5.04	Supply and installation of addressable heat detector with base **make MENVIER/Honeywell/Zeta** or approved equivalent, complete in all respects as per specifications & drawings.	2	Each		
5.05	Supply and Installation of addressable manual call point with back box make **MENVIER/Honeywell/Zeta** or approved equivalent, complete in all respects as per specifications & drawings.	6	Each		
5.06	Supply and Installation of addressable sounder with flasher **make MENVIER/Honeywell/Zeta** or approved equivalent, complete in all respects as per specifications & drawings.	6	Each		
5.07	Testing, Commissioning and Programming for Fire Alarm System.	1	Job		
	SUB TOTAL SECTION (5.0)				
6.0	**IP CCTV SYSTEM**				
6.01	Supply, Installation, Testing and Commissioning of 32 inch LCD **make LG/SONY/SAMSUNG** including cost of all necessary accessories, complete in all respects.	1	Each		

6.02	Supply and Laying of **HDMI cable** with both end jacks (5 meter).	1	Job		
				SUB TOTAL SECTION (6.0)	
7.0	**EARTHING SYSTEM**				
7.01	Supply and Installation of 1½" dia & 10 ft long 16-SWG tin plated copper pipe filled with primary earth chemical to be lowered in **30 feet** deep 4" dia bore hole, complete with clamps from bottom and top of pipe rod to ground surface earth connecting point the pipe & bore hole to be filled with secondary **earth chemical model GEM-25A of ERICO, complete with 1x70mm2 stranded copper conductor** from earth pipe to ground surface in 1½" dia PVC pipe with breather hole (length 5 feet only) with watering cap, earth access hole comprising of 12"x12" and 12" deep 16-SWG M.S. cylinder with 12-SWG M.S. cover, both hot dipped galvanized including copper test link size 4"x2"x½" installed on insulator with brass nuts bolts, as per detail shown in drawings.				
i)	Transformer neutral.	1	Each		
ii)	Transformer body & main switch.	1	Each		
iii)	MPB-Seed.	2	Each		
				SUB TOTAL SECTION (7.0)	
				Total Rs:-	

DRAWINGS

Seed building at UAF

SEED BUILDING

UNIVERSITY OF AGRICULTURE
FAISALABAD

TENDER DRAWINGS
FEBRUARY, 2023

ARCHITECTS, ENGINEERS AND
PLANNING CONSULTANTS

Seed building at UAF

SEED BUILDING

UNIVERSITY OF AGRICULTURE
FAISALABAD

LIST OF DRAWINGS

ARCHITECTURAL

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A-103	PROPOSED SITE PLAN
A-104	GROUND FLOOR (WORKING PLAN)
A-105	FIRST FLOOR (WORKING PLAN)
A-106	MUMTY FLOOR (WORKING PLAN)
A-107	ROOF PLAN (WORKING PLAN)
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A-109	FIRST FLOOR (FURNITURE PLAN)
A-201	ELEVATIONS A & B
A-202	ELEVATIONS C & D
A-203	SECTIONS A & B
A-301	TOILET BLOW-UP PLAN-A & B
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PH-02	GROUND FLOOR (WATER SUPPLY LAYOUT PLAN)
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PH-04	FIRST FLOOR (WATER SUPPLY LAYOUT PLAN)
PH-05	ROOF DRAINAGE PLAN

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ST-01	GENERAL NOTES
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ST-04	COLUMN FOOTING
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ST-07	GROUND FLOOR SLAB REINFORCEMENT PLAN
ST-08	FIRST FLOOR SLAB REINFORCEMENT PLAN
ST-09	MUMTY SLAB REINFORCEMENT PLAN
ST-10	BEAM ELEVATION TABLE
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ELECTRICAL

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E-GF-03	EMERGENCY LIGHTING SYSTEM LAYOUT OF GROUND FLOOR
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E-FF-08	CCTV SYSTEM LAYOUT OF FIRST FLOOR
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E-MF-02	LIGHTING SYSTEM LAYOUT OF MUMTY FLOOR

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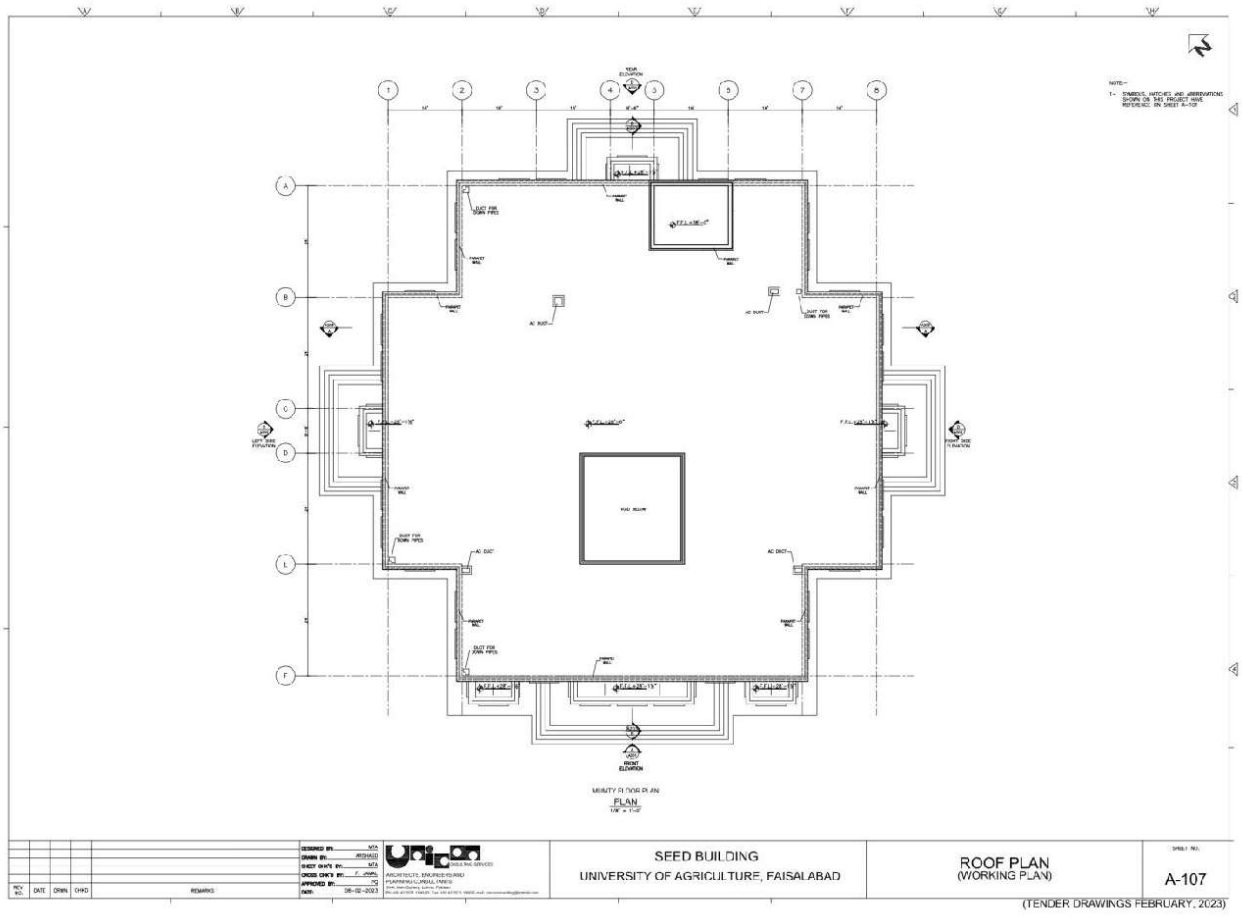
Seed building at UAF



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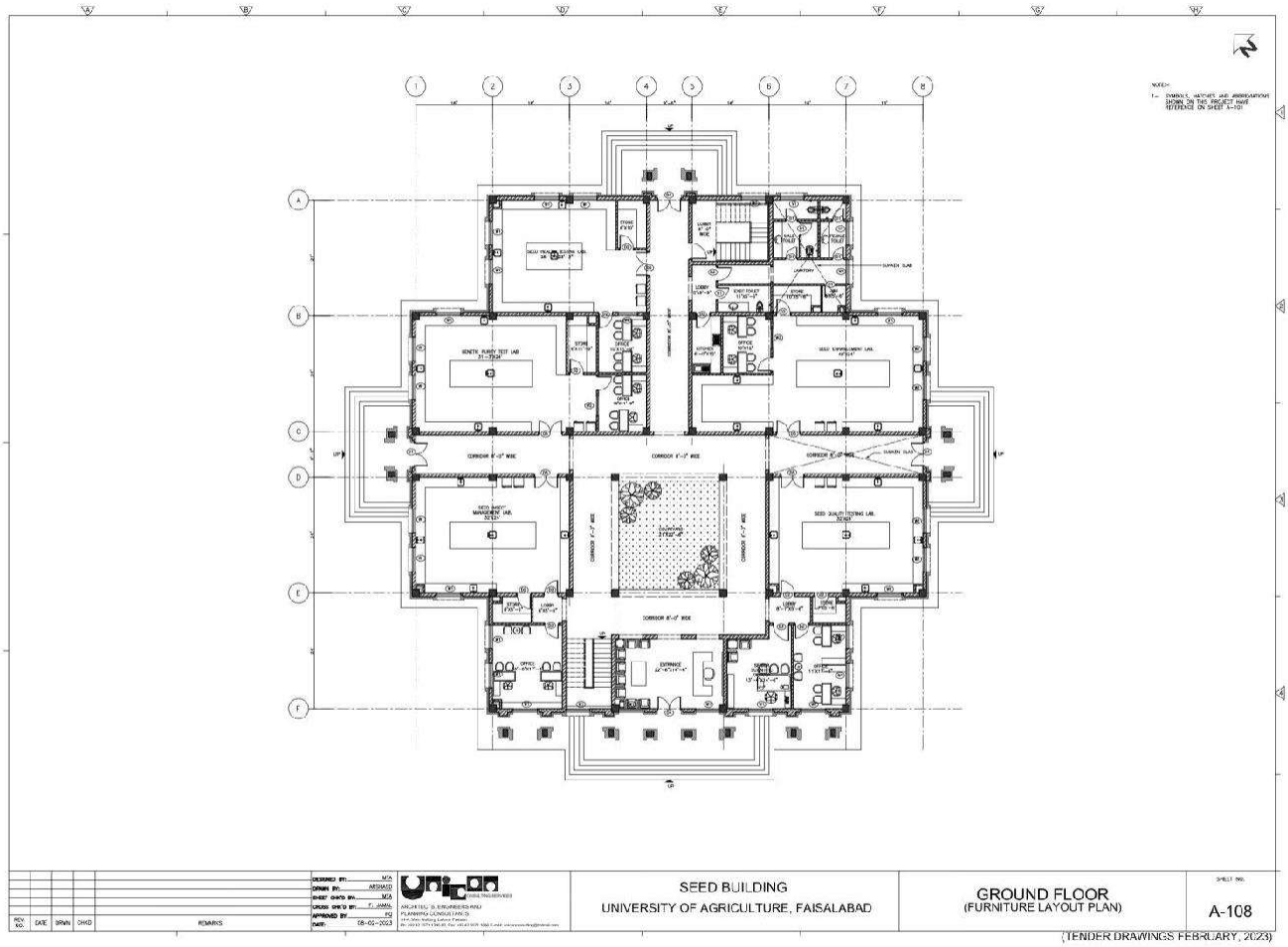

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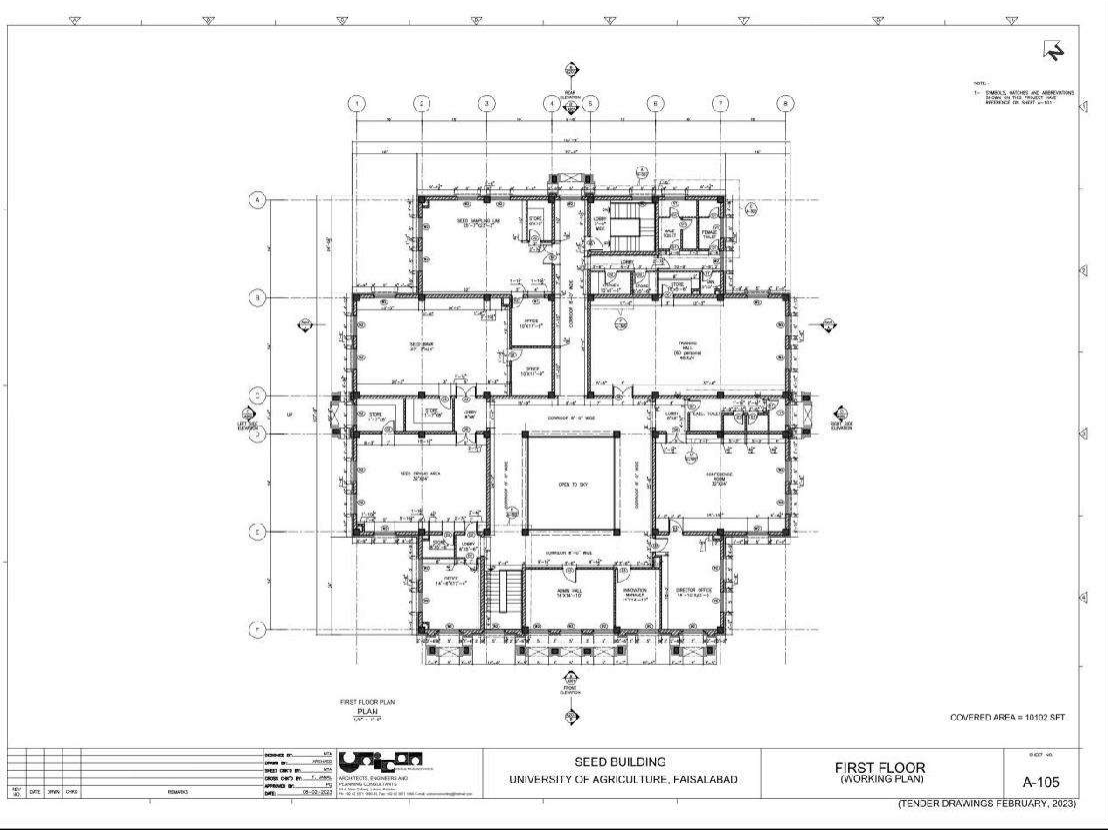

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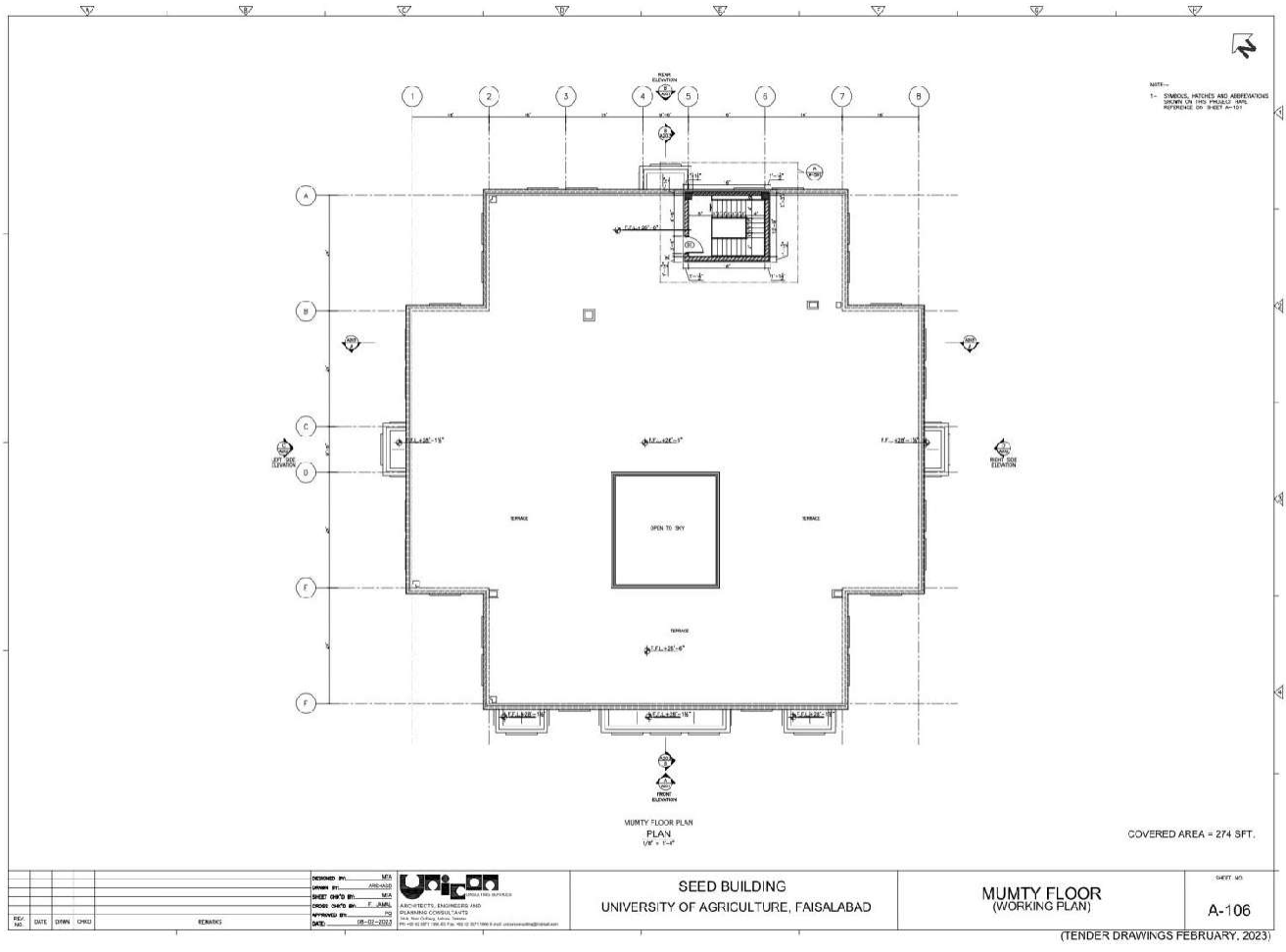

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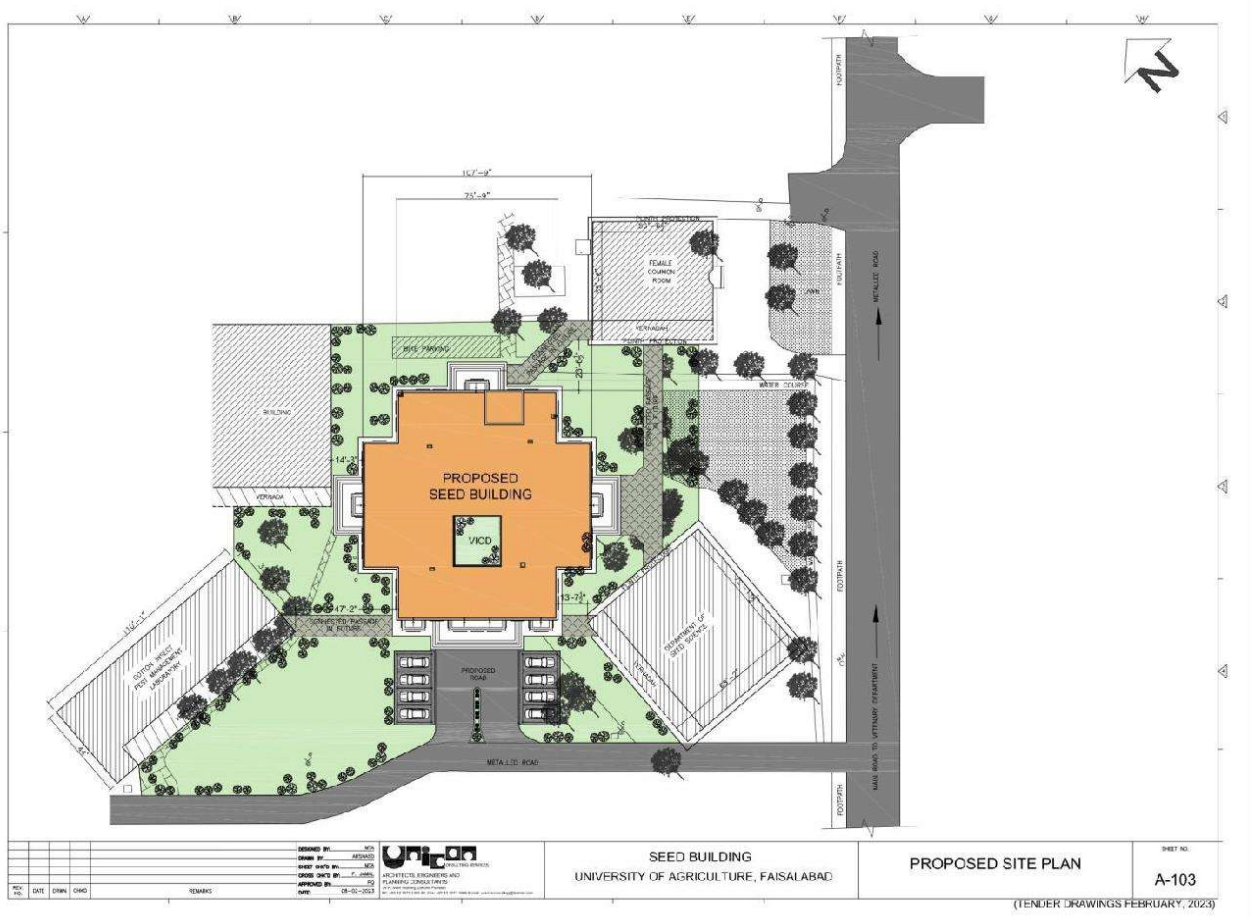

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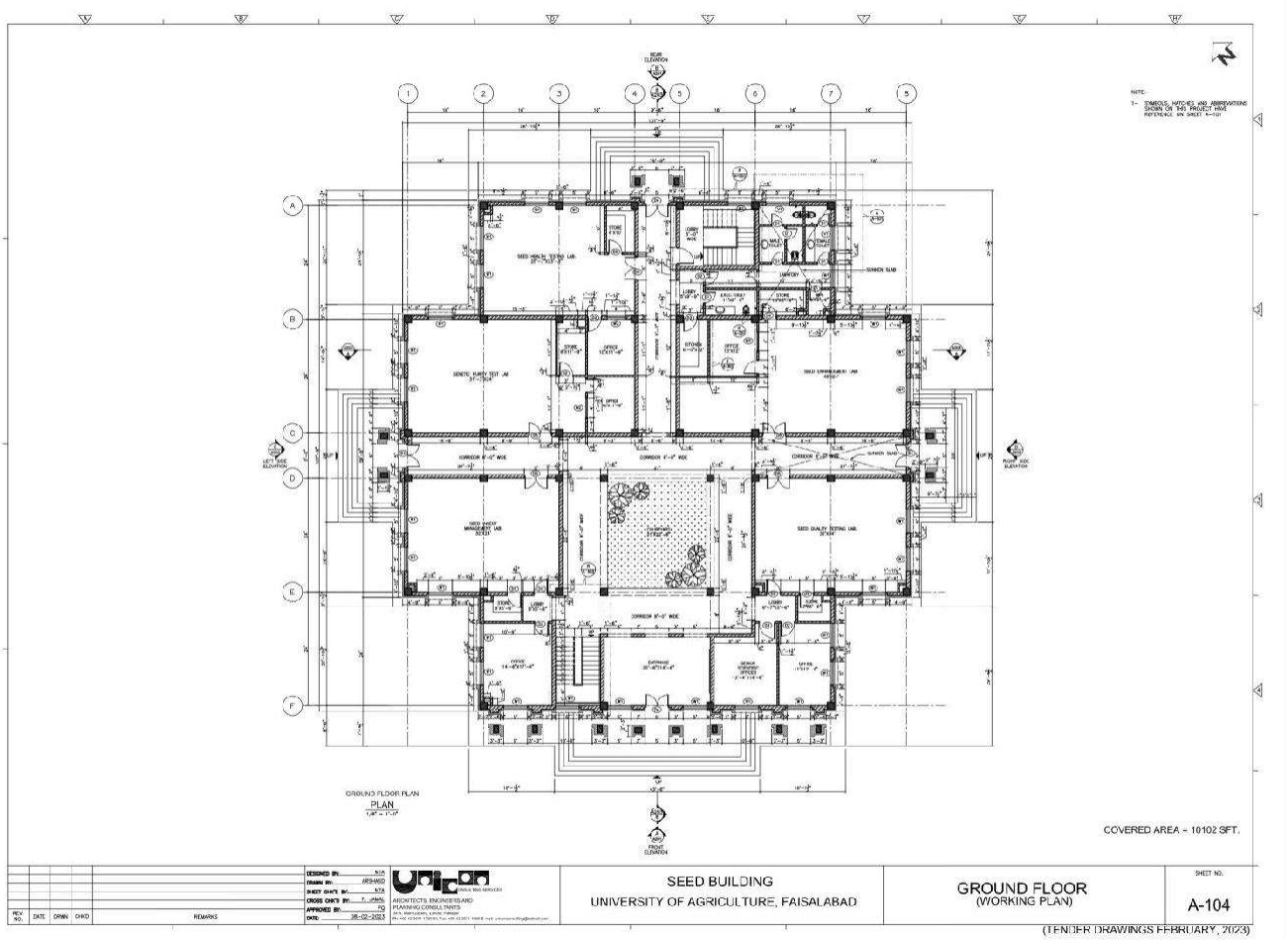

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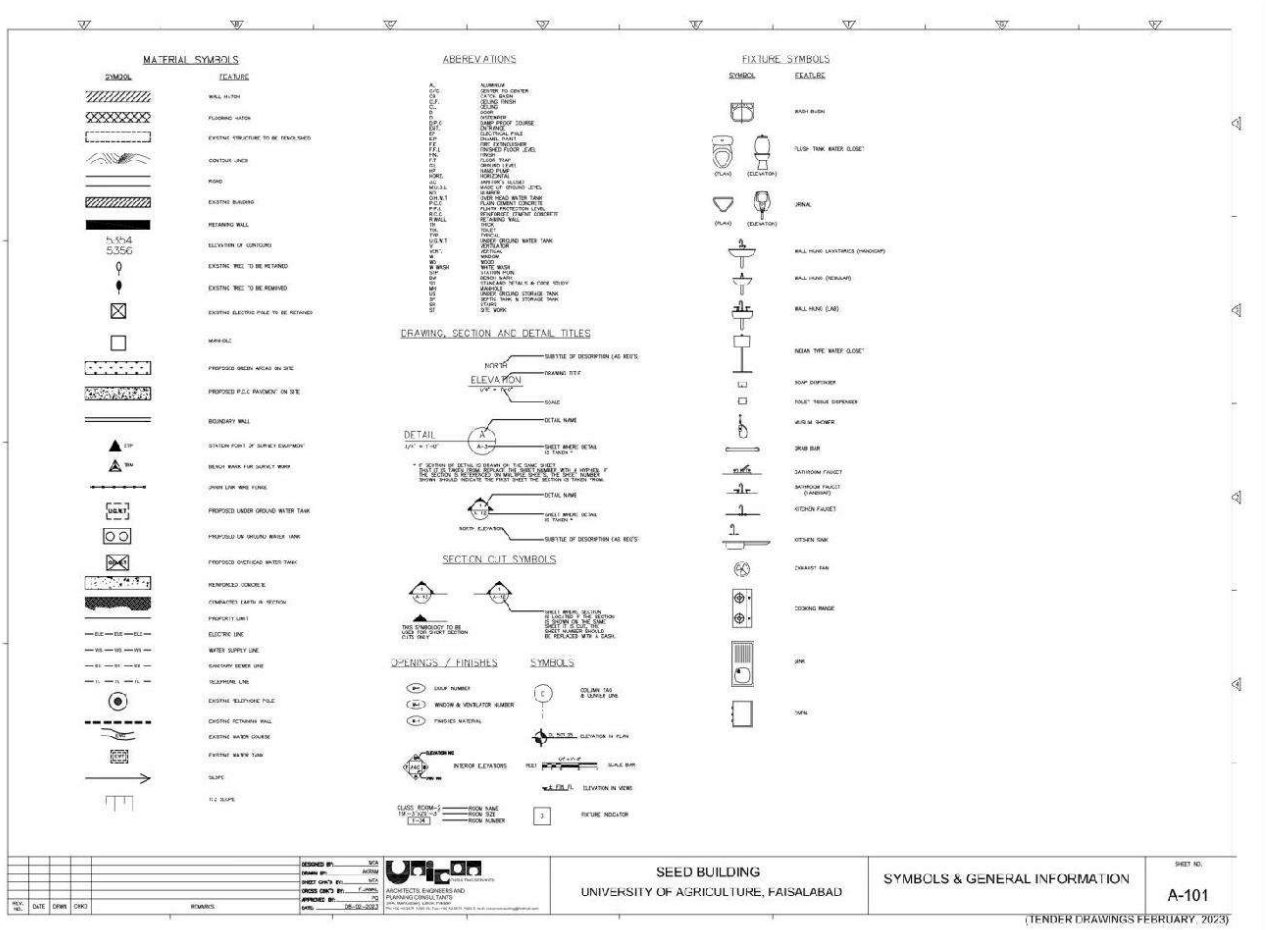

LIST OF CONTRACT DOCUMENTS

Sr. No.	Name of the Document	Status
(1)	Standard Form of Bidding Documents (Civil Works) *(to be used for estimated value of more than Rs. 25 Millions)*	Completed
(2)	Standard Form of Bidding Documents for Procurement of Works (E&M) *(to be used for estimated value of more than Rs. 25 Millions)*	Completed
(3)	Standard Form of Bidding Documents for Procurement of Works (For Smaller Contracts) *(to be used for all type of procurement for estimated value of not more than Rs. 25 Millions)*	Completed
(4)	Standard Form of Contract for Engineering Consultancy Services (For Large Projects) – Time Based Assignments	Completed
(5)	Standard Form of Contract for Engineering Consultancy Services (For Large Projects) – Lump Sum Assignments *(to be used for consultancy fee over Rs. 2 Millions)*	Completed
(6)	Standard Form of Contract For Engineering Consultancy Services (For Smaller Projects) *(to be used for consultancy fee not more than Rs. 2 Millions)*	Completed
(7)	Standard Procedure for Pre-qualifications of Constructors	Completed
(8)	Standard Procedure for Evaluation of Bids for Procurement of Works	Completed
(9)	Standard Procedure for Pre-qualifications of Consultants	Completed
(10)	Standard Procedure for Evaluation of Proposals for Procurement of Engineering Services	Completed
(11)	Standard Procedure and Formula for Price Adjustment	Completed
(12)	Conciliation and Arbitration	Completed

(13)	Standard Form of Bidding Documents for Procurement of Works on BOT Basis	Completed
(14)	Standard Form of Bidding Documents for Procurement of Works on Design and Build Basis	Completed
(15)	Standard Form of Bidding Documents for Procurement of Civil Works (Single Stage Two Envelopes-SSTE)	Completed
(16)	Standard Form of Joint Venture /Consortium Agreements and Memorandum of Understandings	Completed