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

TENDER FORM

Tender # CW/02/24-25

Rehabilitation of Main Gate at City Campus

Date of Issue	:	November 14, 2024
Last Date of Submission	:	December 04, 2024 (3:00 pm)
Date of Opening	:	December 04, 2024 (3:30 pm)
Company Name:		
NTN:		
SRB / GST Registration Number: _		
Pay Order / Demand Draft #		, Drawn on Bank
Amount of Rs		, Dated:

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INVITATION FOR BIDS

Notice Invitation Tender (NIT)

Tender Notice

The Institute of Business Administration, Karachi (IBA) invites electronic bids on EPADS from active taxpayers of manufacture / firm / companies / supplier registered with SPPRA EPADS and relevant tax authorities for the following tender.

Tender Title (Ref. No.)	Procedure	Bid Security
Rehabilitation of Main Gate at City Campus (CW/02/24-25)	Single Stage One Envelop	2% of bid security
• Fee: Rs.5,000/- each		
Issuance start date: November 14, 2024 at 9 AM		

• Issuance end date & time: December 04, 2024 at 3 PM

- Submission date & time: November 14, 2024 to December 04, 2024 from 9 AM to 3 PM
- Opening date & time: December 04, 2024 at 3:30 PM
- Mandatory Site Visit: November 29, 2024 at 11 AM at IBA City Campus

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

N.B.

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

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

<u>REGISTRAR</u>

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

INSTRUCTIONS TO BIDDERS & BIDDING DATA

Notes on the Instructions to Bidders

This section of the bidding documents should provide the information necessary for bidders to prepare responsive bids, in accordance with the requirements of the Procuring Agency. It should also give information on bid submission, opening and evaluation, and on the award of contract.

Matters governing the performance of the Contract or payments under the Contract, or matters affecting the risks, rights, and obligations of the parties under the Contract are not normally included in this Section, but rather in the appropriate sections of the *Conditions of Contract* and/or *Contract Data*.

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INSTRUCTIONS TO BIDDERS

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

A. GENERAL

IB.1 Scope of Bid & Source of Funds

1.1 Scope of Bid

The Procuring Agency as defined in the Bidding Data (hereinafter called —the Procuring Agency)) wishes to receive Bids for the Works summarized in the Bidding Data (hereinafter referred to as —the Works).

Bidders must quote for the complete scope of work. Any Bid covering partial scope of work will be rejected as non-responsive. Site visit will be held on November 29, 2024 at IBA City Campus at 11am with Sr. Manager Contracts (Project) for understanding the exact nature of the job.

1.2 Source of Funds

The Procuring Agency has arranged funds from its own sources or *Federal/ Provincial /Donor agency or any other source,* which may be indicated accordingly in bidding data towards the cost of the project/scheme.

IB.2 Eligible Bidders

- 2.1 Bidding is open to all firms and persons meeting the following requirements:
 - a) Duly licensed by the Pakistan Engineering Council (PEC) in the Cat C-6 or above.

In the event that prequalification of potential bidders has been undertaken, only bids from prequalified bidders will be considered for award of Contract.

b) if prequalification has not undertaken, the procuring agency may ask information and documents not limited to following:-

(i) company profile;

(ii) works of similar nature Minimum 3 Nos performed in last 5 years. Documentary evidence in the form of work order /agreement or experience certificate is mandatory. (iii) construction equipment . Scaffolding Pipes & Joints.

 $(iv) \quad \mbox{qualification} \mbox{ and experience of technical personnel and key site management.}$

- (v) Bank financial statement of last 3 years.
- (vi) information regarding litigations and abandoned works if any.

IB.3 Cost of Bidding

3.1 The bidder shall bear all costs associated with the preparation and submission of its bid and the Procuring Agency will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process (SPP Rules 24 & 25).

B. BIDDING DOCUMENTS

IB.4 Contents of Bidding Documents

4.1 In addition to Invitation for Bids, the Bidding Documents are those stated below, and should be read in conjunction with any Addendum issued in accordance with Sub-Clause IB.6.1.

1. Instructions to Bidders & Bidding Data

2. Form of Bid, Qualification Information & Schedules to Bid Schedules to Bid comprise the following:

- (i) Schedule A: Schedule of Prices/ Bill of Quantities (BoQ).
- (ii) Schedule B: Specific Works Data
- (iii) Schedule C: Works to be Performed by Subcontractors.
- (iv) Schedule D: Proposed Programme of Works
- (v) Schedule E: Method of Performing Works
- (vi) Schedule F: Integrity Pact (works costing Rs 10 million and above)
- 3. Conditions of Contract & Contract Data
- 4. Standard Forms:
 - (i) Form of Bid Security,
 - (ii) Form of Performance Security;
 - (iii) Form of Contract Agreement.
 - (iv) Form of Bank Guarantee for Advance Payment.
- 5. Specifications
- 6. Drawings, if any

IB.5 Clarification of Bidding Documents

5.1 A prospective bidder requiring any clarification(s) in respect of the Bidding Documents may notify the Engineer/Procuring Agency at the Engineer's/ Procuring Agency's address indicated in the Bidding Data.

5.2 An interested bidder, who has obtained bidding documents, may request for clarification of contents of bidding documents in writing and procuring agency shall respond to such quarries in writing within three calendar days, provided they are received at least five calendar days prior to the date of opening of bid (SPP Rule 23-1).

IB.6 Amendment of Bidding Documents (SPP Rules 22(2) & 22).

6.1 At any time prior to the deadline for submission of Bids, the Procuring Agency may, for any reason, whether at his own initiative or in response to a clarification requested by a interested bidder, modify the Bidding Documents by issuing addendum.

6.2 Any addendum thus issued shall be part of the Bidding Documents pursuant to Sub Clause

6.1 hereof and shall be communicated in writing to all purchasers of the Bidding Documents. Prospective bidders shall acknowledge receipt of each addendum in writing to the Procuring Agency.

6.3 To afford interested bidders reasonable time in which to take an addendum into account in preparing their Bids, the Procuring Agency may at its discretion extend the deadline for submission of Bids.

C. PREPARATION OF BIDS

IB.7 Language of Bid

7.1 All documents relating to the Bid shall be in the language specified in the Contract Data.

IB.8 Documents Comprising the Bid

- 8.1 The Bid submitted by the bidder shall comprise the following:
 - (a) Offer /Covering Letter
 - (b) Form of Bid duly filled, signed and sealed, in accordance with IB.14.3.

(c) Schedules (A to F) to Bid duly filled and initialed, in accordance with the instructions contained therein & in accordance with IB.14.3.

- (d) Bid Security furnished in accordance with IB.13.
- (e) Power of Attorney in accordance with IB 14.5.
- (f) Documentary evidence in accordance with IB.2(c) & IB.11
- (g) Documentary evidence in accordance with IB.12.

IB.9 Sufficiency of Bid

9.1 Each bidder shall satisfy himself before Bidding as to the correctness and sufficiency of his Bid and of the premium on the rates of CSR / rates and prices quoted/entered in the Schedule of Prices, which rates and prices shall except in so far as it is otherwise expressly provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper completion of the works.

9.2 The bidder is advised to obtain for himself at his own cost and responsibility all information that may be necessary for preparing the bid and entering into a Contract for execution of the Works.

IB.10 Bid Prices, Currency of Bid and Payment

10.1 The bidder shall fill up the Schedule of Prices (Schedule A to Bid) indicating the percentage above or below the Composite Schedule of Rates/unit rates and prices of the Works to be performed under the Contract. Prices in the Schedule of Prices/Bill of Quantities shall be quoted entirely in Pak Rupees keeping in view the instructions contained in the Preamble to Schedule of Prices.

10.2 Unless otherwise stipulated in the Conditions of Contract, prices quoted by the bidder shall remain fixed during the bidder's performance of the Contract and not subject to variation on any account.

10.3. The unit rates and prices in the Schedule of Prices or percentage above or below on the composite schedule of rates shall be quoted by the bidder in the currency as stipulated in Bidding Data.

10.4 Items for which no rate or price is entered by the Bidder will not be paid for by the Procuring Agency when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities.

IB.11 Documents Establishing Bidder's Eligibility and Qualifications

11.1 Pursuant to Clause IB.8, the bidder shall furnish, as part of its bid, documents establishing the bidder's eligibility to bid and its qualifications to perform the Contract if its bid is accepted.

11.2 Bidder must possess and provide evidence of its capability and the experience as stipulated in Bidding Data and the Qualification Criteria mentioned in the Bidding Documents.

IB.12 Documents Establishing Works' Conformity to Bidding Documents

12.1 The documentary evidence of the Works 'conformity to the Bidding Documents may be in the form of literature, drawings and data and the bidder shall furnish documentation as set out in Bidding Data.

12.2 The bidder shall note that standards for workmanship, material and equipment, and references to brand names or catalogue numbers, *if* any, designated by the Procuring Agency in the Technical Provisions are intended to be descriptive only and not restrictive.

IB.13 Bid Security

13.1 Each bidder shall furnish, as part of his bid, at the option of the bidder, a Bid Security as percentage of bid price/estimated cost or in the amount stipulated in Bidding Data in Pak. Rupees in the form of *Deposit at Call/ Payee's Order or a Bank Guarantee* issued by a Scheduled Bank in Pakistan in favor of the Procuring Agency valid for a period up to twenty eight (28) days beyond the bid validity date (*Bid security should not be below 2%.and not exceeding 5% of bid price/estimated cost SPP Rule 37*).

13.2 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Procuring Agency as non-responsive.

13.3 The bid securities of unsuccessful bidders will be returned upon award of contract to the successful bidder or on the expiry of validity of Bid Security whichever is earlier.

13.4 The Bid Security of the successful bidder will be returned when the bidder has furnished the required Performance Security, and signed the Contract Agreement (SPP Rule 37).

- 13.5 The Bid Security may be forfeited:
 - (a) if a bidder withdraws his bid during the period of bid validity; or
 - (b) if a bidder does not accept the correction of his Bid Price, pursuant to Sub-Clause 16.4 (b) hereof; or
 - (c) in the case of a successful bidder, if he fails within the specified time limit to:
- (i) furnish the required Performance Security or (ii) sign the contract Agreement.

IB.14 Validity of Bids, Format, Signing and Submission of Bid

14.1 Bids shall remain valid for the period stipulated in the Bidding Data after the date of bid opening.

14.2 In exceptional circumstances, Procuring Agency may request the bidders to extend the period of validity for a additional period but not exceeding 1/3 of the original period. The request and the bidders' responses shall be made in writing or by cable. A Bidder may refuse the request without forfeiting the Bid Security. A Bidder agreeing to the request will not be required or permitted to otherwise modify the Bid but will be required to extend the validity of Bid Security for the period of the extension, and in compliance with IB.13 in all respects (SPP Rule 38).

14.3 All Schedules to Bid are to be properly completed and signed.

14.4 No alteration is to be made in the Form of Bid except in filling up the blanks as directed. If any alteration be made or if these instructions be not fully complied with, the bid may be rejected.

14.5 Each bidder shall prepare Original and number of copies specified in the Bidding Data of the documents comprising the bid as described in IB.8 and clearly mark them -ORIGINAL|| and -COPY|| as appropriate. In the event of discrepancy between them, the original shall prevail.

14.6 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign (in the case of copies, Photostats are also acceptable). This shall be indicated by submitting a written Power of Attorney authorizing the signatory of the bidder to act for and on behalf of the bidder. All pages of the bid shall be initialed and official seal be affixed by the person or persons signing the bid.

14.7 The Bid shall be delivered in person or sent by registered mail at the address to Procuring Agency as given in Bidding Data.

D. SUBMISSION OF BID

IB.15 Deadline for Submission, Modification & Withdrawal of Bids

- 15.1 Bids must be received by the Procuring Agency at the address/provided in Bidding Data not later than the time and date stipulated therein.
- 15.2 The inner and outer envelopes shall

(a) be addressed to the Procuring Agency at the address provided in the Bidding Data;

(b) bear the name and identification number of the Contract as defined in the Bidding and Contract Data; and

(c) provide a warning not to open before the specified time and date for Bid opening as defined in the Bidding Data.

(d) in addition to the identification required in 15.2, the inner envelopes shall indicate the name and address of the Bidder to enable the Bid to be returned unopened in case it is declared late.

(e) If the outer envelope is not sealed and marked as above, the Procuring Agency will assume no responsibility for the misplacement or premature opening of the Bid.

15.3 Bids submitted through telegraph, telex, fax or e-mail shall not be considered.

15.4 Any bid received by the Procuring Agency after the deadline for submission prescribed in Bidding Data will be returned unopened to such bidder.

- 15.5 Any bidder may modify or withdraw his bid after bid submission provided that the modification or written notice of withdrawal is received by the Procuring Agency prior to the deadline for submission of bids.
- 15.6 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 pursuant to IB.13.5 (a).

E. BID OPENING AND EVALUATION

IB.16 Bid Opening, Clarification and Evaluation (SPP Rules 41, 42 & 43)

16.1 The Procuring Agency will open the bids, in the presence of bidders' representatives who choose to attend, at the time, date and in the place specified in the Bidding Data.

16.2 The bidder's name, Bid Prices, any discount, the presence or absence of Bid Security, and such other details as the Procuring Agency at its discretion may consider appropriate, will be announced by the Procuring Agency at the bid opening. The Procuring Agency will record the minutes of the bid opening. Representatives of the bidders who choose to attend shall sign the attendance sheet.

Any Bid Price or discount which is not read out and recorded at bid opening will not be taken into account in the evaluation of bid.

16.3 To assist in the examination, evaluation and comparison of Bids the Engineer/Procuring Agency may, at its discretion, ask the bidder for a clarification of its Bid. The request for clarification and the response shall be in writing and no change in the price or substance of the Bid shall be sought, offered or permitted (SPP Rule 43).

16.4 (a) Prior to the detailed evaluation, pursuant to IB.16.7 to 16.9, the Engineer/Procuring Agency will determine the substantial responsiveness of each bid to the Bidding Documents. For purpose of these instructions, a substantially responsive bid is one which conforms to all the terms and conditions of the Bidding Documents without material deviations. It will include determining the requirements listed in Bidding Data.

(b) Arithmetical errors will be rectified on the following basis:

If there is a discrepancy between the unit price and total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected. If there is a discrepancy between the words and figures the amount in words shall prevail. If there is a discrepancy between the Total Bid price entered in Form of Bid and the total shown in Schedule of Prices-Summary, the amount stated in the Form of Bid will be corrected by the Procuring Agency in accordance with the Corrected Schedule of Prices.

If the bidder does not accept the corrected amount of Bid, his Bid will be rejected and his Bid Security forfeited.

16.5 A Bid determined as substantially non-responsive will be rejected and will not subsequently be made responsive by the bidder by correction of the non-conformity.

16.6 Any minor informality or non-conformity or irregularity in a Bid which does not constitute a material deviation **(major deviation)** may be waived by Procuring Agency, provided such waiver does not prejudice or affect the relative ranking of any other bidders.

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

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

(B) Minor Deviations

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

16.7 The Engineer/Procuring Agency will evaluate and compare only the bids previously determined to be substantially responsive pursuant to IB.16.4 to 16.6 as per requirements given hereunder. Bids will be evaluated for complete scope of works. The prices will be compared on the basis of the Evaluated Bid Price pursuant to IB.16.8 herein below.

Technical Evaluation: It will be examined in detail whether the works offered by the bidder complies with the Technical Provisions of the Bidding Documents. For this purpose, the bidder's data submitted with the bid in Schedule B to Bid will be compared with technical features/criteria of the works detailed

in the Technical Provisions. Other technical information submitted with the bid regarding the Scope of Work will also be reviewed.

16.8 Evaluated Bid Price

In evaluating the bids, the Engineer/Procuring Agency will determine for each bid in addition to the Bid Price, the following factors (adjustments) in the manner and to the extent indicated below to determine the Evaluated Bid Price:

(i) making any correction for arithmetic errors pursuant to IB.16.4 hereof.

 $(ii) \qquad$ discount, if any, offered by the bidders as also read out and recorded at the time of bid opening.

- (iii) excluding **provisional sums** and the provisions for **contingencies** in the Bill
- of Quantities **if any**, but including **Day work**, where priced competitively.

IB.17 Process to be Confidential

17.1 Subject to IB.16.3 heretofore, no bidder shall contact Engineer/Procuring Agency on any matter relating to its Bid from the time of the Bid opening to the time the bid evaluation result is announced by the Procuring Agency. The evaluation result shall be announced at least seven (07) days prior to award of Contract (SPP Rule 45). The announcement to all bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated.

17.2 Any effort by a bidder to influence Engineer/Procuring Agency in the Bid evaluation, Bid comparison or Contract Award decisions may result in the rejection of his Bid. Whereas any bidder feeling aggrieved, may lodge a written complaint to Complaint Redressal Committee as per terms and conditions mentioned in SPP Rules 31 & 32. However, mere fact of lodging a complaint shall not warrant suspension of procurement process.

17.3 Bidders may be excluded if involved in **"Corrupt and Fraudulent Practices"** means

either one or any combination of the practices given below SPP Rule2(q);

(i) —**Coercive Practice** means any impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence the actions of a party to achieve a wrongful gain or to cause a wrongful loss to another party;

(ii) —**Collusive Practice** means any arrangement between two or more parties to the procurement process or contract execution, designed to achieve with or without the knowledge of the procuring agency to establish prices at artificial, noncompetitive levels for any wrongful gain; (iii) **"Corrupt Practice"** means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence the acts of another party for wrongful gain;

(iv) —**Fraudulent Practice**" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation.

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

F. AWARD OF CONTRACT IB.18. Post Qualification

18.1 The Procuring Agency, at any stage of the bid evaluation, having credible reasons for or *prima facie* evidence of any defect in contractor 's capacities, may require the contractors to provide information concerning their professional, technical, financial, legal or managerial competence whether already prequalified or not:

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

18.2 The determination will take into account the bidder's financial and technical capabilities. It will be based upon an examination of the documentary evidence of the bidders' qualifications submitted under B.11, as well as such other information required in the Bidding Documents.

IB.19 Award Criteria & Procuring Agency's Right

19.1 Subject to IB.19.2, the Procuring Agency will award the Contract to the bidder whose bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid Price, provided that such bidder has been determined to be qualified to satisfactory perform the Contract in accordance with the provisions of the IB.18.

19.2 Not withstanding IB.19.1, the Procuring Agency reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidders or any obligation to inform the affected bidders of the grounds for the Procuring Agency's action except that the grounds for its rejection of all bids shall upon request be communicated, to any bidder who submitted a bid, without justification of the grounds. Notice of the rejection of all the bids shall be given promptly to all the bidders (SPP Rule 25).

IB.20 Notification of Award & Signing of Contract Agreement

20.1 Prior to expiration of the period of bid validity prescribed by the Procuring Agency, the Procuring Agency will notify the successful bidder in writing (—Letter of Acceptance||) that his bid has been accepted (SPP Rule 49).

20.2 Within seven (07) days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Procuring Agency will send the successful bidder the Form of Contract Agreement provided in the Bidding Documents, incorporating all agreements between the parties.

20.3 The formal Agreement between the Procuring Agency and the successful bidder duly stamped at rate of ----% of bid price(updated from time to time) stated in Letter of Acceptance shall be executed within seven (07) days of the receipt of Form of Contract Agreement by the successful bidder from the Procuring Agency.

IB.21 Performance Security

21.1 The successful bidder shall furnish to the Procuring Agency a Performance Security in the form and the amount stipulated in the Conditions of Contract within a period of fourteen (14) days after the receipt of Letter of Acceptance (SPP 39).

21.2 Failure of the successful bidder to comply with the requirements of Sub-Clauses IB.20.2 & 20.3 or 21.1 or Clause IB.22 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.

21.3 Publication of Award of Contract: within seven days of the award of contract, the procuring shall publish on the website of the authority and on its own website, if such a website exists, the results of the bidding process, identifying the bid through procurement identifying Number if any and the following information:

- (1) Evaluation Report;
- (2) Form of Contract and letter of Award;
- (3) Bill of Quantities or Schedule of Requirements. (SPP Rule 50)

IB.22 Integrity Pact The Bidder shall sign and stamp the Form of Integrity Pact provided at Schedule-F to Bid in the Bidding Document for all Sindh Government procurement contracts exceeding Rupees ten (10) million. Failure to provide such Integrity Pact shall make the bid nonresponsive (SPP Rule 89).

BIDDING DATA

- (a) Name of Procuring Agency: Institute of Business Administration, Karachi
- (b) Brief Description of Works: Rehabilitation of Main Gate at City Campus
- (c) Procuring Agency's address:-Main Campus, University Enclave, Karachi
- (d) Amount of Bid Security:- Bid Security of 2% of total amount/cost will be submitted along with Tender Documents in shape of PAY ORDER / DEMAND DRAFT only in the name of Institute of Business Administration, Karachi.
- (e) Period of Bid Validity (days): Ninety Days
- (f) Performance Security Deposit: Successful bidder should provide 5% Performance Security of total value of Work Order in the form of Pay Order or bank guarantee after acceptance of the Work Order. The Performance Security shall extend at least three months beyond the Date of Delivery/Completion of work / Contract.
- (g) Deadline for Submission of Bids along with time: The last date of submit the Tender Document in sealed envelope in December 04, 2024 by 3:00 PM in the Office of Head of Procurement, Ground Floor, Fauji Foundation Building, IBA Main Campus, University Enclave, Karachi. The Tender will be opened on same day at 3:30 PM in the presence of representatives who may care to attend.
- (h) Venue, Time, and Date of Bid Opening: Tender will be opened on December 04, 2024 on 3:30 PM at IBA, Main Campus, University Enclave, Karachi.
- (i) Time for Completion from written order of commence: 60 days.
- (j) Liquidated damages: 2% liquidated damages of the total amount will be imposed per week for which the company/firm/agency failed to complete work within the delivery/execution period and maximum up to 10%.
- (k) Deposit Receipt No: Date: Amount: (in words and figures) Pay Order / Demand Draft

_____, Amount Rs _____ Drawn on Bank _____ Dated _____.

16.4 Responsiveness of Bids

(i) Bid is valid till required period,

- *(ii) Bid prices are firm during currency of contract/Price adjustment;
 - (iii) Completion period offered is within specified limits,

(iv) Bidder is eligible to Bid and possesses the requisite experience, capability, and qualification.

- (v) Bid does not deviate from basic technical requirements and
- (vi) Bids are generally in order, etc.

*Procuring agency can adopt either of two options. (Select either of them)

(a) **Fixed Price contract:** In these contracts no escalation will be provided during currency of the contract and normally period of completion of these works is upto 12 months.

(b) **Price adjustment contract:** In these contracts' escalation will be paid only on those items and in the manner as notified by Finance Department, Government of Sindh, after bid opening during currency of the contract.

FORM OF BID AND SCHEDULES TO BID

FORM OF BID (LETTER OF OFFER)

Bid Reference No. _____

(Name of Works)

To:

Gentlemen,

1. Having examined the Bidding Documents including Instructions to Bidders, Bidding Data, Conditions of Contract, Contract Data, Specifications, Drawings, if any, Schedule of Prices and Addenda Nos.

______ for the execution of the above-named works, we, the undersigned, being a company doing business under the name of and address

and being duly incorporated under the laws of Pakistan hereby offer to execute and complete such works and remedy any defects therein in conformity with the said Documents including Addenda thereto for the Total Bid Price of Rs______) or such other sum as may be ascertained in accordance with the said Documents.

2. We understand that all the Schedules attached hereto form part of this Bid.

3. As security for due performance of the undertakings and obligations of this Bid, we submit herewith a Bid Security in the amount of _______ drawn in your favor or made payable to you and valid for a period of twenty eight (28) days beyond the period of validity of Bid.

4. We undertake, if our Bid is accepted, to commence the Works and to deliver and complete the Works comprised in the Contract within the time(s) stated in Contract Data.

5. We agree to abide by this Bid for the period of _____ days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

6. Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

7. We undertake, if our Bid is accepted, to execute the Performance Security referred to in Conditions of Contract for the due performance of the Contract.

8. We understand that you are not bound to accept the lowest or any bid you may receive.

9. We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other person or persons making a bid for the Works.

Dated this _____day of _____, 20

Signature _____

in the capacity of ______duly authorized to sign bid for and on behalf of

(Name of Bidder in Block Capitals)

(Seal)

Address

Witness:

(Signature)_____

Name:______ Address: ______

[SCHEDULES TO BID INCLUDE THE FOLLOWING:

- Schedule A to Bid: Schedule of Prices
- Schedule B to Bid: Specific Works Data
- Schedule C to Bid: Works to be Performed by Subcontractors
- Schedule D to Bid: Proposed Program of Works
- Schedule E to Bid: Method of Performing Works
- Schedule F to Bid: Integrity Pact]

SCHEDULE – A TO BID

SCHEDULE OF PRICES

<u>Sr. No.</u>	Page No.
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2. Schedule of Prices	26
*(a) Summary of Bid Prices	
(b) Detailed Schedule of Prices /Bill of Quantities (BOQ)	

*

PREAMBLE TO SCHEDULE OF PRICES

1. General

1.1 The Schedule of Prices shall be read in conjunction with the Conditions of Contract, Contract Data together with the Specifications and Drawings, if any.

1.2 The Contract shall be for the whole of the works as described in these Bidding Documents. Bids must be for the complete scope of works.

2. Description

2.1 The general directions and descriptions of works and materials are not necessarily repeated nor summarized in the Schedule of Prices. References to the relevant sections of the Bidding Documents shall be made before entering prices against each item in the Schedule of Prices.

3. Units & Abbreviations

3.1 Units of measurement, symbols and abbreviations expressed in the Bidding Documents shall comply with the System International d' Unites (SI Units).

(Note: The abbreviations to be used in the Schedule of Prices to be defined by the Procuring Agency).

4. Rates and Prices

4.1 Except as otherwise expressly provided under the Conditions of Contract, the rates and amounts entered in the Schedule of Prices shall be the rates at which the Contractor shall be paid and shall be the full inclusive value of the works set forth or implied in the Contract; except for the amounts reimbursable, if any to the Contractor under the Contract.

4.2 Unless otherwise stipulated in the Contract Data, the premium, rates and prices entered by the bidder shall not be subject to adjustment during the performance of the Contract.

4.3 All duties, taxes and other levies payable by the Contractor shall be included in the rates and prices.

4.4 The whole cost of complying with the provisions of the Contract shall be included in the items provided in the Schedule of Prices, 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 and no separate payment will be made for those items.

The rates, prices and amounts shall be entered against each item in the Schedule of Prices. Any item against which no rate or price is entered by the bidder will not be paid for by the Procuring Agency when executed and shall be deemed covered by the rates and prices for other items in the Schedule of Prices.

4.5 (a) The bidder shall be deemed to have obtained all information as to and all requirements related thereto which may affect the bid price.

*(b) The Contractor shall be responsible to make complete arrangements for the transportation of the Plant to the Site.

*(Procuring Agency may modify as appropriate)

4.6 The Contractor shall provide for all parts of the Works to be completed in every respect. Notwithstanding that any details, accessories, etc. required for the complete installation and satisfactory operation of the Works, are not specifically mentioned in the Specifications, such details shall be considered as included in the Contract Price.

5. Bid Prices

5.1 Break-up of Bid Prices

The various elements of Bid Prices shall be quoted as detailed by the Procuring Agency in the format of Schedule of Prices.

The bidder shall recognize such elements of the costs which he expects to incur the performance of the Works and shall include all such costs in the rates and amounts entered in the Schedule of Prices.

5.2 Total Bid Price

The total of bid prices in the Schedule of Prices shall be entered in the Summary of Bid Prices.

6. Provisional Sums and Day work

6.1 Provisional Sums included and so designated in the Schedule of Prices if any, shall be expended in whole or in part at the direction and discretion of the Engineer/Procuring Agency. The Contractor will only receive payment in respect of Provisional Sums, if he has been instructed by the Engineer/Procuring Agency to utilize such sums.

6.2 Day work rates in the contractor's bid are to be used for small additional amounts of work and only when the Engineer have given written instructions in advance for additional work to be paid for in that way.

WORKS TO BE PERFORMED BY SUBCONTRACTORS*

The bidder will do the work with his own forces except the work listed below which he intends to sub-contract.

Items of Works	Name and address of	Statement of
similar to be Sub-Contracted	Sub-Contractors	works
previously		executed.
		(attach evidence)

Note:

* The Procuring Agency should decide whether to allow subcontracting or not.

In case Procuring Agency decides to allow subcontracting then following conditions shall be complied with:

1. No change of Sub-Contractors shall be made by the bidder without prior approval of the Procuring Agency.

2. The truthfulness and accuracy of the statement as to the experience of Sub-

Contractors is guaranteed by the bidder. The Procuring Agency's judgment shall be final as to the evaluation of the experience of Sub-Contractors submitted by the bidder.

3. Statement of similar works shall include description, location & value of works, year completed and name & address of the clients.

D TO BID

PROPOSED PROGRAMME OF WORKS

Bidder shall provide a program in a bar-chart or Program Evaluation and Review Technique (PERT) or Critical Path Method (CPM) showing the sequence of work items by which he proposes to complete the works of the entire Contract. The program should indicate the sequence of work items and the period of time during which he proposes to complete the works including the activities like designing, schedule of submittal of drawings, ordering and procurement of materials, manufacturing, delivering, construction of civil works, erection, testing and commissioning of works to be supplied under the Contract.

E TO BID

METHOD OF PERFORMING WORKS

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

- The sequence and methods in which he proposes to carry out the Works, including the number of shifts per day and hours per shift, he expects to work.
- A list of all major items of construction and plant erection, tools and vehicles proposed to be used in delivering/carrying out the works at site.
- The procedure for installation of equipment and transportation of equipment and materials to the site.
- Organization chart indicating head office & field office personnel involved in management, supervision and engineering of the Works to be done under the Contract.

F TO BID

(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC PAYABLE BY CONTRACTORS

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE)

Contract No._____ Dated _____ Contract Value: _____ Contract Title: _____

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

[name of Contractor] accepts full responsibility and strict liability that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with PA and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

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

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

[Procuring Agency]

[Contractor]

CONDITIONS OF CONTRACT

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CONDITIONS OF CONTRACT

1. GENERAL PROVISIONS

1.1 **Definitions**

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

The Contract

1.1.1 —Contract || means the Contract Agreement and the other documents listed in the Contract Data.

1.1.2 —Specifications∥ means the document as listed in the Contract Data, including Procuring Agency's requirements in respect of design to be carried out by the Contractor (if any), and any Variation to such document.

1.1.3 —Drawings∥ means the Procuring Agency's drawings of the Works as listed in the Contract Data, and any Variation to such drawings.

Persons

1.1.4 —Procuring Agency means the person named in the Contract Data and the legal successors in title to this person, but not (except with the consent of the Contractor) any assignee.

1.1.5 — Contractor || means the person named in the Contract Data and the legal successors in title to this person, but not (except with the consent of the Procuring Agency) any assignee.

1.1.6 —Party means either the Procuring Agency or the Contractor.

Dates, Times and Periods

1.1.7 —Commencement Date means the date fourteen (14) days after the date the Contract comes into effect or any other date named in the Contract Data.

1.1.8 —Day means a calendar day

1.1.9 —Time for Completion means the time for completing the Works as stated in the Contract Data (or as extended under Sub-Clause 7.3), calculated from the Commencement Date.

Money and Payments

1.1.10 —Cost∥ means all expenditure properly incurred (or to be incurred) by the Contractor, whether on or off the Site, including overheads and similar charges but does not include any allowance for profit.

Other Definitions

1.1.11 — Contractor's Equipment || means all machinery, apparatus and other things required for the execution of the Works but does not include Materials or Plant intended to form part of the Works.

1.1.12 —Country∥ means the Islamic Republic of Pakistan.

1.1.13 — Procuring Agency's Risks || means those matters listed in Sub-Clause 6.1.

1.1.14 —Force Majeure means an event or circumstance which makes performance of a Party's obligations illegal or impracticable and which is beyond that Party's reasonable control.

1.1.15 _Materials|| means things of all kinds (other than Plant) to be supplied and incorporated in the Works by the Contractor.

1.1.16 — Plant∥ means the machinery and apparatus intended to form or forming part of the Works.

1.1.17 — Site∥ means the places provided by the Procuring Agency where the Works are to be executed, and any other places specified in the Contract as forming part of the Site.

1.1.18 —Variation means a change which is instructed by the Engineer/Procuring Agency under Sub-Clause 10.1.

1.1.19 _Works means any or all the works whether Supply, Installation, Construction etc. and design (if any) to be performed by the Contractor including temporary works and any variation thereof.

1.1.20 — Engineer∥ means the person notified by the Procuring Agency to act as Engineer for the purpose of the Contract and named as such in Contract Data.

1.2 Interpretation

Words importing persons or parties shall include firms and organizations. Words importing singular or one gender shall include plural or the other gender where the context requires.

1.3 **Priority of Documents**

The documents forming the Contract are to be taken as mutually explanatory of one another. If an ambiguity or discrepancy is found in the documents, the priority of the documents shall be in accordance with the order as listed in the Contract Data.

1.4 **Law**

The law of the Contract is the relevant Law of Islamic Republic of Pakistan.

1.5 **Communications**

All Communications related to the Contract shall be in English language.

1.6 **Statutory Obligations**

The Contractor shall comply with the Laws of Islamic Republic of Pakistan and shall give all notices and pay all fees and other charges in respect of the Works.

2. THE PROCURING AGENCY

2.1 **Provision of Site**

The Procuring Agency shall provide the Site and right of access thereto at the times stated in the Contract Data.

Site Investigation Reports are those that were included in the bidding documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.

2.2 **Permits etc.**

The Procuring Agency shall, if requested by the Contractor, assist him in applying for permits, licences or approvals which are required for the Works.

2.3 Engineer's/Procuring Agency's Instructions

The Contractor shall comply with all instructions given by the Procuring Agency or the Engineer, if notified by the Procuring Agency, in respect of the Works including the suspension of all or part of the works.

2.4 Approvals

No approval or consent or absence of comment by the Engineer/Procuring Agency shall affect the Contractor's obligations.

3. ENGINEER'S/PROCURING AGENCY'S REPRESENTATIVES

3.1 Authorized Person

The Procuring Agency shall appoint a duly authorized person to act for him and on his behalf for the purposes of this Contract. Such authorized person shall be duly identified in the Contract Data or otherwise notified in writing to the Contractor as soon as he is so appointed. In either case the Procuring Agency shall notify the Contractor, in writing, the precise scope of the authority of such authorized person at the time of his appointment.

3.2 Engineer's/Procuring Agency's Representative

The name and address of Engineer's/Procuring Agency's Representative is given in Contract Data. However the Contractor shall be notified by the Engineer/Procuring Agency, the delegated duties and authority before the Commencement of works.

4. THE CONTRACTOR

4.1 General Obligations

The Contractor shall carry out the works properly and in accordance with the Contract. The Contractor shall provide all supervision, labour, Materials, Plant and Contractor's Equipment which may be required

4.2 **Contractor's Representative**

The Contractor shall appoint a representative at site on full time basis to supervise the execution of work and to receive instructions on behalf of the Contractor but only after obtaining the consent of the Procuring Agency for such appointment which consent shall not be withheld without plausible reason(s) by the Procuring Agency. Such authorized representative may be substituted/ replaced by the Contractor at any time during the Contract Period but only after obtaining the consent of the Procuring Agency as aforesaid.

4.3 Subcontracting

The Contractor shall not subcontract the whole of the works. The Contractor shall not subcontract any part of the works without the consent of the Procuring Agency.

4.4 **Performance Security**

The Contractor shall furnish to the Procuring Agency within fourteen (14) days after receipt of Letter of Acceptance a Performance Security at the option of the bidder, in the form of Payee's order /Bank Draft or Bank Guarantee from scheduled bank for the amount and validity specified in Contract Data.

5. DESIGN BY CONTRACTOR

5.1 Contractor's Design

The Contractor shall carry out design to the extent specified, as referred to in the Contract Data. The Contractor shall promptly submit to the Engineer/Procuring Agency all designs prepared by him, within fourteen (14) days of receipt the Engineer/Procuring Agency shall notify any comments or, if the design submitted is not in accordance with the Contract, shall reject it stating the reasons. The

Contractor shall not construct any element of the works designed by him within fourteen (14) days after the design has been submitted to the Engineer/Procuring Agency or which has been rejected. Design that has been rejected shall be promptly amended and resubmitted. The Contractor shall resubmit all designs commented on taking these comments into account as necessary.

5.2 **Responsibility for Design**

The Contractor shall remain responsible for his bided design and the design under this Clause, both of which shall be fit for the intended purposes defined in the Contract and he shall also remain responsible for any infringement of any patent or copyright in respect of the same. The Engineer/Procuring Agency shall be responsible for the Specifications and Drawings.

6. **PROCURING AGENCY'S RISKS**

6.1 The Procuring Agency's Risks

The Procuring Agency's Risks are:-

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

b) rebellion, terrorism, revolution, insurrection, military or usurped power, or civil war, within the Country;

c) riot, commotion or disorder by persons other than the Contractor's personnel and other employees including the personnel and employees of Sub Contractors, affecting the Site and/or the Works;

d) ionizing radiations, or contamination by radio-activity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosive, or other hazardous properties of any explosive nuclear assembly or nuclear component of such an assembly, except to the extent to which the Contractor/Sub-Contractors may be responsible for the use of any radio-active material; Pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds;
e) use or occupation by the Procuring Agency of any part of the Works, except as may be specified in the Contract;

f)late handing over of sites, anomalies in drawings, late delivery of designs and drawings of any part of the Works by the Procuring Agency's personnel or by others for whom the Procuring Agency is responsible;

g) a suspension under Sub-Clause 2.3 unless it is attributable to the Contractor's failure; and

h) physical obstructions or physical conditions other than climatic conditions, encountered on the Site during the performance of the Works, for which the Contractor immediately notified to the Procuring Agency and accepted by the Procuring Agency.

7. TIME FOR COMPLETION

7.1 Execution of the Works

The Contractor shall commence the Works on the Commencement Date and shall proceed expeditiously and without delay and shall complete the Works, subject to Sub-Clause 7.3 below, within the Time for Completion.

7.2 Program

Within the time stated in the Contract Data, the Contractor shall submit to the Engineer/Procuring Agency a program for the Works in the form stated in the Contract Data.

7.3 Extension of Time

The Contractor shall, within such time as may be reasonable under the circumstances, notify the Procuring Agency/Engineer of any event(s) falling within the scope of Sub-Clause 6.1 or 10.3 of these Conditions of Contract and request the Procuring Agency/Engineer for a reasonable extension in the time for the completion of works. Subject to the aforesaid, the Procuring Agency/Engineer shall determine such reasonable extension in the time for the completion of works as may be justified in the light of the details/particulars supplied by the Contractor in connection with the such determination by the Procuring Agency/Engineer within such period as may be prescribed by the Procuring Agency/Engineer for the same; and the Procuring Agency may extend the time for completion as determined.

7.4 Late Completion

If the Contractor fails to complete the Works within the Time for Completion, the Contractor's only liability to the Procuring Agency for such failure shall be to pay the amount as **liquidity damages** stated in the Contract Data for each day for which he fails to complete the Works.

8. TAKING-OVER

8.1 Completion

The Contractor may notify the Engineer/Procuring Agency when he considers that the Works are complete.

8.2 Taking-Over Notice

Within fourteen (14) days of the receipt of the said notice of completion from the Contractor the Procuring Agency/Engineer shall either takeover the completed works and issue a Certificate of Completion to that effect or shall notify the Contractor his reasons for not taking-over the works. While issuing the Certificate of Completion as aforesaid, the Procuring Agency/Engineer may identify any outstanding items of work which the Contractor shall undertake during the Maintenances Period.

9. REMEDYING DEFECTS

9.1 **Remedying Defects**

The Contractor shall for a period stated in the Contract Data from the date of issue of the Certificate of Completion carry out, at no cost to the Procuring Agency, repair and rectification work which is necessitated by the earlier execution of poor quality of work or use of below specifications material in the execution of Works and which is so identified by the Procuring Agency/Engineer in writing within the said period. Upon expiry of the said period, and subject to the Contractor's faithfully performing his aforesaid obligations, the Procuring Agency/Engineer shall issue a Maintenance Certificate whereupon all obligations of the Contractor under this Contract shall come to an end.

Failure to remedy any such defects or complete outstanding work within a reasonable time shall entitle the Procuring Agency to carry out all necessary works at the Contractor's cost. However, the cost of remedying defects not attributable to the Contractor shall be valued as a Variation.

9.2 Uncovering and Testing

The Engineer/Procuring Agency may give instruction as to the uncovering and/or testing of any work. Unless as a result of an uncovering and/or testing it is established that the Contractor's design, materials, plant or workmanship are not in accordance with the Contract, the Contractor shall be paid for such uncovering and/or testing as a Variation in accordance with Sub-Clause 10.2.

10. VARIATIONS AND CLAIMS

10.1 **Right to Vary**

The Procuring Agency/Engineer may issue Variation Order(s) in writing. Where for any reason it has not been possible for the Procuring Agency/Engineer to issue such Variations Order(s), the Contractor may confirm any verbal orders given by the Procuring Agency/Engineer in writing and if the same are not refuted/denied by the Procuring Agency/Engineer within ten (10) days of the receipt of such confirmation the same shall be deemed to be a Variation Orders for the purposes of this Sub-Clause.

10.2 Valuation of Variations

Variations shall be valued as follows:

- a) at a lump sum price agreed between the Parties, or
- b) where appropriate, at rates in the Contract, or

c) in the absence of appropriate rates, the rates in the Contract shall be used as the basis for valuation, or failing which

d) at appropriate new rates, as may be agreed or which the Engineer/Procuring Agency considers appropriate, or

e) if the Engineer/Procuring Agency so instructs, at day work rates set out in the Contract Data for which the Contractor shall keep records of hours of labour and Contractor's Equipment, and of Materials, used.

10.3 **Changes in the Quantities.**

a) If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25 percent, provided the change exceeds 1 percent of the Initial Contract Price, the Procuring Agency/Engineer shall adjust the rate to allow for the change and will be valued as per sub clause 10.2.

b) The Engineer shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15 percent, except with the prior approval of the Procuring Agency.

c) If requested by the Engineer, the contractor shall provide the Engineer with a detailed cost breakdown of any rate in the Bill of Quantities.

10.4 Early Warning

The Contractor shall notify the Engineer/Procuring Agency in writing as soon as he is aware of any circumstance which may delay or disrupt the Works, or which may give rise to a claim for additional payment.

To the extent of the Contractor's failure to notify, which results to the Engineer/Procuring Agency being unable to keep all relevant records or not taking steps to minimize any delay, disruption, or Cost, or the value of any Variation, the Contractor's entitlement to extension of the Time for Completion or additional payment shall be reduced/rejected.

10.5 Valuation of Claims

If the Contractor incurs Cost as a result of any of the Procuring Agency's Risks, the Contractor shall be entitled to the amount of such Cost. If as a result of any Procuring Agency's Risk, it is necessary to change the Works, this shall be dealt with as a Variation subject to Contractor's notification for intention of claim to the Engineer/Procuring Agency within fourteen (14) days of the occurrence of cause.

10.6 Variation and Claim Procedure

The Contractor shall submit to the Engineer/Procuring Agency an itemized detailed breakdown of the value of variations and claims within twenty eight (28) days of the instruction or of the event giving rise to the claim. The Engineer/Procuring Agency shall check and if possible agree the value. In the absence of agreement, the Procuring Agency shall determine the value.

11. CONTRACT PRICE AND PAYMENT

11.1 (a) Terms of Payments

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 11.3, be paid by the Procuring Agency to the Contractor within 30 days after such Interim Payment Certificate has been jointly verified by Procuring Agency and Contractor, or, in the case of the Final Certificate referred to in Sub Clause 11.5, within 60days after such Final Payment Certificate has been jointly verified by Procuring Agency and Contractor; Provided that the Interim Payment shall be caused in thirty (30) days and Final Payment in 60 days in case of foreign funded project. In the event of the failure of the Procuring Agency to make payment within 90 days then Procuring Agency shall pay to the Contractor compensation at the 28 days rate of KIBOR+2% per annum in local currency and LIBOR+1% for foreign currency, upon all sums unpaid from the date by which the same should have been paid.

(b) Valuation of the Works

The Works shall be valued as provided for in the Contract Data, subject to Clause 10.

11.2 Monthly Statements

The Contractor shall be entitled to be paid at monthly intervals:

a) the value of the Works executed less to the cumulative amount paid previously; and

b) value of secured advance on the materials and valuation of variations (if any).

The Contractor shall submit each month to the Engineer/Procuring Agency a statement showing the amounts to which he considers himself entitled.

11.3 Interim Payments

Within a period not exceeding seven (07) days from the date of submission of a statement for interim payment by the Contractor, the Engineer shall verify the same and within a period not exceeding thirty (30/60) days from the said date of submission by the Contractor, the Procuring Agency shall pay to the Contractor the sum subject to adjustment for deduction of the advance payments and retention money.

11.4 Retention

Retention money shall be paid by the Procuring Agency to the Contractor within fourteen (14) days after either the expiry of the period stated in the Contract Data, or the remedying of notified defects, or the completion of outstanding work, all as referred to in Sub-Clause 9.1, whichever is the later.

11.5 Final Payment

Within twenty one (21) days from the date of issuance of the Maintenance Certificate the Contractor shall submit a final account to the Engineer to verify and the Engineer shall verify the same within fourteen (14) days from the date of submission and forward the same to the Procuring Agency together with any documentation reasonably required to enable the Procuring Agency to ascertain the final contract value.

Within sixty (60) days from the date of receipt of the verified final account from the Engineer, the Procuring Agency shall pay to the Contractor any amount due to the Contractor. While making such payment the Procuring Agency may, for reasons to be given to the Contractor in writing, withhold any part or parts of the verified amount.

11.6 Currency

Payment shall be in the currency stated in the Contract Data.

12. DEFAULT

12.1 **Defaults by Contractor**

If the Contractor abandons the Works, refuses or fails to comply with a valid instruction of the Engineer/Procuring Agency or fails to proceed expeditiously and without delay, or is, despite a written complaint, in breach of the Contract, the Procuring Agency may give notice referring to this Sub-Clause and stating the default.

If the Contractor has not taken all practicable steps to remedy the default within fourteen (14) days after receipt of the Procuring Agency's notice, the Procuring Agency may by a second notice given within a further twenty one (21) days, terminate the Contract. The Contractor shall then demobilize from the Site leaving behind any Contractor's Equipment which the Procuring Agency instructs, in the second notice, to be used for the completion of the Works at the risk and cost of the Contractor.

12.2 Defaults by Procuring Agency

If the Procuring Agency fails to pay in accordance with the Contract, or is, despite a written complaint, in breach of the Contract, the Contractor may give notice referring to this Sub-Clause and stating the default. If the default is not remedied within fourteen (14) days after the Procuring Agency's receipt of this notice, the Contractor may suspend the execution of all or parts of the Works.

If the default is not remedied within twenty eight (28) days after the Procuring Agency's receipt of the Contractor's notice, the Contractor may by a second notice given within a further twenty one (21) days, terminate the Contract. The Contractor shall then demobilize from the Site.

12.3 Insolvency

If a Party is declared insolvent under any applicable law, the other Party may by notice terminate the Contract immediately. The Contractor shall then demobilize from the site leaving behind, in the case of the Contractor's insolvency, any Contractor's Equipment which the Procuring Agency instructs in the notice is to be used for the completion of the Works.

12.4 **Payment upon Termination**

After termination, the Contractor shall be entitled to payment of the unpaid balance of the value of the works executed and of the Materials and Plant reasonably delivered to the site, adjusted by the following:

- a) any sums to which the Contractor is entitled under Sub-Clause 10.4,
- b) any sums to which the Procuring Agency is entitled,

c) if the Procuring Agency has terminated under Sub-Clause 12.1 or 12.3, the Procuring Agency shall be entitled to a sum equivalent to twenty percent (20%) of the value of parts of the Works not executed at the date of the termination, and

d) if the Contractor has terminated under Sub-Clause 12.2 or 12.3, the Contractor shall be entitled to the cost of his demobilization together with a sum equivalent to ten percent (10%) of the value of parts of the works not executed at the date of termination.

The net balance due shall be paid or repaid within twenty eight (28) days of the notice of termination.

13. RISKS AND RESPONSIBILITIES

13.1 **Contractor's Care of the Works**

Subject to Sub-Clause 9.1, the Contractor shall take full responsibility for the care of the Works from the Commencement Date until the date of the Procuring Agency's/Engineer's issuance of Certificate of Completion under Sub-Clause 8.2. Responsibility shall then pass to the Procuring Agency. If any loss or damage happens to the Works during the above period, the Contractor shall rectify such loss or damage so that the Works conform with the Contract.

Unless the loss or damage happens as a result of any of the Procuring Agency's Risks, the Contractor shall indemnify the Procuring Agency, or his agents against all claims loss, damage and expense arising out of the Works.

13.2 Force Majeure

If Force Majeure occurs, the Contractor shall notify the Engineer/Procuring Agency immediately. If necessary, the Contractor may suspend the execution of the Works and, to the extent agreed with the Procuring Agency demobilize the Contractor's Equipment.

If the event continues for a period of eighty four (84) days, either Party may then give notice of termination which shall take effect twenty eight (28) days after the giving of the notice. After termination, the Contractor shall be entitled to payment of the unpaid balance of the value of the Works executed and of the Materials and Plant reasonably delivered to the Site, adjusted by the following:

- a) any sums to which the Contractor is entitled under Sub-Clause 10.4,
- b) the cost of his demobilization, and
- c) less any sums to which the Procuring Agency is entitled. The net balance due shall be paid or repaid within thirty-five (35) days of the notice of termination.

14. INSURANCE

14.1 Arrangements

The Contractor shall, prior to commencing the Works, effect insurances of the types, in the amounts and naming as insured the persons stipulated in the Contract Data except for items (a) to (e) and (i) of the Procuring Agency's Risks under SubClause 6.1. The policies shall be issued by insurers and in terms approved by the Procuring Agency. The Contractor shall provide the Engineer/Procuring Agency with evidence that any required policy is in force and that the premiums have been paid.

14.2 Default

If the Contractor fails to effect or keep in force any of the insurances referred to in the previous Sub-Clause, or fails to provide satisfactory evidence, policies or receipts, the Procuring Agency may, without prejudice to any other right or remedy, effect insurance for the cover relevant to such as a default and pay the premiums due and recover the same plus a sum in percentage given in Contractor Data from any other amounts due to the Contractor.

15. RESOLUTION OF DISPUTES

15.1 Engineer's Decision

If a dispute of any kind whatsoever arises between the Procuring Agency and the Contractor in connection with the works, 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 twenty eight (28) days after the day on which he received such reference, the

Engineer shall give notice of his decision to the Procuring Agency (Superintending Engineer) and the Contractor.

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

15.2 Notice of Dissatisfaction

If a Party is dissatisfied with the decision of the Engineer of consultant or if no decision is given within the time set out in Sub-Clause 15.1 here above, the Party may give notice of dissatisfaction referring to this Sub-Clause within fourteen (14) days of receipt of the decision or the expiry of the time for the decision. If no notice of dissatisfaction is given within the specified time, the decision shall be final and binding on the Parties. If notice of dissatisfaction is given within the specified time, the decision shall be binding on the Parties who shall give effect to it without delay unless and until the decision of the Engineer is revised by an arbitrator.

If a contractor is dissatisfied with the decision of the Engineer of the department or decision is not given in time then he can approach Superintending Engineer within 14 days, in case of dissatisfaction with decision of Superintending Engineer or not decided within 28 days, then arbitration process would be adopted as per clause 15.3.

15.3 Arbitration

A dispute which has been the subject of a notice of dissatisfaction shall be finally settled as per provisions of Arbitration Act 1940 (Act No. X of 1940) and Rules made there under and any statutory modifications thereto. Any hearing shall be held at the place specified in the Contract Data and in the language referred to in Sub-Clause 1.5.

16 INTEGRITY PACT

16.1 If the Contractor or any of his Sub-Contractors, agents or servants is found to have violated or involved in violation of the Integrity Pact signed by the Contractor as Schedule-F to his Bid, then the Procuring Agency shall be entitled to:

(a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by the Contractor or any of his Sub-Contractors, agents or servants;

(b) terminate the Contract; and

(c) recover from the Contractor any loss or damage to the Procuring Agency as a result of such termination or of any other corrupt business practices of the Contractor or any of his Sub-Contractors, agents or servants.

On termination of the Contract under Sub-Para (b) of this Sub-Clause, the Contractor shall demobilize from the site leaving behind Contractor's Equipment which the Procuring Agency instructs, in the termination notice, to be used for the completion of the works at the risk and cost of the Contractor. Payment upon such termination shall be made under Sub-Clause 12.4, in accordance with Sub-Para (c) thereof, after having deducted the amounts due to the Procuring Agency under Sub-Para (a) and (c) of this Sub-Clause.

CONTRACT DATA

(Note: Except where otherwise indicated, all Contract Data should be filled in by the Procuring Agency prior to issuance of the Bidding Documents.)

Sub-Clauses of Conditions of Contract

1.1.3 Procuring Agency's Drawings, if any (To be listed by the Procuring Agency)

1.1.4 The Procuring Agency means

1.1.5 The Contractor means

1.1.7 **Commencement Date** means the date of issue of Engineer's Notice to Commence which shall be issued within fourteen (14) days of the signing of the Contract Agreement.

_ __

1.1.9 Time for Completion _____ days

(The time for completion of the whole of the Works should be assessed by the Procuring Agency)

1.1.20 Engineer (mention the name along with the designation including whether he belongs to department or consultant) and other details

1.3 Documents forming the Contract listed in the order of priority:

- (a) The Contract Agreement
- (b) Letter of Acceptance
- (c) The completed Form of Bid
- (d) Contract Data
- (e) Conditions of Contract
- (f) The completed Schedules to Bid including Schedule of Prices
- (g) The Drawings, if any
- (h) The Specifications
- (i) _____
- (j) _____

(The Procuring Agency may add, in order of priority, such other documents as form part of the Contract. Delete the document, if not applicable)

- 2.1 **Provision of Site:** On the Commencement Date
- 3.1 Authorized person:
- 3.2 Name and address of Engineer's/Procuring Agency's representative

4.4 **Performance Security:**

Amount_____

Validity_____

(Form: As provided under Standard Forms of these Documents)

5.1 **Requirements for Contractor's design (if any):**

Specification Clause No's_____

7.2 **Program:**

Time for submission: Within fourteen (14) days* of the Commencement

Date. Form of program: ______ (Bar Chart/CPM/PERT or other)

7.4 Amount payable due to failure to complete shall be __% per day up to a maximum of

(10%) of sum stated in the Letter of Acceptance

(Usually the liquidated damages are set between 0.05 percent and 0.10 percent per day.)

7.5 Early Completion

In case of earlier completion of the Work, the Contractor is entitled to be paid bonus up-to limit and at a rate equivalent to 50% of the relevant limit and rate of liquidated damages stated in the contract data.

9.1 **Period for remedying defects**

10.2 (e) Variation procedures:

Day work rates_____ (details)

11.1 Terms of Payments

a) Mobilization Advance

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

(i) on submission by the Contractor of a Mobilization Advance Guarantee for the full amount of the Advance in the specified form from a Scheduled Bank in Pakistan to the Procuring Agency;

(ii) Contractor will pay interest on the mobilization advance at the rate of 10% per annum on the advance; and

(iii) This Advance including the interest shall be recovered in 5 equal installments from the five (05) R.A bills and in case the number of bills is less than five (05) then $1/5^{th}$ of the advance **inclusive of the interest** thereon shall be recovered from each bill and the balance together with interest be recovered from the final bill. It may be insured that there is sufficient amount in the final bill to enable recovery of the Mobilization Advance.

OR

2) Secured Advance on Materials

(a) The Contractor shall be entitled to receive from the Procuring Agency Secured Advance against an INDENTURE BOND in P W Account Form No. 31(Fin. R. Form No. 2 acceptable to the Procuring Agency of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the Site but not yet incorporated in the Permanent Works provided that:

(i) The materials are in accordance with the Specifications for the Permanent Works;

(ii) Such materials have been delivered to the Site and are properly stored and protected against loss or damage or deterioration to the satisfaction and verification of the Engineer but at the risk and cost of the Contractor;

(iii) The Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records shall be available for inspection by the Engineer;

(iv) The Contractor shall submit with his monthly statement the estimated value of the materials on Site together with such documents as may be required by the Engineer for the purpose of valuation of materials and providing evidence of ownership and payment therefore;

(v) Ownership of such materials shall be deemed to vest in the Procuring Agency and these materials shall not be removed from the Site or otherwise disposed of without written permission of the Procuring Agency;

(vi) The sum payable for such materials on Site shall not exceed 75
% of the (i) landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of locally manufactured or produced materials, or (iii) market price of stands other materials;

(vii) Secured Advance should not be allowed unless &until the previous advance, if an, fully recovered;

 $(viii)\quad$ Detailed account of advances must be kept in part II of running account bill; and

(ix) Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 2 months from the date of issue of secured advance and definitely not for full quantities of materials for the entire work/contract

(b) Recovery of Secured Advance:

(i) Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis, but not later than period specified in the rules not more than two months (even if unutilized); other conditions.

(ii) As recoveries are made the outstanding accounts of the items concerned in Part II should be reduced b making deduction entries in the column; —deduct quantity utilized in work measured since previous bill, equivalent to the quantities of materials used by the contractor on items of work shown as executed in part I of the bill.

(c) Interim payments: The Contractor shall submit to the Engineer monthly statements of the estimated value of the work completed less the cumulative amount certified previously.

(i) The value of work completed comprises the value of the quantities of the items in the Bill of Quantities completed.

(ii) value of secured advance on the materials and valuation of variations (if any).

(iii) Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

(v) Retention money and other advances are to be recovered from the bill submitted by contractor.

11.2 *(a) Valuation of the Works:

- i) Lump sum price_____(details), or
- ii) Lump sum price with schedules of rates _____ (details),
- or iii) Lump sum price with bill of quantities_____(details),

or iv) Re-measurement with estimated/bid quantities in the Schedule of Prices or on premium above or below quoted on the rates mentioned in CSR (details), or/and

v) Cost reimbursable_____(details)

11.3 **Percentage of retention*:** *five (5%)*

11.6 **Currency of payment:** Pak. Rupees

14.1 **Insurances:** (*Procuring Agency may decide, keeping in view the nature and the scope of the work*)

Type of cover

The Works

Amount of cover

The sum stated in the Letter of Acceptance plus fifteen percent (15%)

Type of cover

Contractor's Equipment:

Amount of cover

Full replacement cost

Type of cover

Third Party-injury to persons and damage to property

(The minimum amount of third party insurance should be assessed by the Procuring Agency and entered).

Workers:

Other

cover*:

(In each case name of insured is Contractor and Procuring Agency)

14.2 Amount to be recovered

Premium plus ______ percent (____%).

15.3 Arbitration**

Place of Arbitration:_____

* (Procuring Agency to specify as appropriate)

** (It has to be in the Province of Sindh)

STANDARD FORMS

(Note: Standard Forms provided in this document for securities are to be issued by a bank. In case the bidder chooses to issue a bond for accompanying his bid or performance of contract or receipt of advance, the relevant format shall be tailored accordingly without changing the spirit of the Forms of securities).

FORM OF BID	SECURITY
-------------	----------

(Bank Guarantee)

	Guarantee No	
	Executed on	
(Letter by the Guarantor to the Procuring	Agency)	
Name of Guarantor (Scheduled Bank in Pa	kistan) with	Name
of Principal (Bidder) with		
address:		
Sum of Security (express in words and		
figures):		
Bid Reference No.	Date of Bid	

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bid and at the request of the said Principal, we the Guarantor above-named are held and firmly bound unto the ______, (hereinafter called The —Procuring Agency||) in the 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 Principal has submitted the accompanying Bid numbered and dated as above for

______ (Particulars of Bid) to the said Procuring

Agency; and

WHEREAS, the Procuring Agency has required as a condition for considering the said Bid that the Principal furnishes a Bid Security in the above said sum to the Procuring Agency, conditioned as under:

(1) that the Bid Security shall remain valid for a period of twenty eight (28) days beyond the period of validity of the bid;

(2) that in the event of;

(a) the Principal withdraws his Bid during the period of validity of Bid, or

(b) the Principal does not accept the correction of his Bid Price, pursuant to Sub-Clause 16.4 (b) of Instructions to Bidders, or

(c) failure of the successful bidder to

 $(i) \qquad \mbox{furnish the required Performance Security, in accordance with Sub-Clause IB-21.1 of Instructions to Bidders, or }$

(ii) sign the proposed Contract Agreement, in accordance with Sub-Clauses IB-20.2 & 20.3 of Instructions to Bidders, the entire sum be paid immediately to the said Procuring Agency for delayed completion and not as penalty 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 Agreement with the said Procuring Agency in accordance with his Bid as accepted and furnish within fourteen (14) days of receipt of Letter of Acceptance, a Performance Security with good and sufficient surety, as may be required, upon the form prescribed by the said Procuring Agency for the faithful performance and proper fulfilment of the said Contract or in the event of non with drawal of the said Bid within the time specified then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

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

PROVIDED ALSO THAT the Procuring Agency shall be the sole and final judge for deciding whether the Principal 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 Guarantor shall pay without objection the sum stated above upon first written demand from the Procuring Agency forthwith and without any reference to the Principal or any other person.

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

	Guara	ntor (Bank)	_
Witness:	1. Signature		
1	2. Name		
	3. Title		
Corporate Secretary (Seal)			
2			
	Name, Title & Address)		Corporate Guarantor (Seal)
FORM OF	PERFORMANCE SECURITY (Ba	ank Guarantee	:)
	GL	uarantee No Executed on	
	Expiry [Date	
(Letter by the Guarantor to Name of Guarantor (Sche address:	o the Procuring Agency) duled Bank in Pakistan) with		
Name of Principal (Contrac address:	ctor) with		
Penal Sum of Security (exp figures)	ress in words and		
Letter of Acceptance No		Dated	

_____ (Name of Project).

NOW THEREFORE, if the Principal (Contractor) shall well and truly perform and fulfill all the undertakings, covenants, terms and conditions of the said Documents during the original terms of the said Documents and any extensions thereof that may be granted by the Procuring Agency, with or without notice to the Guarantor, which notice is, hereby, waived and shall also well and truly perform and fulfill all the undertakings, covenants terms and conditions of the Contract and of any and all modifications of the 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 9, Remedying Defects, of Conditions of Contract are fulfilled.

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

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

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

IN WITNESS WHEREOF, the above bounded 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.

Witness	Guarantor (Bank)
1	1. Signature
	2. Name
Corporate Secretary (Seal)	3. Title
2	
(Name, Title & Address)	Corporate Guarantor (Seal)

FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the —Agreement||) made on the _____ day of _____ 200 _____ between ______(hereinafter called the _____ Procuring Agency||) of the one part and ______ (hereinafter called the ______ Contractor||) of the other part.

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

NOW this Agreement witnessed as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents after incorporating addenda, if any except those parts relating to Instructions to Bidders, shall be deemed to form and be read and construed as part of this Agreement, viz:

- (a) The Letter of Acceptance;
- (b) The completed Form of Bid along with Schedules to Bid;
- (c) Conditions of Contract & Contract Data;
- (d) The priced Schedule of Prices/Bill of quantities (BoQ);
- (e) The Specifications; and
- (f) The Drawings

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

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

IN WITNESS WHEREOF the parties hereto have caused this Contract 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 the Procuring Agency
(Seal)	(Seal)
Signed, Sealed and Delivered in the presence of:	
Witness:	Witness:
(Name, Title and Address)	(Name, Title and Address)

MOBILIZATION ADVANCE GUARANTEE

Guarantee No				
Execute		xecuted on		
(Letter by the Guarantor to	the Procuring Ager	ісу)		
WHEREAS the			(hereinafte	r called
the Procuring Agency) has e	entered into a Conti	ract for		
				_
		(Parti	culars of Contract), with	ı
	(hereir	after called the C	Contractor).	
AND WHEREAS the Procuri	ng Agency has agre	ed to advance to	the Contractor, at the	
Contractor's request,	an amount	of Rs		Rupees
) which amount	shall be advand	ced to the Contractor	as per
provisions of the Contract.				

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

AND WHEREAS (Scheduled Bank) (hereinafter called the Guarantor) at the request of the Contractor and in consideration of the Procuring Agency agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

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

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

This Guarantee shall come into force as soon as the advance payment has been credited to the account of the Contractor.

This Guarantee shall expire not later than by which date we must have received any claims by registered letter, telegram, telex or telefax.

It is understood that you will return this Guarantee to us on expiry or after settlement of the total amount to be claimed hereunder.

Guarantor (Scheduled Bank)

1. _____ 1. Signature _____

_____ 2. Name _____ Corporate Secretary (Seal) 3. Title _____

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Witness:

Stamp & Signature

2. _____

(Name, Title & Address)

Corporate Guarantor (Seal)

INDENTURE FOR SECURED ADVANCES.

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

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

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

on ----- — and on such covenants and conditions as are hereinafter contained

and the Government has reserved to itself the option of marking any further advance or advances on the security of other materials brought by the Contractor to the site of the said works.

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

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

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

(2) That the materials detailed in the said Running Account Bill (B) which have been Fin R Form No. 17-A

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

(3) That the said materials detailed in the said Running Acco<u>unt Bill (B)</u> and all other Fin. R. Form No. 17-A

Materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in *the* execution of the said works in accordance with the directions of the

Divisional Officer ------ (hereinafter called the Divisional Officer) and in the terms of the said agreement.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangement for the proper watch, safe custody and protection against all risks of the said material and that until used in construction as aforesaid the said materials shall remain at the site of the said

works in the Contractor's custody and at his own risk and on his own responsibility and shall at all times be open to inspection by (he Divisional Officer or any officer authorized by him. In the event of the said materials of any part (hereof being stolen, destroyed or damaged or becoming deteriorated in a grater degree than is due to reasonable use and wear thereof Contractor will forthwith replace the same with other materials of like qualify or repair and make good the same as required by the Divisional Officer and the materials so brought to replace the said materials so repaired and made good shall also be considered as security for the said amount.

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

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

(7) That if the Contractor shall at any time make any default in the performance or observation in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the Government shall immediately on the happening of such default be repayable by the Contractor to the Government together with interest thereon at twelve percent per annum from the date or respective dates of such advance or advances to the date or repayment and with all costs, charges, damages and expenses incurred by the Government in or for the recovery thereof or the enforcement of this security or otherwise by reason of (he default of the Contractor to the Government and the Contractor hereby covenants and agrees with the Government to repay and the same respectively to it accordingly.

 without prejudice to the powers contained therein if and whether the covenant for payment and repayment hereinbefore contained shall become enforceable and the money owing shall not be paid to accordingly.

Once therewith the Government may at any time thereafter adopt all or any of following courses as it may deem best ;-

(a) Seize and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor he is to pay the same to the Government on demand.

(b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable to the Government under these presents and pay over the surplus (if any) to the Contractor.

(c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

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

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been hereinbefore expressly provided for the same shall be

referred to the Superintending Engineer Circle whose.....

decision shall be final and the provisions of the Indian Arbitration Act for the time being in force so far as they are applicable shall apply to any such reference.

Signed, sealed and delivered by* In the presence of

Seal 1st witness 2nd witness

Signed, sealed and delivered by* In the presence of Seal

1st Witness 2nd witness

SPECIFICATIONS

[Note for Preparing the Specifications]

A set of precise and clear specifications is a prerequisite for bidders to respond realistically and competitively to the requirements of the user without qualifying their Bids. The specifications must be drafted to permit the widest possible competition and, at the same time, present a clear statement of the required standards of workmanship, materials, performance of the works. Only if this is done objectives of economy, efficiency, and fairness in procurement will be realized and responsiveness of Bids can be ensured, and the subsequent task of bid evaluation can be facilitated. The specifications should require that materials to be incorporated in the works be new, unused, and of the most recent or current models, and incorporated all recent improvements in design and materials unless provided for otherwise in the contract.

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Stamp & Signature

Samples of specifications from similar to previous procurements are useful in this respect. The use of metric units is encouraged. Depending on the complexity of the works and the repetitiveness of the type of procurement, it may be advantageous to standardize the Technical Specifications that should cover all classes of workmanship, materials and equipment although not necessarily to be used in a particular procurement.

Care must be taken in drafting specifications to ensure that they are not restrictive. In the specification of standards for equipment, materials, and workmanship, recognized international standards should be used as much as possible. The specifications shall consider all conditions but not limited to seismic conditions, weather conditions and environmental impact. The specifications should state that equipment, materials, and workmanship that meet other authoritative standards, and which ensure at least a substantially equal quality than the standards mentioned, will also be acceptable. The following clause may be inserted in the Specifications.

Sample Clause: Equivalency of Standards and Codes

Wherever reference is made in the Specifications to specific standards and codes to be met by Works to be furnished and tested, the provisions of the latest current edition or revision of the relevant shall apply, unless otherwise expressly stated in the Contract. Other authoritative standards that ensure equivalence to the standards and codes specified will be acceptable.]

FORM OF BID AND SCHEDULES TO BID

FORM OF BID

(LETTER OF OFFER / LETTER OF ACCEPTANCE)

Bid Reference No. _____

(Name of Works)

To:

Gentlemen,

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 Having examined the Bidding Documents including Instructions to Bidders, Bidding Data, Conditions of Contract, Contract Data, Specifications, Drawings, if any, Schedule of Prices and Addenda Nos. for the execution of the above-named works, we, the undersigned, being a company doing business under the name of and address
and being

duly incorporated under the laws of Pakistan hereby offer to execute and complete such works and remedy any defects therein in conformity with the said Documents including Addenda thereto for the Total Bid Price of Rs. ______ or such other sum as may be ascertained in accordance with the said Documents.

- 2. We understand that all the Schedules attached hereto form part of this Bid.
- 4. We undertake, if our Bid is accepted, to commence the Works and to deliver and complete the Works comprised in the Contract within the time(s) stated in Contract Data.
- 5. We agree to abide by this Bid for the period of day from the date days from the

date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

- 6. Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.
- 7. We undertake, if our Bid is accepted, to execute the Performance Security referred to in Conditions of Contract for the due performance of the Contract.

- 8. We understand that you are not bound to accept the lowest or any bid you may receive.
- 9. We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other person or persons making a bid for the Works.

Dated this	day of	, 20
------------	--------	------

Signature _____

in the capacity of ______duly authorized to sign bid for and on behalf of

(Name of Bidder in Block Capitals)

(Seal)

Addross

Address:			
Witness:			
(Signature)		_	
Name:			
Address:			

SCHEDULES TO BID INCLUDE THE FOLLOWING:

- Schedule A to Bid: Schedule of Prices
- Schedule B to Bid: Specific Works Data
- Schedule C to Bid: Works to be Performed by Subcontractors
- Schedule D to Bid: Proposed Program of Works
- Schedule E to Bid: Method of Performing Works
- Schedule F to Bid: Integrity Pact]

SCHEDULE – A TO BID SCHEDULE OF PRICES:

* (b) Detailed Schedule of Prices /Bill of Quantities (BOQ)

* [To be prepared by the Engineer/IBA, Karachi]

SCHEDULE - A TO BID

PREAMBLE TO SCHEDULE OF PRICES

1. General

- 1.1 The Schedule of Prices shall be read in conjunction with the Conditions of Contract, Contract Data together with the Specifications and Drawings, if any.
- 1.2 The Contract shall be for the whole of the works as described in these Bidding Documents. Bids must be for the complete scope of works.

2. Description

2.1 The general directions and descriptions of works and materials are not necessarily repeated nor summarized in the Schedule of Prices. References to the relevant sections of the Bidding Documents shall be made before entering prices against each item in the Schedule of Prices.

3. Units & Abbreviations

3.1 Units of measurement, symbols and abbreviations expressed in the Bidding Documents shall comply with the System International d' Unites (SI Units).

(Note: The abbreviations to be used in the Schedule of Prices to be defined by the IBA, Karachi).

4. Rates and Prices

4.1 Except as otherwise expressly provided under the Conditions of Contract, the rates and amounts entered in the Schedule of Prices
shall be the rates at which the Contractor shall be paid and shall be the full inclusive value of the works set forth or implied in the Contract; except for the amounts reimbursable, if any to the Contractor under the Contract.

- 4.2 Unless otherwise stipulated in the Contract Data, the premium, rates and prices entered by the bidder shall not be subject to adjustment during the performance of the Contract.
- 4.3 All duties, taxes and other levies payable by the Contractor shall be included in the rates and prices.
- 4.4 The whole cost of complying with the provisions of the Contract shall be included in the items provided in the Schedule of Prices, and where

SCHEDULE - A TO BID

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 and no separate payment will be made for those items.

The rates, prices and amounts shall be entered against each item in the Schedule of Prices. Any item against which no rate or price is entered by the bidder will not be paid for by the IBA, Karachi when executed and shall be deemed covered by the rates and prices for other items in the Schedule of Prices.

- 4.5 (a) The bidder shall be deemed to have obtained all information as to and all requirements related thereto which may affect the bid price.
 - (b) The Contractor shall be responsible to make complete arrangements for the transportation of the Plant to the Site.

*(IBA, Karachi may modify as appropriate)

4.6 The Contractor shall provide for all parts of the Works to be completed in every respect. Notwithstanding that any details, accessories, etc. required for the complete installation and satisfactory operation of the Works, are not specifically mentioned in the Specifications, such details shall be considered as included in the Contract Price.

5. Bid Prices

5.1 Break-up of Bid Prices

The various elements of Bid Prices shall be quoted as detailed by the IBA, Karachi in the format of Schedule of Prices. The bidder shall recognize such elements of the costs which he expects

to incur the performance of the Works and shall include all such costs in the rates and amounts entered in the Schedule of Prices.

5.2 Total Bid Price The total of bid prices in the Schedule of Prices shall be entered in the Summary of Bid Prices.

6. **Provisional Sums and Day work**

- 6.1 Provisional Sums included and so designated in the Schedule of Prices if any, shall be expended in whole or in part at the direction and discretion of the Engineer/IBA, Karachi. The Contractor will only receive payment in respect of Provisional Sums, if he has been instructed by the Engineer/IBA, Karachi to utilize such sums.
- 6.2 Day work rates in the contractor's bid are to be used for small additional amounts of work and only when the Engineer have given written instructions in advance for additional work to be paid for in that way.

SCHEDULE – A TO BID

<u>SCOPE OF WORK</u> Rehabilitation of Main Gate at City Campus

BILL OF QUANTITIES (BOQ)

	BASED ON COMPOSITE SCHEDULE OF RATES 2024						
Sr No	Description	Units	Qty	Rate	Amount		
<u>(A) CI</u>	VIL WORK - GREY STRUCTURE						
1	Excavation						
	Excavation in foundation of Building Bridges and other structures including dagbelling dressing, refilling around structure with excavated earth Watering and ramming lead upto 5 ft., lead upto one chain (30 metre) and lift upto 5 ft. (1.5 metre). (Ch 1, Item 18)						
a)	Ordinary Soil	P.Cft	3,570.00	11.88	42,411.60		
2	Under Floor Filling Work						
	Filling, watering and ramming earth under floor. with new earth (Excavated from outside) lift upto 5 ft and lead upto 10 miles. Including cost of earth. (Ch 1, Item 22)	P.Cft	500.00	47.02	23,510.00		
3	Brick Ballast	-					
	Dry rammed brick or stone ballast 1 1/2" to 2" gauge. (Ch 4, Item 2)	P.Cft	109.72	104.97	11,517.31		
	A						
4	Anti Termite Providing Anti -termite treatment by spraying /sprinkling /spreading Neptachlar 0.5% Emulsion as an overall pre- construction treatment in slab type construction under the slab and along attached perches or entrances etc, complete as per directions of Engineer In charge. (Ch 18, Item 92-A)	P.Sft	3,506.00	11.46	40,178.76		
-	DCC Concrete (Lean) 1: 4: 9						
5	Cement concrete plain including placing, compacting, Cement concrete plain including placing compacting, finishing and curing, complete (including screening and washing at stone aggregate without shuttering. (Ch 4, item 5)						

ii)	Lean (1:4:8)	P.Cft	297.00	348.83	103,602.51
6	Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds, lifting, centering, shuttering and curing. (including screening and washing of shingle. (Ch 4, Item 6)				
a)	R.C.C work in roof slab, beams, column, rafts, lintels and other structural members laid in situ or precast laid in position complete in all respects.				
i)	Ratio (1 : 2: 4) 90 Lbs of cement, 2 Cft sand and 4 Cft shingle 1/8" to 3/4" gauge				
1	Raft/Footing	P.Cft	540.00	717.59	387,498.60
2	Plinth Beams	P.Cft	659.16	717.59	473,006.62
3	Roof Beams	P.Cft	454.82	717.59	326,374.28
4	Slab	P.Cft	600.36	717.59	430,812.33
ii)	Ratio (1 : 1-1/2 : 3) 90 Lbs of cement, 1-1/2 Cft sand and 4 Cft shingle 1/8" to 3/4" gauge.				
1	Columns	P.Cft	925.00	787.71	728,631.75
7	Steel Work				
	Fabrication of mild steel reinforcement for cement concrete including cutting, bending, laying in position, making joints and fastenings, including cost of binding wire (also includes removal of rust from bars. (ch 4, Item 8)				
a)	Deformed Bar				
i)	Grade-60	P.Cwt	256.27	18,934.0 2	4,852,183.44
8	DPC (2" thick Horizontal)				
	Damp proof course with (cement sand and shingle concrete 1:2 :4) including 2 coats of asphaltic mixture. (Ch 4, Item 28)				
b)	2" Thick	P.Sft	279.19	126.97	35,448.75
9	Providing and laying 1 :3 : 6 Cement concrete solid Block masorany wall above 6" in thickness set in 1 : 6 cement mortar in G.F ground floor superstructure including raking out joints & curing etc, complete. (Ch 4, Item 24)	P.Cft	1,041.97	493.79	514,514.37

10	Plaster work				
	Cement plaster 1:4 upto 12' height. (Ch 7, Item 11)				
b)	1/2" Thick	P.Sft	5,368.60	39.83	213,831.34
- /					
11	MS Expanded metal and Deodar strip				
	Providing and fixing expanded metal ½" to ¾"(12mm to 20mm) mesh 16 gauge. Fixed to chowkhat with 1" (25mm) thick deodar fixed to chowkhat deodar wood strip and screws etc. (12mm to 20mm) mesh 16 gauge. (Ch 10,, Item 22)				
a)	Fixed to chowkhat with 1" (25mm) thick deodar wood strip and screws etc	P.Sft	42.00	1,127.21	47,342.82
Total	$\lambda_{mount}(\Lambda) =$				0 220 061 10
TOLAT	anount (A) -				0,230,004.40
<u>(B) CI</u>	<u>/IL WORK - FINISHING</u>				
1	Floor Tile 60cm x 120 cm				
	Providing & Laying Full Body Porcelain Tile in Flooring or Facing of Approved Design Set in Gry Cement Motor 1:2 or of 3/4" thickness I/C Washing & Joints With White Cement Slurry Using Colour Pigment for matching complete as per Specification (Ch 8, Item 28 (iiv))				
	24"x48"x5/16"	P.Sft	206.47	651.48	134,511.08
					,
2	White Vinyl Emulsion Paint				
	Preparing the surface and painting with plastic emulsion paint of approved make I/c rubbing the surface with sand Paper, filling the voids with chalk/plaster of paris and then painting etc. complete. (Ch 9, Item 40)				
Α	First Coat	P.Sft	4,056.47	38.71	157,025.95
В	2nd & subsequent coat.	P.Sft	4,056.47	22.66	91,919.61
3	Wall Matt Tile				
	Laying floor of approved with glazed tiles 1/4" thick dado of approved color & size jointing in white cement and laid over 1:2 cement sand mortor 3/4" thick including grouting with matching color and finishing (Ch 8, Item 24)				
i	Wall Matt Tile 15cm x 90cm	P.Sft	300.63	389.36	117,053.30
ii	Wall Matt Tile 60cm x 120cm	P.sft	770.00	389.36	299,807.20
4	Weather Shield - Off White				

A	Preparing the surface and painting with weather coat I/c rubbing the surface with rubbing brick / sand Paper, filling the voids with chalk/ plaster of Paris and then painting with weather coat of approved make. (Ch 9, Item 38A)	P.Sft	5,592.50	39.38	220,232.65
В	2nd & subsequent coat.	P.Sft	5,592.50	23.60	131,983.00
5	<u>Weather Shield - Mountain Mist</u>	P Sft	1 928 02	30.38	75 925 //3
А	rubbing the surface with rubbing brick / sand Paper, filling the voids with chalk/ plaster of Paris and then painting with weather coat of approved make. (Ch 9, Item 38A)	F.SIT	1,928.02	33.38	73,323.43
В	2nd & subsequent coat.	P.Sft	1,928.02	23.60	45,501.27
6	Supplying & fixing in position iron/steel grill of 3/4" x 1/4" size flat iron of approved design including painting 3 coats etc. complete (weight not to be less than 3.7 Lbs./Sq . Foot of finished grill). (Ch 17, Item 26)	P.Sft	158.06	1,124.10	177,675.25
7	MS Door (Guardroom)				
	Providing and fixing G.I frames /Choukhats of size 7" x 2" or 4 1/2" x 3" for door using 20 gauge G.I sheet I/c welded hinges and fixing at site with necessary hold fasts, filling with cement sand slurry of ratio 1:6 and repairing the jambs. The cost also i/c all carriage , tools and plants used in making and fixing. (Ch 17, Item 28)	P.Rft	42.00	690.67	29,008.14
8	MS Main Gate				
	Supplying and fixing special heavy type steel doors for look - ups within angle iron frame of 2- 1/2" to 2- 1/2" x 3/8" size and shutter of 2" x 2" x 3/8" with 1" diameter M.S bars placed @ 4" center to center with a separate locking box having size of 12" x 12" of M. steel sheet embedded in masonary with proper locking arrangement as per approved design including cost of erection of steel gate and fixing in masonry wall in cement concrete 1: 2: 4 etc. complete, as per instructions of Engineer Incharge. (Ch 17, Item 27)	P.Sft	273.00	4,300.68	1,174,085.64
٥	Pre-cast Rain Water shouts				
	Providing and fixing reinforced cement concrete spout including fixing in position with top and bottom khuras. Refer Item # 27, Chapter No. 4	Each	8.00	2,023.24	16,185.92

Total	Amount (B) =				2,670,914.43
(C) LAI	NDSCAPE WORK				
1	9"x24" boticina marble (Green Area Sides)				
	Laying Super Botisina, Crème, Badal or Black Marble 12"x12"				
	/ 12"x24" fine dressed on the surface without winding set in				
	lime mortar 1:2 including rubbing and polishing of the joints.				
	(Ch 8, Item 28 (v))				
а	3/4" thick marble	Sft	19.88	337.90	6,717.45
2	<u>30"x30" badal marble (for Passage Runway)</u>				
	Laying Super Botisina, Crème, Badal or Black Marble 12"x12"				
	/ 12"x24" fine dressed on the surface without winding set in				
	lime mortar 1:2 including rubbing and polishing of the joints.				
	(Cn 8, item 28)				
b	1" thick marble	Sft	115.00	378.19	43,491.85
3	Ceramic Tile (12"x12")				
	Laying floors of approved coloured glazed tiles 1/4" thick				
	floor of approved color & size jointing in white cement and				
	laid over 1:2 cement sand mortar 3/4" thick including	Sft	38.50	325.40	12,527.90
	grouting with matching color and finishing. (Ch 8, Item 25)				
4	Kerh Stone (Highway Works)				
	Providing & fixing Precast Edge Block 3750 PSI Industrial				
	Made Size 6 inches thick x 12 inches long x 18 inches high				
	including the cost of Cartage, excavation, form Work for				
	haunching, 1450 PSI lean concrete, 2250 PSI concrete for	P.Rft	46.00	678.38	31,205.48
	haunching, 1:4 cement sand mortar. (Ch Misc., Item 14, Page				
	221)				
E	Non-Skid Tile - Light Grey (Bench Side Floor)				
5	Providing & Laving Full Body Porcelain Tile in Flooring or				
	Facing of Approved Design Set in Grv Cement Motor 1:2 or of				
	3/4" thickness I/C Washing & Joints With White Cement				
	Slurry Using Colour Pigment for matching complete as per				
	Specification (Ch 8, Item 28 (iiv))				
viii- b)	18"x18"x5/16" flooring	P.Sft	80.00	373.80	29,904.00
Total Amount (C) =					123,846.68
TOTAL AMOUNT OF SCHEDULED ITEMS CSR 2024 (CIVIL WORKS) {A+B+C}				11,025,625.60	

PREMIUM/REBATE (%)	
TOTAL AMOUNT OF SCH	EDULED BASED ITEMS CSR 2024 (INCLUDING PREMIUM/REBATE) (A+B+C)	

<u>NON-S</u>	NON-SCHEDULE ITEMS (BASED ON PREVAILING MARKET RATES)						
Sr No	Description	Units	Qty	Rate	Amount		
<u>(D) CIV</u>	/IL WORK - Finishing						
1	Minalite Glossy Taupe Windsor Wall Tile						
	Provided and lay Minalite Glossy Taupe Windsor Wall Tile Floor comprising 1/2" thick 1:4 cement sand mortar bed under-coat, and best quality Tiles of approved colour ceramic tiles and filling of joints using imported epoxy grout with matching colour, fixing of ss beading as approved, complete in all respect, as per Specifications, and as per sample as approved by the Engineer.	Sft	57.75				
2	UPVC Windows						
	Providing and fixing all types of glazed UPVC windows of anodized champagne colour partly fixed and party sliding using deluxe section of approvd manufacturer having Frame of quality aluminum jali, 5mm thick imported tinted glass with rubber gasket using approved standard latches, wheel, stopper ,brush chennel angle joint and hardware etc	Sft	158.06				
3	Aluminium Beams 1 1/2"x3" ss anodizing aluminum beam, prime steel Or equivalent as per approved pattern And color by architect / engineer or client.	Sft	64.00				
4	Latters & Lago						
4	CNC cutting stainless steel front lit Approved by the employer/ consultant to the entire Satisfaction of the engineer in charge.	Nos	16.00				
5	Terrazzo Flooring						
	½" th. Terrazzo in gray cement with 3/8"x1½" black Marble dividing strips.	Sft	531.00				

6	Terrazzo Skirting				
	Terrazo skirting of 4"x12" in gray cement .	Sft	58.41		
7	Roof Screeding				
	Providing and laying 3" to 4" thick (avg) cement concrete screed of 1:2:4 ratio, using 3000 psi concrete, laid in panels at any floor or height, including form work, vibrating, curing etc. Complete in all respects and conforming to the requirements of drawings, specifications and to the entire satisfaction of the Engineer.	Sft	1,200.72		
•	Water Preefing				
8	Providing & Laying elastomeric cementitious waterproofing and protective coating of Expancote Rubber-flex two component acrylic polymer modified cementitious coating manufactured by M/s FOSPAK or equivalent confirming to ASTM D412 & ASTM D4541:1989 in two coats to achieve a total dry film thickness of 1.25 - 2.00 mm as per manufacturer's recommendation with experiences applicator.	P.Sft	1,200.72		
Total Amount (D) =					

(E) LANDSCAPE WORK					
1	Green Grass (Dhaka Grass) with Manure & Sweet earth				
	Supply & Grassing fine by dribbling grass roots 3" apart including watering, weeding till such time the grass is set and become green and is fir for mowing including the cost of sweet earth spread equally over which spread decayed sewage manure from approve source including all leads and lift.	Sft	233.28		
2	Tree				

 Preparing Circular Tree Pit of dia 5' and depth 4' wherever required by excavating into any strata. Application of antitermite treatment @ 20 ml of Chloropyriphos per plant on the walls & base of the pit. Filling the pit with compost. (ratio 1 animal manure : 3 sweet earth). Flooding with water at least 20 ltr. Per tree, dressing including removal of rubbish & surplus earth if any with all leads & lifts, planting and staking (with a bamboo dipped in charcoal) in full and final location including all locations specified. Maintenance of trees for a period of 3 months from the date of plantation, replacement of any dead & unhealthy tree in this period. Supply & spraying of insecticides as required. 				
Bonsai Tree	Nos	3		
		Total Amount	(E)=	
ECTRICAL WORKS	1	I	I	
Description	Units	Qty	Rate	Amount
Sub Distribution Board				
Providing and fixing of Sub Distribution Board/DB complete in all respect as per drawing/as approved by the Engineer incharge.	Nos.	1.00		
WIRING AND CONDUITING				
Circuit				
Supply, installation and commissioning of light circuit wiring, from MCB in DB to Switch Board to be wired with 2x2.5mm sq. PVC insulated 300/500 V grade wire, manufactured by M/s. Pakistan Cables Ltd,newage,fast,G.M,Ali. including cost of 25mm dia. heavy	Nos	5.00		
	 1) Preparing Circular Tree Pit of dia 5' and depth 4' wherever required by excavating into any strata. 2) Application of antitermite treatment @ 20 ml of Chloropyriphos per plant on the walls & base of the pit. 3) Filling the pit with compost. (ratio 1 animal manure : 3 sweet earth). 4) Flooding with water at least 20 ltr. 5) Per tree, dressing including removal of rubbish & surplus earth if any with all leads & lifts, planting and staking (with a bamboo dipped in charcoal) in full and final location including all locations specified. 6) Maintenance of trees for a period of 3 months from the date of plantation, replacement of any dead & unhealthy tree in this period. 7) Supply & spraying of insecticides as required. Bonsai Tree ECTRICAL WORKS EURICAL WORKS Output: Description Sub Distribution Board Providing and fixing of Sub Distribution Board/DB complete in all respect as per drawing/as approved by the Engineer incharge. WIRING AND CONDUITING Circuit Supply, installation and commissioning of light circuit wiring, from MCB in DB to Switch Board to be wired with 2x2.5mm sq. PVC insulated 300/500 V grade wire, manufactured by M/s. Pakistan Cables Ltd, newage, fast, G.M, Ali. including cost of 25mm dia. heavy	1) Preparing Circular Tree Pit of dia 5' and depth 4' wherever required by excavating into any strata. 2) Application of antitermite treatment @ 20 ml of Chloropyriphos per plant on the walls & base of the pit. 3) Filling the pit with compost. (ratio 1 animal manure : 3 sweet earth). 4) Flooding with water at least 20 ltr. 5) Per tree, dressing including removal of rubbish & surplus earth if any with all leads & lifts, planting and staking (with a bamboo dipped in charcoal) in full and final location including all locations specified. 6) Maintenance of trees for a period of 3 months from the date of plantation, replacement of any dead & unhealthy tree in this period. 7) Supply & spraying of insecticides as required. Bonsai Tree Nos CTRICAL WORKS Units Sub Distribution Board Providing and fixing of Sub Distribution Board/DB complete in all respect as per drawing/as approved by the Engineer incharge. Nos. WIRING AND CONDUITING Nos Circuit Supply, installation and commissioning of light circuit Nos wiring, from MCB in DB to Switch Board to be wired with 2x2.5m	1) Preparing Circular Tree Pit of dia 5' and depth 4' wherever required by excavating into any strata. 2) Application of antitermite treatment @ 20 ml of Chloropyriphos per plant on the walls & base of the pit. 3) Filling the pit with compost. (ratio 1 animal manure : 3 sweet earth). 4) Flooding with water at least 20 ltr. 5) Per tree, dressing including removal of rubbish & surplus earth if any with all leads & lifts, planting and staking (with a bamboo dipped in charcoal) in full and final location including all locations specified. 6) Maintenance of trees for a period of 3 months from the date of plantation, replacement of any dead & unhealthy tree in this period. 7) Supply & spraying of insecticides as required. Bonsai Tree Nos Obscription Units CTRICAL WORKS Units Query in fixing of Sub Distribution Board/DB complete In all respect as per drawing/as approved by the Engineer Nos. 1.00 1.00 In all respect as per drawing/as approved by the Engineer Nos. Incharge. VIRING AND CONDUITING Circuit	1) Preparing Circular Tree Pit of dia 5' and depth 4' wherever required by excavating into any strata. 2) Application of antitermite treatment @ 20 ml of Chloropyriphos per plant on the walls & base of the pit. 3) Filling the pit with compost. (ratio 1 animal manure : 3 sweet earth).Image: strate interval of rubbish & surplus earth if any with all leads & lifts, planting and staking (with a bamboo dipped in charcoal) in full and final location including all locations specified. 6) Maintenance of trees for a period of 3 months from the date of plantation, replacement of any dead & unhealthy tree in this period. 7) Supply & spraying of insecticides as required.Nos3CTRICAL WORKSDescriptionUnitsQtyRateSub Distribution BoardNos.1.00Sub Distribution BoardNos.1.00Intervention of Sub Distribution Board/DB complete in all respect as per drawing/as approved by the Engineer incharge.Nos.1.00Supply, installation and commissioning of light circuit wiring, from MCB in DB to Switch Board to be wired with 2x2.5mm sq. PVC insulated 300/500 V grade wire, manufactured by M/s. Pakistan Cables Ltd, newage, fast, G.M.Ali, including cost of 25mm dia, heavy duty PVC conduit make Refa Ponular Turk Plast orNos5.00

	Wiring from switch to first light point with 2 x 1.5mm sq. PVC insulated 300/500 V grade wire, manufactured by M/s. Pakistan Cables Ltd,Newage,Fast,G.M,Ali + 1.5 mm sq. PVC insulated wire of color green as circuit protective conductor (CPC), in 25 mm dia PVC conduit make Beta,Popular,Turk Plast or approved equivalent installed on RCC slab, above false ceiling, recessed in wall, columns slabs or above light carrier including all PVC conduit accessories, junction boxes, pull boxes, steel pull wires, ceiling rose, M.S. sheet steel switch box 16 SWG with earth terminal and 2 coats of enameled paint, M.S. box shall be of the same size as that of 1, 2 upto 8 gang Approved switches including cost of gang type light switch 10 amps with all necessary accessories as per the specifications and drawings and approval by the Engineer.	Nos	12.00	
2.03	Wiring from point to point			
	Wiring and conduiting from light point to point with 2 x 1.5 mm sq. PVC insulated 300/500 V grade wire, manufactured by M/s. Pakistan Cables Ltd.,newage,fast,G.M,Ali + 1.5 mm sq. PVC insulated wire of color green as circuit protective conductor (CPC), in 25 mm. dia PVC conduit including all necessary accessories such as connectors, ceiling rose, flexible wires/conduits, sheet steel boxes etc. as per the specifications and drawings and approval by the Engineer.	Nos	12.00	
2.04	Wiring of 1-3 Flat Pin 20 Amps Switch Socket for AC			
2.05	Wiring and fixing of 1-3 pin 20 Amps combined switch socket away from switch board and wired with 3 x 1 core 4 mm sq. P+N+CPC, Cu/PVC wires 300/500 Volt grade, in and including cost of 25mm dia. heavy duty PVC conduit, recessed in walls, floor, above false ceiling or as required as per site conditions, all PVC conduit accessories, pull boxes, steel pull wires, M.S. box shall be made of 16 SWG sheet steel with earth terminal having 2 coats of antirust paint , M.S. box shall be of the same size as that of 1-20 Amps switch socket, including cost of 20 Amps 3 pin combined switch socket with porcelain base and plug, make CLIPSAL, LEGRAND, ABB or as approved by engineer incharge complete in all respect. Wiring shall be done directly from the MCB installed in the respective DB without any claim of circuit. Pakistan cable, newage, fast, G.M, Ali	Nos	1.00	
2.05	Wiring of 1 Nos. 3 Pin 13 Amps Switch Socket			

	Same as item No. 2.05 mentioned above but wiring of 1 Nos. 3 pin 13 Amp universal switch socket wiring from Distribution Board (DB) as shown on drawings, including cost of 1 Nos. universal 13 Amps switch sockets back box and face plats, complete in all respects.Pakistan cable,newage,fast,G.M,Ali	Nos	1.00	
2.06	Wiring of 1 Nos. 3 Pin 5 Amps Switch Socket			
	Same as item No. 2.01 mentioned above but wiring of 1 Nos. 3 pin 5 Amp Round Pin switch socket loop wiring from 3 pin 13 Amp universal switch socket installed as shown on drawings, including cost of 1 Nos. universal 13 Amps switch sockets back box and face plats, complete in all respect. Pakistan cable,newage,fast,G.M,Ali	Nos	3.00	
2.07	Ceiling Fan Point			
	Same as per Item No. 4.02 mentioned above but wiring of ceiling fan point including cost of M. S. fan hook box circular type having M. S. 5/8" dia. hook to be fixed on RCC slab, M. S. sheet steel switch box 16 SWG with earth terminal and 2 coats of enameled paint, M.S box shall be of the same size as that of Electronic Dimmer and 1 gang switch from one of the Approved MAKE complete in all respects.Pakistan cable,newage,fast,G.M,Ali	Nos	3.00	
2.80	Lighting (As Per Architect)			
	Supply at site, Installation, testing and commissioning of following light fittings, ceiling, wall mounted, recessed type, etc. complete with electronic blast, lamps, lamp holders, LED drivers, power factor correction capacitor, internal wiring, connecting cables, earthing terminals, transformers, hanging arrangements where required complete in all respects, fittings shall be duly approved by Architect / Engineer.			
i	Led spot light/Ceilling mounted light 12W-20W or equivalent as per architect. (Philips)	Nos.	7.00	
ii	Led water proof light 12W-20W or equivalent as per architect. (Philips)	Nos.	12.00	
2.90	Ceiling Fans			
	Supply, installation and commissioning of ceiling fans of following sizes steel body, complete with capacitor, hanging rod, canopy, blades, dimmers nuts and bolts complete in all respect of Approved MAKE . (G,F.C,Pak fan.Super asia,Millat,Royal)			
i	Delux 56" sweep.	Nos.	3.00	
2.10	AC UNIT			

	Supply, installation Testing & Commissioning of the			
	following as per drawings and specification. split type			
	reversible Air-Conditioning units, wall mounted complete			
	with condensing units, refrigerant piping, insulation,			
	door units power wiring conducting complete in all respect			
	Note: wiring between indoor, and outdoor unit should be			
	flexible 3c 4mm2.(Gree,Haier,Pel,Orient,kenwood)			
	Wall mounted reversable Split type Air Conditioner 1.5 Ton	Nos.	1.00	
;	with remote controlled and nano shield air filter.capacity			
1	19,500			
	BTU/hr.power supply: 220-240V/1-phase/50HZ.			
2.11	L.V Power Cables			
	Supply at site, installation, testing and commissioning of			
	PVC insulated non armoured copper conductor cable 600 /			
	1000 Volt grade installed in pre laid pipes / conduit or in			
	trenchs as per routes shown on drawings including cost of			
	all necessary materials, connections, identification tags,			
	cables lugs properly crimped at both ends for the			
	collos to be installed shall be practically measured at site			
	by the Contractor, duly authenticated by the employers			
	electrical engineer before placing the order with the			
	manufacturer, however, approximate length of cables are			
	shown herewith. Payments shall be made as per actual			
	length installed.			
2.12	4 Core Cable PVC/PVC			
i	2 core 10 mm Sq (Single Phase DB)	Rft	50.00	
2.13	Circuit Protective Conductor (CPC)			
i	1 core 6mm sq. PVC insulated colour Green/Yellow	Rft	55.00	
2.14	P.V.C. Conduit and Accessories			
	Supply at site of PVC conduit heavy duty make,			
	Beta,Popular,Turk Plast to be installed on RCC slabs, walls,			
	floor, columns above false ceiling or as required as per site			
	conditions including cost of all PVC conduit accessories,			
	steer puir wires, complete in all respects.			
i	2" dia. PVC conduit to pull electric cable.	Rft	100.00	
2.15	FIRE ALARM & DETECTION SYSTEM			
	Fire Alarm Panel & Devices			

5.1	Supply, installation, testing and commissioning of wiring of smoke sensors, heat sensors and manual stations, bell buzzers with 2 core 1.5mmsq. twisted Fire resistant cable, manufactured by Beldon or any approved by the engineer incharge, in 1" dia PVC conduit make Beta,Popular,Turk Plast or Approved equivalent, complete with cables, conduits and other necessary installation accessories, as per the specifications and drawings and approval by the Engineer.	Nos	2.00		
5.2	Supply, installation, testing and commissioning of microprocessor based 2 Zone Compact Control Panel Intelligent (Conventional) Fire Alarm Panel with built-in power supply unit and NICAD battery backup, supervisory buzzer, alarm cancelling device, complete in all respects, as per the specifications and drawings and to the satisfaction of the Engineer make Honey Well Notifier Inertia / GENT or Bentel Italy.	Nos.	1.00		
5.3	Supply, installation, testing and commissioning of Optical type Conventional Smoke Sensor with light indication Protection against false alarms, complete in all respects, as per the specifications and drawings and approval by the Engineer. make Honey Well Notifier Inertia / GENT or Bentel Italy	Nos	2.00		
5.4	Supply, installation, testing and commissioning of Conventional fire alarm Manual Pull Station, Protection category as per EN 60529 IP 52 Environmental class as per EN 54 T2 II complete in all respects, as per the specifications and drawings and to the satisfaction of the Engineer. make Honey Well Notifier Inertia / GENT or Bentel Italy	Nos	1.00		
5.5	Supply, installation, testing and commissioning of fire alarm Electronic Bell/Sounder with Conventional output module, 6" dia gong and operation at 24V dc, with built in fault isolators and integral strobe, as per the specifications and drawings and approval by the Engineer. Make Honey Well Notifier Inertia / GENT or Bentel Italy	Nos	1.00		
5.6	Fire Extinguisher Supply & Fixing Of Dry Chemical Powder 6Kg Fire Extinguisher With Strong Bracket Complete In all respectHaseen Hasib	Nos	1.00		
6.00	UPS (5KVA & 100AH & Power Kit)				

6.1	Supply, installation and Commisioning of Baykee SL 5000VA/4000W, Line interactive, Pure Sinewave, Transfer Time :2~6ms, Wide Input Range 145-275VAC, Built-in Super Charger 5A/10A, 48 VDC, LCD (Display), Tower, 230V External Battery enclosure with power kit consisting of 4 x	Nos	1.00	
	time at 80% load,25c External Battery enclosure with			
	power kit including cable, conduit, fitting installation and all			
	related accessories complete in all respects com[plete			
6.00	job.made by BAYKEE			
6.00				
1	Wiring for CCTV IP Cameras			
i	Wiring for each CCTV IP Cameras to be installed on walls / slabs or on false ceiling with 4 pair Cat. 6, UTP cable with pure copper conductor PVC insulated PVC sheathed manufactured by M/s. Molex, Clipsal and 3M in and including cost of 1" dia PVC conduit heavy duty make Beta,Popular,Turk Plast, recessed in walls, columns, slabs, floors or above false ceiling with all necessary fixing accessories as required as per site condition, including cost of all PVC conduit accessories, pull boxes, steel pull wires, M.S junction boxes 16 SWG of size 4"x4" with 2 coats of powder coating of orange colour, including cost of all necessary accessories and materials, complete in all respects.	Nos	2.00	
2	Fixed IR Camera			
i	Supply at site, installation, testing and commissioning of IP66-rated, HDTV, day/night, fixed network camera with varifocal 3-8 mm DC-iris lens and remote back focus. Multiple, individually configurable H.264 and Motion JPEG streams; max HDTV 1080p or 2MP resolution at 30 fps. WDR. Video motion detection and active tampering alarm. Two- way audio. SD/SDHC memory card slot for optional local video storage. Operation in -30°C to +50°C. Model AXIS P1344-E or approved equivalent, including the cost of 850 nm semi-covert IR LED Illuminator for use with the Axis Day/Night network cameras. Fixed angle 50 degrees. Range 14 meters. Input: Power over Ethernet(PoE). Consumption : 10 W AXIS T90A01 IR-LED 50 DEG or approved equivalent.	No	8.00	
3	Network Video Recorder			

i	Supply at site, installation, testing and commissioning of NVR 32 Channel 1080p Preview capability. DVD writer.2 x USB 2.0. One E- SATA. Embedded Linux Operating system. Jog Shuttle, Function Keypad, PTZ Controls, Power Switch Extender, LCM Display. Supports 8 SATA HDD. RS 485 & RS 232 Communication Ports. 1x - 10/100/1000 Base-T Ethernet, RJ-45. Operating Interface USB mouse, USB PC keyboard, Remote controller. Operating Temperature 32 ° to 104 °F. Remote DVR connectivity are Web Viewer (All Reknowed Browsers), Remote Console Java Viewer, PDAViewer, IPhone and Android Support. Software PTZ Control Zoom-in/Zoom-out, Focus- in/Focus-out, Direction, Autopan. Power supply; 100-240 VAC 50/60 Hz. Model iSmart D9132NH or Approved Equivalent including cost of all necessary accessories and materials Like HDD, complete is all recents.	Nos.	1.00		
4	LED Type Colour Monitors				
	Supply at site, installation, testing and commissioning of 32 inch LED type colour monitors. Model Samsung or Approved equivalent, including cost of all necessary accessories and materials, complete in all respects.	Nos	1.00		
Total A	Total Amount (F)=				

(G) PLUMBING WORKS					
Sr No	Description	Units	Qty	Rate	Amount
1	PPRC Piping				
	Providing, fixing, jointing and testing Polypropylene Random (PPR) PN20 pressure pipe for cold, hot and hot water return water as per DIN 8077- 8078 for pipes and DIN 16962,PN25 for fittings (polyfusion welded joints)including fittings and specials (sockets, tees, elbows, bends, crosses, reducers, adaptor, plugs and union etc.) concealed on walls or floor,walls cutting for pipelines, complete in all respect as per specifications and drawings as well as directed by the Engineer.(Beta,Turk Plast, Popular)				
i	25 mm dia	Rft.	44.79		
ii	32 mm dia	Rft.	48.96		
2	GATE / BALL VALVE				

	Providing and installing gate/ball valves of following					
	nominal dia, of approved equivalent make ,including					
	jointing ,fitting, painting, testing, complete in all respects					
	to match with following PPR pipe					
	diameters.(Beta, Adamjee, Popular)					
i	25 mm dia	Each	4.00			
ii	32 mm dia	Each	2.00			
3	EXTERNAL SEWERAGE , VENTS & ROOF DRAINAGE					
	Supply and lay UPVC pipes of Pak Arab/ Steelex (SDR-41),					
	Nikasi for soil, waste and vent system including specials					
	such as tees, bends, plugs, reducers, etc. with solvent					
	cement jointing / rubber ring push fit jointing method					
	including cutting holes in masonry or concrete in walls,					
	floor and in slab, making good the same, complete in all					
	respect as per drawing, specification and as directed by					
	the Engineer.					
i	3 Inch dia Pipe	Rft.	250.20			
5	MULTI-FLOOR TRAP					
i	Providing and fixing 3" dia multi floor trap and cover of	Nos.	2.00			
	approved make including all necessary accessories					
	required for installation, complete in all respect as per					
	specifications and drawings as well as directed by the					
	Engineer.					
6	MS DRAIN					
	Providing and fixing 9" wide Ms Steel grating outer Frame	Rft.	82.40			
	angle Iron 1.5"x 1.5"x3/8" and inner side C/C 3" MS					
i	Square Bar 1/2" by 1/2 " dia only including all necessary					
	accessories required for installation, complete in all					
	respect as per specifications and drawings as well as					
	directed by the Engineer.					
7	KHURAAS					
	Khurras : Make 2'x2' Khurras on roof 2'x2' for drainage of	Nos.	1.00			
i	rain water made in P.C.C. 1:2:4 complete in all respects as					
1	per drawing, specifications, and					
	or as directed by the Engineer					
Total Amount (G) =						
	Note					
	It chould be clearly understand by the contractor / bidder that the above mentioned items shall be complete in all respects including as					
	of all necessary materials / accessories whether mentioned or not but are required for proper functioning of the system shall be deemed					
	to be included in the cost of each above mentioned items, no extra charge shall be paid or claimed by					

the contractor / bidder.

SS TOTAL AMOUNT OF A+B+C+D+E+F+G	
15 % SRB ON GROSS TOTAL AMOUNT	
ND TOTAL AMOUNT OF A+B+C+D+E+F+G	

Grand Total Amount of A+B+C+D+E+F+G in Words:

Rupees: ______

DRAWINGS

STRUCTION DRAWINGS








































JCTURAL DRAWINGS

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LIC HEALTH DRAWINGS









TRICAL DRAWINGS















SCHEDULE – C TO BID

WORKS TO BE PERFORMED BY SUBCONTRACTORS*

The bidder will do the work with his own forces except the work listed below which he intends to sub-contract.

Items of Works to be Sub-Contracted Name and address of Sub-Contractors Statement of similar works previously executed. (attach evidence)

Note:

* The IBA, Karachi should decide whether to allow subcontracting or not.

In case Procuring Agency decides to allow subcontracting then following conditions shall be complied with:

- 1. No change of Sub-Contractors shall be made by the bidder without prior approval of the IBA, Karachi.
- 2. The truthfulness and accuracy of the statement as to the experience of Sub-Contractors is guaranteed by the bidder. The IBA, Karachi's judgment shall be final as to the evaluation of the experience of Sub-Contractors submitted by the bidder.
- 3. Statement of similar works shall include description, location & value of works, year completed and name & address of the clients.

SCHEDULE – D TO BID

PROPOSED PROGRAMME OF WORKS

Bidder shall provide a programme in a bar-chart or Program Evaluation and Review Technique (PERT) or Critical Path Method (CPM) showing the sequence of work items by which he proposes to complete the works of the entire Contract. The programme should indicate the sequence of work items and the period of time during which he proposes to complete the works including the activities like designing, schedule of submittal of drawings, ordering and procurement of materials, manufacturing, delivering, construction of civil works, erection, testing and commissioning of works to be supplied under the Contract.

SCHEDULE – E TO BID

METHOD OF PERFORMING WORKS

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

- The sequence and methods in which he proposes to carry out the Works, including the number of shifts per day and hours per shift, he expects to work.
- A list of all major items of construction and plant erection, tools and vehicles proposed to be used in delivering/carrying out the works at site.
- The procedure for installation of equipment and transportation of equipment and materials to the site.
- Organisation chart indicating head office & field office personnel involved in management, supervision and engineering of the Works to be done under the Contract.

BIDDER QUALIFICATION CRITERIA

	Mandatory Eligibility Criteria	Remarks
S. No		
	(Attach Supporting Document)	Yes / No
	3 years (at least) relevant experience	
	3 years' average annual turnover with minimum 40 million	
	vear) as bank statement or financial statement.	
	,,	
	s tax registration certificate both EBR and / or SPB" and NTN	
	Category C-6 or above with specialization codes of Electrical &	

(INTEGRITY PACT)

SCHEDULE – F TO BID

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC PAYABLE BY CONTRACTORS

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE)

Contract No	
Contract Value:	
Contract Title:	

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

[name of Contractor] accepts full responsibility and strict liability that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with PA and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[name of Contractor] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured

as aforesaid shall, without prejudice to any other rights and remedies available to PA under any law, contract or other instrument, be voidable at the option of PA.

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

[IBA, Karachi]

[Contractor]

CONDITIONS OF CONTRACT CONTRACT DATA

(Note: Except where otherwise indicated, all Contract Data should be filled in by the IBA, Karachi prior to issuance of the Bidding Documents.)

Sub-Clauses of Conditions of Contract

- 1.1.3 IBA, Karachi's Drawings, if any (To be listed by the IBA, Karachi)
- 1.1.4 The IBA, Karachi means
- 1.1.5 **The Contractor** means
- 1.1.7 **Commencement Date** means the date of issue of Engineer's Notice to Commence which shall be issued within fourteen (14) days of the signing of the Contract Agreement.
- 1.1.9 Time for Completion ______ days

(The time for completion of the whole of the Works should be assessed by the

IBA, Karachi)

1.1.20 Engineer (mention the name along with the designation including whether he belongs to department or consultant) and other details

1.3 Documents forming the Contract listed in the order of priority:

- (a) The Contract Agreement
- (b) Letter of Acceptance
- (c) The completed Form of Bid
- (d) Contract Data
- (e) Conditions of Contract
- (f) The completed Schedules to Bid including Schedule of Prices
- (g) The Drawings, if any
- (h) The Specifications
- (i) _____(j) _____

(The IBA, Karachi may add, in order of priority, such other documents as form part of the Contract. Delete the document, if not applicable)

- 2.1 **Provision of Site:** On the Commencement Date
- 3.1 Authorized person:
- 3.2 Name and address of Engineer's/IBA, Karachi's representative
- 4.4 **Performance Security:**

Amount_____Validity____

(Form: As provided under Standard Forms of these Documents)

5.1 **Requirements for Contractor's design (if any):**

Specification Clause No's_____

7.2 **Programme:**

Time for submission: Within fourteen (14) days* of the Commencement Date.

Form of programme: (Bar Chart/CPM/PERT or other)

7.4 Amount payable due to failure to complete shall be __% per day up to a maximum of

(10%) of sum stated in the Letter of Acceptance

(Usually the liquidated damages are set between 0.05 percent and 0.10 percent per day.)

7.5 Early Completion

In case of earlier completion of the Work, the Contractor is entitled to be paid bonus up-to limit and at a rate equivalent to 50% of the relevant limit and rate of liquidated damages stated in the contract data.

9.1 **Period for remedying defects**

10.2 Variation procedures:

Day work rates (detail)

11.1 **Terms of Payments**

a) Mobilization Advance

(1) Mobilization Advance up to 10 % of the Contract Price stated in the Letter of Acceptance shall be paid by the IBA, Karachi to the Contractor on the works costing Rs.2.5 million or above on following conditions:

- (i) on submission by the Contractor of a Mobilization Advance Guarantee for the full amount of the Advance in the specified form from a Scheduled Bank in Pakistan to the IBA, Karachi;
- (ii) Contractor will pay interest on the mobilization advance at the rate of

10% per annum on the advance; and

- (iii) This Advance including the interest shall be recovered in 5 equal installments from the five (05) R.A bills and in case the number of bills is less than five (05) then 1/5th of the advance **inclusive of the interest** thereon shall be recovered from each bill and the balance together with interest be recovered from the final bill. It may be insured that there is sufficient amount in the final bill to enable recovery of the Mobilization Advance.
 - O R

2) Secured Advance on Materials

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

and providing evidence of ownership and payment therefore;

 (iii) Ownership of such materials shall be deemed to vest in the IBA, Karachi and these materials shall not be removed from the Site or otherwise disposed of without written permission of the IBA, Karachi;

(iv) The sum payable for such materials on Site shall not exceed 75 % of the
(i) landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of
locally manufactured or produced materials, or (iii) market price of stands other
materials;

(v) Secured Advance should not be allowed unless &until the previous advance, if an, fully recovered;

- (viii) Detailed account of advances must be kept in part II of running account bill; and
- (ix) Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 2 months from the date of issue of secured advance and definitely not for full quantities of materials for the entire work/contract
- (b) Recovery of Secured Advance:
 - (i) Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis, but not later than period specified in the rules not more than three months (even if unutilized); other conditions.
 - (ii) As recoveries are made the outstanding accounts of the items concerned in Part II should be reduced b making deduction entries in the column; -deduct quantity utilized in work measured since previous bill, equivalent to the quantities of materials used by the contractor on items of work shown as executed in part I of the bill.

(d) Interim payments: The Contractor shall submit to the Engineer monthly statements of the estimated value of the work completed less the cumulative amount certified previously.

- (i) The value of work completed comprises the value of the quantities of the items in the Bill of Quantities completed.
 - (ii) value of secured advance on the materials and valuation of variations (if any).
 - (iii) Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.
 - (v) Retention money and other advances are to be recovered from the bill submitted by contractor.
 - i) Lump sum price_____(details), or
 - ii) Lump sum price with schedules of rates _____(details), or
 - iii) Lump sum price with bill of quantities _____(details), or
 - iv) Re-measurement with estimated/bid quantities in the Schedule of Prices or on premium above or below quoted on the rates mentioned in CSR _____(details), or/and
 - v) Cost reimbursable (details)
- 11.3 **Percentage of retention*:** *five (5%)*
- 11.6 Currency of payment: Pak. Rupees
- 14.1 **Insurances:** (*IBA, Karachi may decide, keeping in view the nature and the scope of the work*)

Type of cover The Works Amount of cover

The sum stated in the Letter of Acceptance plus fifteen percent (15%)

Type of cover Contractor 's Equipment: Amount of cover Full replacement cost

Type of cover

b

Third Party-injury to persons and damage to property

(The minimum amount of third party insurance should be assessed by the IBA, Karachi and entered).

Workers:

Other cover*:

(In each case name of insured is Contractor and IBA, Karachi)

14.2 Amount to be recovered

Premium plus ______percent (____%).

15.3 Arbitration**

Place of Arbitration:

* (IBA, Karachi to specify as appropriate)

** (It has to be in the Province of Sindh)

STANDARD FORMS

(Note: Standard Forms provided in this document for securities are to be issued by a bank. In case the bidder chooses to issue a bond for accompanying his bid or performance of contract or receipt of advance, the relevant format shall be tailored accordingly without changing the spirit of the Forms of securities).

FORM OF BID SECURITY (Bank

. Guarantee)
(Letter by the Guarantor to the IBA, Karachi)

Guarantee No. Executed on Name of Guarantor (Scheduled Bank in Pakistan) with ad<u>dress:</u> Name of Principal (Bidder) with address:

Sum of Security (express in words and figures):

Bid Reference No.

Date of Bid

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bid and at the request of the said Principal, we the Guarantor above-named are held and firmly bound unto the

, (hereinafter called The -Procuring

Agency[]) in the 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 Principal has submitted the accompanying Bid numbered and dated as above <u>for (Particulars of Bid) to the said Procuring Agency;</u> and Agency; and

WHEREAS, the IBA, Karachi has required as a condition for considering the said Bid that the Principal furnishes a Bid Security in the above said sum to the IBA, Karachi, conditioned as under:

- (1) that the Bid Security shall remain valid for a period of twenty-eight (28) days beyond the period of validity of the bid;
- (2) that in the event
- of;
- (a) the Principal withdraws his Bid during the period of validity of Bid, or
- (b) the Principal does not accept the correction of his Bid Price, pursuant to Sub- Clause 16.4 (b) of Instructions to Bidders, or
- (c) failure of the successful bidder to
 - (i) furnish the required Performance Security, in accordance with Sub- Clause IB-21.1 of Instructions to Bidders, or
 - (ii) sign the proposed Contract Agreement, in accordance with Sub- Clauses IB-20.2 & 20.3 of Instructions to Bidders,

the entire sum be paid immediately to the said Procuring Agency for delayed completion and not as penalty 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 Agreement with the said IBA, Karachi in accordance with his Bid as accepted and furnish within fourteen (14) days of receipt of Letter of Acceptance, a Performance Security with good and sufficient surety, as may be required, upon the form prescribed by the said IBA, Karachi 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 then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

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

PROVIDED ALSO THAT the Procuring Agency shall be the sole and final judge for deciding whether the Principal 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 Guarantor shall pay without objection the sum stated above upon first written demand from the IBA, Karachi forthwith and without any reference to the Principal or any other person.

IN WITNESS WHEREOF, the above bounded Guarantor has executed the instrument under its seal on the date indicated above, the name and 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) 1

Witness:

1. -----

Corporate Secretary (Seal)

2. -----

3. Title

(Name, Title & Address)

Corporate Guarantor (Seal)

FORM OF PERFORMANCE SECURITY (Bank Guarantee)

Guarantee	
No.	
Executed	
on Expiry	
Date	

(Letter by the Guarantor to the IBA, Karachi) Name of Guarantor (Scheduled Bank in Pakistan)

with

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address:

Name of Principal (Contractor) with address:

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

Letter of Acceptance No.

Dated

NOW 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 IBA, Karachi)

in the penal sum of the amount stated above, for the payment of which sum well and truly to be made to the said IBA, Karachi, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

______ (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 IBA, Karachi, 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 the 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 9, Remedying Defects, of Conditions of Contract are fulfilled.

Our total liability under this Guarantee is limited to the sum stated above and it is a condition of any liability attaching to us under this Guarantee that the claim for payment in writing shall

be received by us within the validity period of this Guarantee, failing which we shall be discharged of our liability, if any, under this Guarantee.

We, (the Guarantor), waiving all objections and

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

PROVIDED ALSO THAT the Procuring Agency shall be the sole and final judge for

deciding whether the Principal (Contractor) has duly performed his obligations under the Contract or has defaulted in fulfilling said obligations and the Guarantor shall pay without objection any sum or sums up to the amount stated above upon first written demand from the IBA, Karachi forthwith and without any reference to the Principal or any other person.

IN WITNESS WHEREOF, the above bounded 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.

Witness:

1. _____

Guarantor (Bank)

2. _____

Corporate Secretary (Seal)

3. Title _____

(Name, Title & Address)

Corporate Guarantor (Seal)

FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the -Agreement||) made on the day of 200 between

(hereinafter called the -Procuring Agency]) of the one part and -Contractor]) of the other part.

(hereinafter called the

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

NOW this Agreement witnesseth as follows:

- 1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
- 2. The following documents after incorporating addenda, if any except those parts relating to Instructions to Bidders, shall be deemed to form and be read and construed as part of this Agreement, viz:
 - (a) The Letter of Acceptance;
 - (b) The completed Form of Bid along with Schedules to
 - Bid; (c) Conditions of Contract & Contract Data;
 - (d) The priced Schedule of Prices/Bill of quantities
 - (BoQ); (e) The Specifications; and
 - (f) The Drawings
- 3. In consideration of the payments to be made by the Procuring Agency to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the

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Stamp & Signature

IBA, Karachi to execute and complete the Works and remedy defects therein in conformity and in all respects within the provisions of the Contract.

4. The IBA, Karachi 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 Contract 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 the IBA, Karachi

(Seal)

(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:

Witness:

(Name, Title and Address)

(Name, Title and Address)

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Stamp & Signature

MOBILIZATION ADVANCE GUARANTEE

(Letter by the Guarantor to the	e IBA, Karacł	ni)					
Guarantee No	_Executed of	on					
WHEREAS the							
(hereinafter							
called the Procuring	Agency)	has	entered	into	а	Contract	for
			(F	articular	rs of	Contract),	_ with
	(h	ereinaft	er called the	e Contra	ctor).		
AND WHEREAS the IBA, K	arachi has a	agreed	to advance	to the	Contra	actor, at the	ž
Contractor 's request, ar	n amount	of	Rs			Rupee	S
which amount shall be adva	nced to the	e Contra	actor as pe	r provisi	ons of	f the Contra	ct.
AND WHEREAS the IBA, Karac the advance payment for the p	hi has askeo performance	d the Co of his c	ontractor to obligations u	furnish Inder the	Guara e said	antee to sec Contract.	ure

AND WHEREAS

(Scheduled Bank)

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

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

Notice in writing of any default, of which the IBA, Karachi shall be the sole and final judge, as aforesaid, on the part of the Contractor, shall be given by the IBA, Karachi 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 come into force as soon as the advance payment has been credited to the account of the Contractor.

This Guarantee shall expire not later than ______

by which date we must have received any claims by registered letter, telegram, telex or telefax.

It is understood that you will return this Guarantee to us on expiry or after settlement of the total amount to be claimed hereunder.

Guarantor (Scheduled Bank)

Witness:

1._____

1. Signature _____

Corporate Secretary (Seal)

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2.	Name		
----	------	--	--

- 3. Title _____
- 2. _____

(Name, Title & Address)

Corporate Guarantor (Seal)

INDENTURE FOR SECURED ADVANCES.

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

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

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

AND WHEREAS the contractor has applied to the

— for an advance to him of Rupees ------.
(Rs.) on the security of materials absolutely belonging to him and brought by

him to the site of the said works the subject of the said agreement for use in the construction of such of the said works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labour and other charge) AND WHEREAS the Government has agreed to advance to the Contractor the sum of Rupees, (Rs.) on the security of materials the quantities and other particulars of

which are detailed in Part II of Running Account Bill (E). the said works signed by the contractor

R.Form.I7.A

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

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

(Rs. $\hfill \hfill \h$

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

follow :-

And doth hereby covenant and agree with the Government and declare ay

(1) That the said sum of Rupees ------ (RF. ------) so advanced by the Government to the Contractor as aforesaid and

all or any further sum or sums which may be advanced aforesaid shall be employed by the contractor in or towards expending the execution of the said works and for no other purpose whatsoever.

(2) That the materials detailed in the said Running Account Bill (B) which have been Fin R Form No. 17-A

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

(3) That the said materials detailed in the said Running Account Bill (B) and all other

Fin. R. Form No. 17-A

Materials on the security of which any further advance or advances may hereafter be

made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in *the* execution of the said works in accordance with the directions of the Divisional Officer------(hereinafter called the Divisional Officer) and in the terms of the said agreement.

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

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

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

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

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

all costs charges damages and expenses payable under these present PROVIDED ALWAYS and it is hereby agreed and declared that not withstanding anything in the said agreement and without prejudice to the powers contained therein if and whether the

covenant for payment and repayment hereinbefore contained shall become enforceable and the money owing shall not be paid to accordingly.

Once therewith the Government may at any time thereafter adopt all or any of following courses as it may deem best ;-

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

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

In witnesses whereof the* — or	n behalf	of
the Governor of Sindh and the said —	h	ave
hereunto set their respective hands and seals the day and first above v	written.	

Signed, sealed and delivered by* In the presence of

Seal 1st witness 2nd witness

Signed, sealed and delivered by* In the presence of

Seal

1st Witness 2nd witness

SPECIFICATIONS

[Note for Preparing the Specifications]

A set of precise and clear specifications is a prerequisite for bidders to respond realistically and competitively to the requirements of the user without qualifying their Bids. The specifications must be drafted to permit the widest possible competition and, at the same time, present a clear statement of the required standards of workmanship, materials, performance of the works. Only if this is done objectives of economy, efficiency, and fairness in procurement will be realized and responsiveness of Bids can be ensured, and the subsequent task of bid evaluation can be facilitated. The specifications should require that materials to be incorporated in the works be new, unused, and of the most recent or current models, and incorporated all recent improvements in design and materials unless provided for otherwise in the contract.

Samples of specifications from similar to previous procurements are useful in this respect. The use of metric units is encouraged. Depending on the complexity of the works and the repetitiveness of the type of procurement, it may be advantageous to standardize the Technical Specifications that should cover all classes of workmanship, materials and equipment although not necessarily to be used in a particular procurement.

Care must be taken in drafting specifications to ensure that they are not restrictive. In the specification of standards for equipment, materials, and workmanship, recognized international standards should be used as much as possible. The specifications shall consider all conditions but not limited to seismic conditions, weather conditions and environmental impact. The specifications should state that equipment, materials, and workmanship that meet other authoritative standards, and which ensure at least a substantially equal quality than the standards mentioned, will also be acceptable. The following clause may be inserted in the Specifications.

Sample Clause: Equivalency of Standards and Codes

Wherever reference is made in the Specifications to specific standards and codes to be met by Works to be furnished and tested, the provisions of the latest current edition or revision of the relevant shall apply, unless otherwise expressly stated in the Contract. Other authoritative standards that ensure equivalence to the standards and codes specified will be acceptable.

VOLUME II TECHNICAL SPECIFICATION

(PLANNING & DEVELOPMENT DEPARTMENT) INSTITUTE OF BUSINESS ADMINISTRATION KARACHI

TECHNICAL SPECIFICATION

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- 4. PLAIN AND REINFORCED CONCRETE.
- 5. DAMP PROOF COURSE, WATER PROOFING
- 6. CEMENT CONCRETE BLOCK MASONRY.
- 7. FLOORING.
- 8. PLASTER RENDERING.
- 9. PAINTING & POLISHING

10. GLASS & GLAZING

11 WOODEN CARPENTARY & JOINERY

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13 MISCELLENIOUS

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TECHNICAL SPECIFICATION

CHAPTER 1. CLEARING & GRUBBING

1. CLEARING & GRUBBING

1.1 SCOPE

The Scope of work includes removal of the bushes, vegetation, debris, garbage, lose material/ earth etc laying at proposed side of constructions and it shall also be inclusive of grubbing stumps, roots and matted roots and disposal of all material resulting from the clearing and grubbing of the proposed site of construction.

1.2 LOCATION OF WORKS

The Engineer shall mark the limit of working space. Normally it will be inclusive of ROW (Right of Way)

1.3 DISPOSAL

The contactor shall dispose off all the rubbish, bushes etc with in fifteen days. No tree trunk, stump or other debris shall be removed from site with out prior written approval of Engineer Incharge.

1.4 PROTECTION AND RESTORATION

The Contractor shall prevent all damages to under ground or on surface, water supply, Sewerage, Power Supply, Communication Cables, ducts, Land Marking Posts, property fences, Official Datum Points. If damaged accidentally during work then it will be restored immediately.

1.5 MEASUREMENT AND PAYMENT

The Measurement and payment for this item including loading unloading and stacking shall be made corresponding to tems as provided in the BOQ of Contract Agreement and shall constitute full compensation for performance and completion of work in all respects as specified and approved by the Engineer-in-Charge. No additional payment shall be made to Contractor for charges like demurrage, wharf age, toll tax, zila tax etc.

TECHNICAL SPECIFICATION

CHAPTER 2. EARTHWORK

2.0. SCOPE

The Work to be done under this section "Earth work" consists of performing all earth work in accordance with required levels, elevations and grades shown on the drawings/plans or as established by the Engineer .

- a) Excavation and formation of embankment in all types of soils. It also covers lifting and transporting excavated material. Suitable material intended for use as backfill shall be placed in temporary stockpiles. The method of carrying out earthwork shall be subject to approval of the Engineer-in-Charge in writing.
- b) Any excavation made excess than the required shall be filled by lean concrete for which no extra payment shall be made.
- c) Fill and backfill using selected excavated material or imported material obtained from approved sources or by blending the excavated and imported materials.
- d) Before commencement and during the execution of works, the Contractor shall be responsible for surveys, layout and their maintenance for execution of works according to contract and as approved by the Engineer-in-Charge-

2.1. CODES AND STANDARDS

The following Codes and Standards shall be followed wherever relevant and as directed by the Engineer-in-Charge.

ASTM D-1556-74 Test for density of soil in place by the sand cone method. B.S 1377-75 Methods of tests for soils for Civil Engineering purposes.

2.2. CLASSIFICATION OF SOILS

The earthwork shall be classified under the following categories and measured separately for each category:

2.2.1 ORDINARY SOIL

It includes cutting in earth which in general can be ploughed. Generally, the ordinary soils comprise of:

- a) Spoil or rubbish of every description.
- b) Earth and sandy loam
- c) Any other formation into which a shovel can be entered with foot pressure and can be easily excavated.

2.2.2. MURUM AND HARD SOILS

There are the following two types of hard soils: It includes a stiff and heavy clay soil having specific gravity of 1.5 and above.

2.2.3. SHINGLE AND GRAVEL/GRAVELLY SOIL

This Includes;

- (I) Gravel Formation
- (II) Large Boulders Above 20 Percent Which Can Be Individually Lifted By Hand

(iii) Soils which contain more than 50% of larger than 1-2" size particles of gravel and requires more labour to excavate than the soft or hard soil will be classed as gravelly soil.

2.3. ANTIQUITIES AND USEFUL MATERIALS

Any as ancient carvings, relics of antiquity, coins, fossils or other articles of archaeological value discovered or excavated during progress of work shall be delivered to the Engineer-in-Charge and shall be the property of the IBA /Government.

2.4. SETTING OUT AND SITE PREPARATION

The Contractor shall set out the Works and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If at any time any error in this respect shall appear the Contractor shall at his own expense rectify such error, to the satisfaction of the Engineer-in-Charge.

The bench marks or datum for setting out the Works will be provided by the Engineer-in-Charge. The Contractor shall however maintain accurate bench marks and survey monuments so that the lines and levels can be easily checked by the Engineer-in-Charge.

2.5. EXCAVATION IN ALL KINDS OF SOILS

2.5.1 EXCAVATION OPERATIONS

All excavation operations manually or by mechanical means shall include excavation and disposal of the excavated material for, buildings foundations, trenches, basements, water tanks sewers, drains foundations and manholes; including excavation in hard soils and under water etc. The work shall include of depositing the excavated materials as specified. The disposal of the excavated material beyond free lead shall be either stated as a separate item or included with the items of excavation stating lead.

The excavation shall be done true to levels, slope, shape and pattern as per drawings and directed by the Engineer-in-Charge. Only the excavation shown on the drawings or as approved by the Engineer-in-Charge- shall be measured for payment. No separate measurement and payment shall be made for excavation, centering, shuttering and for contractor's convenience.

For excavation in foundation in trenches and other like areas, the bed of excavations shall be to the correct level or slope and consolidated by watering and ramming and other means when necessary.

If the excavation is done to a depth greater than that shown in the drawings unless it is required by the Engineer-in-Charge-, the excess depth shall be made good by the

contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations.

2.7.2 DISPOSAL OF EXCAVATED MATERIALS

The free lead for disposal of excavated materials where stated in the "Schedule of Quantities" against various items is the average lead for the disposal of excavated earth within the site of work. The subsequent disposal of the excavated material where required shall be either stated as a separate item or included with the item of excavation stating lead. The contractor has to take written permission about place of disposal of earth before the earth is disposed of, from Engineerin-Charge.

2.8. EXCAVATION IN ORDINARY / HARD ROCK

2.8.1 GENERAL

All excavation operations shall include excavation and disposal of the excavated material as shown on drawings and approved by the Engineer-in-Charge-. In case of excavation for trenches, basements, water tanks etc. the excavation shall include disposal of the excavated materials within free lead as specified. The disposal of the excavated material beyond free lead shall be stated as a separate item unless it is included with the item of excavation.

2.8.2 ORDINARY / SOFT ROCK

The ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be adopted.

2.8.3 HARD ROCK

a) General EXCAVATION & GRADING OF ROCKS

a) Excavation Methods for Rock

The Method relates to rock strength and fracture density.

Direct excavation: Possible in fractured lock and in all soils; using face shovel, backhoe, clam shell grab or dragline or as stated..

2.10. CARE OF WATER/ DEWATERING

All water that may accumulate in excavations and seepage from subsoil aquifer shall be bailed, pumped out or otherwise removed by the contractor. The contractor shall take adequate measures for bailing and/or pumping out water from excavations and/or pumping out water from excavations. Pumping shall be done directly from the foundations or from a sump outside the excavation or any other appropriate method proposed by Contractor, and approved by the Engineer-in-Charge- in such a manner as to preclude the possibility of movement of water through any fresh concrete or masonry and washing away parts of concrete or mortar.

Capacity and number of pumps, location at which the pumps are to be installed, pumping hours etc. shall be proposed from time to time by the contractor and approved by the Engineer-in-Charge. The approval by the Engineer-in-Charge of the Method Statement for pumping shall not relieve the contractor of his responsibility. The applicable extra unit rate for wet and underwater

excavation of earthwork includes full compensation for performance of the work and no separate payment shall be allowed, in case item for dewatering in not listed in the bid separately.

2.10.3 MEASUREMENTS

The unit, namely, metre /ft depth shall be the depth measured from the level of foul position/ subsoil water level and upto the centre of gravity of the cross sectional area of excavation actually done in the conditions classified above.

Pumping or bailing out water met within excavations from the sources specified in above where envisaged and specifically ordered in writing by the Engineer-in-Charge shall be measured separately and paid. Quantity of water shall be recorded in kilolitres correct to two places of decimal. This payment shall be in addition to the payment under respective items of earthwork and shall be admissible only when pumping or bailing out water has been specifically ordered by the Engineer-in-Charge in writing.

Bailing or pumping out water, accumulated in excavation, due to rains is included under respective items of earthwork and is not to be paid separately.

2.11. FILLING /BACK FILLING

2.11.1. GENERAL

- i. For fillings foundation and embankment construction, the earth from excavation as far as practicable shall be directly used for filling and no payment for double handling of earth shall be admissible. All costs shall be deemed to be included in the unit rate for excavation.
- ii. The earth used for filling and embankment construction shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish. Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in thickness unless otherwise specified or approved by the Engineer-in-Charge-. All lumps exceeding 8 cm in any direction shall be broken.

2.11.1. BORROW SOIL

Materials required for fill and embankment construction not available from excavations be imported from pre-determined borrow areas approved by the Engineer-in-Charge.

2.11.2. MEASUREMENTS

The length and breadth of excavation or filling shall be measured with a steel tape and paid as per drawing.. The depth of cutting or height of filling shall be measured, by recording levels before the start of the work and after the completion of the work. The cubical contents shall be worked out to the nearest two places of decimal in cubic metres./Cuft.

In case of open footings up to the depth of 1.5 metres, around excavation of 30 cm. beyond the outer dimension of footing shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment.

2.11.3. EXCAVATION IN TRENCHES FOR PIPES, CABLES ETC. AND REFILL ING

'a) General

This shall comprise excavation to any depth in trenches for pipes, cables etc. and returning the suitable excavated material to fill the trenches after pipes, cables etc. are laid and their joints tested and passed, and disposal of surplus excavated material.

b) Refilling /Back filling

Filling in trenches shall be commenced soon after the joints of pipes, cables, conduits etc. have been tested and passed. The space all around the pipes, cables conduits etc. shall be cleared of all debris, brick bats etc. Where the trenches are excavated in hard/ soft soil, the filling shall be done with earth on the side and top of pipes unless otherwise approved in layers not exceeding 20cm in depth. Each layer shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the excavated earth is used for filling. In case of excavation trenches in ordinary/ hard rock, the filling up to a depth of 30cm above the crown of pipe, cable, conduits etc. shall be done with fine material like earth, moorum or pulverized/ decomposed rock according to the availability at site. Excavated material containing deleterious material, salt peter earth etc. shall not be used for filling.. Special care shall be taken to ensure that no damage is caused to the pipes, Cables, Conduits etc. laid in the trenches.

i) Measurements

Trenches for pipes, cables, conduits etc. shall be measured in running meter/ft correct to the nearest cm /inch.

Where two or more categories of each work are involved due to different classification of soil within the same stage of trench depth or where the soil is soft loose or slushy requiring increase in the width of trench or sloping sides or shoring, trenches for pipes, cables, conduits, etc. shall be measured in cubic meters. Extra excavation, if any, on account of collar/ socket of pipes shall neither be measured nor paid for separately.

2.11.4. FILLING IN PLINTH, UNDER FLOOR ETC.

2.11.4.1 EARTH FILLING

Normally excavated earth from same area shall be used for filling. Earth used for filling shall be free from shrubs, rank, vegetation, grass, brushwood, stone shingle and boulders (larger than 75mm in any direction), organic or any other foreign matter. Earth containing deleterious materials, salt peter earth etc. shall not be used for filling. All clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the earth is used for filling.

The space around the foundations and drains shall be cleared of all debris, brick bats etc. The filling unless otherwise specified shall be done in layers not exceeding 20cm in depth. Each layer shall be watered, rammed and consolidated

a) **MEASUREMENTS**

Filling Side of Foundations: The cubical contents of bed concrete levelling course and masonry/concrete in foundations up to the ground level shall be worked out and the same deducted from the cubical contents of earthwork in excavation for foundations already measured under the respective item of earth work to arrive at the quantity for filling sides of foundation. The quantity shall be calculated correct to two places of decimal.

Filling in Plinth and under Floors: Depth of filling shall be the consolidated depth. The dimensions of filling shall be on the basis of pre-measurement correct to the nearest cm and cubical content worked out in cubic metres correct to two places of decimal.

2.11.6. SAND FILLING IN PLINTH

Sand shall be clean and free from dust organic and foreign matter. Sand filling shall be done in a manner similar to earth filling in plinth specified above except that consolidation shall be done by flooding with water. The surface of the consolidated sand filling shall be dressed to the required level or slope and shall not be covered till the Engineer-in-Charge has inspected and approved the sand filling.

a) **MEASUREMENTS**

The length, breadth and depth of consolidated sand shall be measured with steel tape correct to the nearest cm and cubical contents worked out in cubic metres correct to two places of decimal.

2.12 TERMITE CONTROL TREATMENT

2.12.1 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. Anti-termite treatment can be either during the time of construction i.e. pre-constructional chemical treatment or after the building has been constructed i.e. treatment for existing building. Prevention of the termite from reaching the super-structure of the building and its contents can be achieved by creating a chemical barrier between the ground, from where the termites come and other contents of the building which may form food for the termites. This is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide.

The scope also covers treatment of all wood works with insecticides before installation in position.

2.12.2 CODES AND STANDARDS

All methods of termite protection used herein shall be in accordance with the standard practice of National Pest Control Association, U.S.A. and the British Wood Preserving Association.

2.12.3 SUBMITTALS

Samples of all the materials to be used for termite control for approval of the Engineer and testing in accordance with the specified standards.

2.12.4 Method statement for application of anti-termite chemical.

2.12.5 QUALITY ASSURANCE

2.12.5.1 Manufacturer's Instructions

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

2.12.5.2 Application

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

2.12.5.3 Guarantee

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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 one year from the date of acceptance of the building.

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

2.12.6 MATERIAL

- 2.12.6 An emulsible concentrated insecticide shall be used for dilution with water, specially formulated to prevent infestation by termites. Provide a working solution of one of the following chemical with clean portable water in ratio 1:40 unless otherwise specified by the manufacturer/ supplier.
 - 5.1.1.1 Termidor
 - 5.1.1.2 Biflex
 - 5.1.1.3 Dursban
 - 5.1.1.4 TENEKIL or any other material as specified.

Insecticide shall be obtained from the Sole distributor, in sealed drums in quantity necessary for the requirement of works. All mixing shall be done at site and mixing proportion of insecticide with water shall be as per manufacturer's instructions and verified by the Engineer.

2.12.7 METHOD AND EXTENT OF APPLICATION

Insecticide solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150psi 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. No covering of earth or concrete should be applied over soil treatment until at least 24 hours after treatment has been made. 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 2 meter beyond building line. Solution shall be applied in amounts of not less than 6.00 litter /sq.m of area. If applied over gravel or sand fill, application shall not be less than 7.50litre /sq.metre of area. Insecticide shall penetrate to a depth of 25mm minimum in porous earth at bottom and 50 mm to 75 mm at sides of excavations.

Sides of foundation excavations, grade beam, and similar areas shall be treated with solution at a rate of 0.37 gallon per square feet upon inner sides of such excavations, and at all locations where concrete slabs for platforms and similar work abut 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.

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.

All woodwork for the entire project is to be insecticide treated (before application of solignum). Insecticide shall be sprayed on all surfaces of all the wooden work viz., door frames, blocking, furring, planks, boards etc. before installation. Spraying is to be done at the site, after delivery and before installation.

2.12.8 MEASUREMENT & PAYMENT

General

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

2.12.8.1 Measurement

Measurement of acceptably completed works of termite control treatment will be made on the basis of number of square feet/Sq meter of area treated by measuring the two dimensions (length & breadth) of treated surface.

2.12.8.2 Payment

TECHNICAL SPECIFICATION

Payment will be made for acceptable measured quantity of termite control treatment on the basis of unit rate per square Feet /Sq meter quoted in the Bills of Quantities & shall constitute full compensation for all the works related to the item.

CHAPTER-3. DISMANTLING (DEMOLITION)

3.0 SCOPE

The work shall comprise dismantling/demolishing whole or part of work including all relevant items consisting of but not limited to , concrete, floorings, roofing and metal work structural steel as specified and or shown on the drawings. Only such work or part of works which are designated on the Drawings or by the Engineer to be removed shall be included in the work to be done under these specifications.

When approved by the Engineer, the contractor shall remove the dismantled/works required to be removed and clear the site, as specified or directed by the Engineer.

3.1. SERVICEABLE AND UNSERVICEABLE MATERIALS

Upon written instructions of Engineer-in-Charge, the Contractor shall make a list of all such items which in opinion of Engineer-in-Charge can be re-used. The Contractor shall take such measures to protect these materials / items from damage during dismantling process. The Contractor shall provide labour and other arrangements to properly stack / store such items safely until handed over to the Engineer-in-Charge.

All unserviceable materials, rubbish etc. shall be disposed off as directed by the Engineer -in-Charge.

3.2. PRECAUTIONS

- a) Before commencement of dismantling/demolition, the Contractor shall prepare and submit his proposals and program for proceeding with the work for approval of the Engineer-in-Charge.
- b) The work should generally be performed in reverse order of the one in which the structure was constructed. Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the workers, adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage

is caused to the adjoining work or property. Temporary enclosures or partitions and necessary scaffolding wherever specified shall also be provided, as directed by the Engineer-in-Charge.

- c) Necessary steps/ precautions should be taken to keep noise and dust nuisance to a minimum
- d) No demolition work should be carried out at night especially when the building or structure to be demolished is in an inhabited area. Screens shall be placed where necessary to prevent injuries due to falling pieces. Water may be used to reduce dust while tearing down plaster from brick work. Safety belts shall be used by labourers while working at higher level to prevent falling from the structure. First-aid equipment shall be got available at all demolition works of any magnitude.

3.3. MEASUREMENT AND PAYMENT

All work shall be measured net in the decimal system, as fixed in its place, subject to the following limits, unless otherwise stated hereinafter in BOQ.

CHAPTER - 4. PLAIN AND REINFORCED CONCRETE

4.1 SCOPE

The work shall include all Cast –in Place and Precast Concrete including furnishing of all labour, materials, plant, equipment, accessories ,Erection & Removal of Mold/ Form Work , Testing at Site & Laboratory and services as required to complete the concrete items as shown on the drawings, specified herein and/or as directed by the Engineer-in-Charge. The materials herein specified shall be proportioned, mixed, formed and placed in accordance with the herein stated requirements. The

TECHNICAL SPECIFICATION

stipulations and requirements herein set forth shall apply except when such stipulations and requirements are specifically modified by the Engineer-in-Charge for any particular item of work. The Contractor shall submit method statement before starting of concreting operations. The method statement shall provide the procedures and resources planned to be employed for completion of construction. The General Condition, Special Condition of Contract, General Note on Structural and Architectural Drawings shall be a part of this section. Finishing, Curing, protection of Concrete is a part of the Scope of Work.

4.2 CLASSIFICATION OF CONCRETE

In order to meet the strength and durability of the requirements, the concrete is divided into the following categories in the context of this Contract.

4.2.1 VOLUMETRIC PROPORTION (CEMENT: SAND: AGGREGATE)

a) 1:1:2

Concrete made by using Ordinary Portland Cement (OPC) and other basic ingredients i.e. course aggregate, fine aggregate and water. The concrete having Volumetric proportions of 1:1:2 (1 Cement: 1 Fine Aggregate: 2 Coarse Aggregate). Nominal 28 days Cylinder Compressive Strength of such concrete is **28 MPa (4000 psi).** However, it may vary depending on physical and chemical properties of aggregates.

b) 1:1.5:3

Concrete made by using Ordinary Portland Cement (OPC) and other basic ingredients i.e. course aggregate, fine aggregate and water. The concrete having Volumetric proportions of 1:1.5:3 (1 Cement : 1.5 Sand : 3 Aggregate). Nominal 28 days Cylinder Compressive Strength of such concrete is 21

MPa (3000 psi). However, it may vary depending on physical and chemical properties of aggregates.

c) 1:2:4

Concrete made by using Ordinary Portland Cement (OPC) and other basic ingredients i.e. course aggregate, fine aggregate and water. The concrete having Volumatic proportions of 1:2:4 (1 Cement : 2 Sand : 4 Aggregate). Nominal 28 days Cylinder Compressive Strength of such concrete is 16.5 MPa (2400 psi). However, it may vary depending on physical and chemical properties of aggregates.

d) Lean 1:3:6

Concrete made by using Ordinary Portland Cement (OPC) and other basic ingredients i.e. course aggregate, fine aggregate and water. The concrete having Volumetric proportions of 1:3:6 (1 Cement : 3 Sand : 6 Aggregate). Nominal 28 days Cylinder Compressive Strength of such concrete is 10.5 MPa (1500 psi). However, it may vary depending on physical and chemical properties of aggregates.

e). Lean 1:4:8

Concrete made by using Ordinary Portland Cement (OPC) and other basic ingredients i.e. course aggregate, fine aggregate and water. The concrete having Volumetric proportions of 1:4:8 (1 Cement : 4 Sand : 8 Aggregate). Nominal 28 days Cylinder Compressive Strength of such concrete is 8 MPa (1200 psi). However, it may vary depending on physical and chemical properties of aggregates. It shall be used for no structural works like floor underlay, lean concrete etc.

4.3 MATERIALS

4.3.1 CEMENT

a) General

Cement shall be fresh, furnished in sacks or in bulk form as approved by the Engineer-in-Charge. Unless otherwise permitted, cement from not more than two plants shall be used and in general, the product of only one plant shall be used in any particular section of the work. **Portland Cement** Portland cement shall be of Pakistan origin as per approved brand and manufacturer and, shall conform to Pakistan Standard 232 or to British Standard 12 or to ASTM C 150 Type I or Sulphate Resistant, Type-V or conforming to BS 4027 or ASTM C-150 may also be used in certain parts of the Works as specified or directed by the Engineer-in-Charge. The slag cement conforming to BS 146 or ASTM C 595 may also be used with prior approval of Engineer-In charge. The mix will normally be designed by the Contractor to have:

A mortar bar reduction not less than 75% at 14 days when tested in accordance with ASTM C441, ii) A heat of hydration of less than 70 calories per gram of Pozzolanic materials (blast-furnace slag or fly ash or calcined clay) at 7 days when tested in accordance with ASTM C186.

b. STORAGE OF CEMENT

Cement shall be stored at Site in dry, weather tight and properly ventilated stores. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification of each consignment

c. Sampling, Cement Usage

Sampling of cement shall be in accordance with AASHTO T 127. Mill Test Certificates shall accompany delivery of the material to the work.

4.3.2 AGGREGATES

a) General Requirements

i) Cleanliness.

The aggregates should be free from injurious amount of clay, salt, alkali, organic matter, shale, loam, soft flaky particles and other deleterious substance. Aggregate when not obtained in clean state are invariably washed before use. **Shape.**

Crushed aggregate should be sharp, angular and of hard grains, approximately cubical in size and those obtained from natural source be rounded, well-shaped and of hard grains. The fine aggregate should be such shape that it covers the maximum voids between coarse aggregates. **ii) Size.**

TECHNICAL SPECIFICATION

To obtain high crushing strength of concrete the maximum size of aggregate should be as large as conveniently possible but it should not be normally greater than one- fourth in plain concrete and onefifth in reinforced concrete of the smallest dimension in the structure. Similarly, the nominal maximum size of the aggregates shall not be larger than one fifth of the narrowest dimension of the finished wall or slab, or larger than three fourth of the minimum clear spacing between the reinforcing steel and embedment.

iii) Grading.

Aggregate are required to be graded into different size and mixed in desired proportions for producing mortar and concrete of specified quality and strength. The aggregates are graded into minimum of cement per unit volume to give required strength. The aggregates are graded into nominal size by sieving and their fineness Modulus determined. A smaller value of the fineness modulus indicated the presence of large proportions of fine particles.

iv) Durability.

Aggregates should be hard to resist grading actions; tough to withstand impact and sound to remain whole during changes in weather conditions. The soundness test is carried out by means of Sodium Sulphate Test. Crushing strength test is carried out to determine the strength. The specific gravity test is required to determine the density.

vi) Storage.

Storing on dusty, muddy or grassy spots, should be avoided. Aggregate which has deteriorated or which has been contaminated shall not be used for concrete

b) Test Requirements for Fine Aggregate

The fine aggregate shall consist of sand, stone screenings or other approved inert materials with similar characteristics,

For exposed work, the fine aggregate shall be free from any substance that will discolor the concrete surface.

The fine aggregate shall be uniformly graded and when tested in accordance with AASHTO T 11

Table 4.2

and

T 27 shall meet the following grading requirements:

GRADING OF FINE AGGREGATES					
Percentage Passing by Weight					
100					
95~100					
45~85					
10~30					
2~10					
0~3					

For the purpose of determining the degree of uniformity, a fineness modulus determination shall be made upon representative samples submitted by the Contractor from such sources as he proposes to use.

i) Sand for Mortar

All sand for mortar used in the construction of brick paving, brick lining and brick masonry shall be natural sand and when tested by means of standard screens (ASTM Designation: E11) shall conform to the following limits:

Screen No.	Percentage by weight, passing screen
8	100
100	15 (Maximum)

Within the above range, the sand shall be well-graded and as coarse as practicable for the production of workable mortar.

ii) GRADING TABLE OF COARSE AGGREGATES:

TABLE 4.2 GRADING OF COARSE AGGREGATES

Designated	Percentage by Weight Passing Laboratory Sieves, in inches,
Sizes	Having Square Openings
51265	naring equale eperinge

	2 1/2	2	1 1⁄2	1	3⁄4	1⁄2	3/8	No. 4
1⁄2" to No. 4	-	-	-	-	100	90~100	40~70	0~15*
¾" to No. 4	-	-	-	100	90~100	-	20~55	0~10*
1" to No. 4	-	-	100	95~100	-	25~60	-	0~10*
1½" to No. 4	-	100	95~100	-	35~70	-	10~30	0~5
2" to No. 4	100	95~100	-	35~70	-	10~30	-	0~5
1½" to¾"	-	100	90~100	20~55	0~15	-	0~5	-
2" to 1"	100	90~100	35~70	0~15	-	0~5	-	-

Not more than five (5) % shall pass No. 8 sieve.

Coarse aggregate gradation should conform to the requirements of ASTM C 33

d) Tests & Approval

All aggregates shall be subject to testing which shall be carried out by the contractor at his own expanse upon instructions of Engineer-in-Charge. Aggregates not meeting the requirements of these Specifications as determined by tests or inspection may be rejected. **e) Water**

The water for curing, for washing aggregates and for mixing shall be subject to the approval of the Engineer in charge. Generally it should be free from oil and the turbidity limit shall not exceed 2000 parts per million and the pH value shall range between 6.0 to 8.0.

e) Admixtures

An, admixture is added to concrete mix in quantities not more than 5% by mass of cement during mixing or during an additional mixing operation prior to the placing of the concrete, for achieving a specific modification, to normal properties of the concrete..

Classification of admixtures as per ASTM C-494 is given as under

Type A Water Reducing (Normal Plasticizing)

Type B Retarding

Type C Accelerating

Type D Water Reducing and Retarding

Type E Water Reducing and Accelerating

Approval Required

Admixtures, including air-entraining admixtures, foaming chemicals and water-reducing admixtures, shall not be used, except with the prior approval of the Engineer-in-Charge. Before

using admixtures in concreting process, trial mixes shall be made to determine the mix design by laboratory testing. **Measurement**

Where so specified, Admixture of approved quality shall be added to the concrete mixture in accordance with the manufacturer's specification stating the quantity in litres or kg as specified and will be paid for separately as per item of BOQ or as approved.

f) Water stops

g) PVC Water-stops

Except as otherwise shown on the Drawings, water-stops shall be installed with an approximately equal width of material embedded in concrete on each side of the joint. Water stops shall be sealed to other cut off systems as shown on the Drawings or as directed by the Engineer-in-Charge. The PVC Stopper confirm the following Properties.

Physical Characteristics of PVC waterstop						
Physical Characteristics Test Method Typical Val						
Ultimate Elongation	ASTM D 638 (CRD C 573)	350 % min				
Tensile Strength	ASTM D 638 (CRD C 573)	1750 psi (12.07 Mpa) min				
Low Temperature Brittleness	ASTM D 746 (CRD C 570)	No Failure @ - 35 F (-37 C)				
TECHNICAL SPECIFICATION						
Stiffness in Flexure	ASTM D 747 (CRD C 571)	400 psi (2.76 Mpa) min				
Specific gravity	ASTM D 792	1.37 max				
Hardness, Shore A ASTM D 2240 70 - 80						

Table 4.3
Physical Characteristics of PVC Watersto

g) Joint Sealing Compound

Sealing compound shall be either of the cold application type conforming to ASTM D-1850 or of the single or multiple component type or of the hot poured type conforming to the requirements of ASTM D-1190 or their equivalents as specified on drawing or as per approval

Measurements

The measurement of the finished work shall be measured as per BOQ and be paid as per approved.

4.1.2 PROPORTIONING & MIXING OF CONCRETE MIX

4.1.2.1 PROPORTIONING OF INGREDIENTS

a) The proportioning of the concrete for its ingredients namely cement, sand and coarse aggregates is specified for BOQ items on volume basis and on weight basis for the specified use. The proportioning and batching of concrete mix shall accordingly be done on volume basis.

Mix proportions and water- cement ratio shall be so determined as to produced concrete having suitable workability, density, im-permeability, durability or strength. The contractor shall not be entitled to any compensation because of these adjustments.

b) The amount of water used in the concrete shall be so regulated as to secure concrete of a proper consistency and to adjust for any variation in the moisture contents, or grading of the aggregates as they enter the mixer. Water shall not be allowed to be added to undo the stiffening of the concrete resulting from excessive over-mixing or objectionable drying before placing. Uniformity in concrete consistency from batch to batch shall be required. Unless otherwise specified or directed by the Engineer-in-Charge the slump of concrete after it has been deposited, but before it has consolidated, shall have the following values under different situations:

Sr. No.	Purpose	Slump (inches)
2.	High strength reinforced and pre-stressed concrete section, paving and mass concrete compacted by vibration.	0 – 1
3.	Normally reinforced concrete sections compacted by vibration, hand compacted mass concrete.	1 – 2
4.	Heavily reinforced concrete sections compacted by vibration, hand compacted concrete in normally reinforced slabs, beams, columns and walls.	2 – 4
5.	Heavily reinforced concrete sections compacted without vibration and work where compaction is particularly difficult.	4 – 6

4.1.3 PROPORTIONING ON VOLUMETRIC BASES

For volumetric proportioning suitable gauge boxes shall be used. Cement shall be taken as weighing 50 Kg as per standard bag of 0.035 cubic meter (1.25 ft³). The bulking effect of aggregates shall be taken into the consideration.

The Engineer in Charge shall ensure preparations for various strength requirements, based on the availability of local materials. Depending upon the variations in site condition and locally available aggregate (both coarse and fine) the Engineer in Charge shall ensure preparation of Concrete mix designs as specified by the Designer and get them tested from an authenticated Government Material Testing Laboratory at the expense of the contractor before commencement of the Job. The following table shows the proportions of the concrete ingredients on volumetric bases: -

Table 4.5

Estimated Mix Proportions for Regular / Normal Concrete For Various Strength Requirements

Minimum 28	Туре	Approximate Concrete Mix for Estimation	Estimated Quantities per Cum		
Days Cylinder Compressive Strength			Cement Kg	Aggregate (Cum)	
				Fine	Coarse
24 MPa (3500 psi)	В	1:1.5:3	415.5	0.436 (15.4 ft ³)	0.872 (30.8ft ³)
21 MPa (3000 psi)	С	1:2:4	327	0.457 (16.14 ft ³)	0.914 (32.28 ft ³)
10.5 MPa (1500 psi)	D	1:3:6	228.5	0.480 (16.95 ft ³)	0.960 (33.90 ft ³)

Consistency

Concrete shall have a consistency such that it will be workable in the required position. The consistency of concrete shall be determined to be as dry as it is practicable to satisfy the requirements for transportation and placing of the concrete as described hereinafter. Consistency of concrete shall be determined as specified in AASHTO T 119. c) Water Cement Ratio

The selection of water cement ratio as a basis for designing a concrete mixture involves consideration of both the degree of exposure to which the concrete is to be subjected and the strength requirements of the structure

It is expected that water- cement ratio by weight will vary from 0.45 for concrete in thin sections to 0.65 for mass concrete in severe weather conditions. Maximum permissible water cement ratio will also vary from 0.67 for low strength concrete to 0.38 for the concrete 28 days strength of 4000 Psi and above.

4.2.0. STRENGTH EQUIVALENCY OF CUBE AND CYLINDER STRENGTH

28 days 6 inches x 12 inches (15cm x 30 cm) cylinder strength corresponding to 28 days cube strength in the Table are given hereunder:

28 days cube strength (Psi)	6" x 12" cylinder strength (Psi)
4500	4000
3750	3000
3000	2200
2000	1500

4.2.1 HAND MIXING

No Hand Mix is allowed for Structural Concrete. However for non Structural Concrete Hand mixing shall not be carried out with the approval of the Engineer in Charge.
Unless otherwise specified or directed, hand mixing shall be done on the following lines:

4.2.2 MACHINE MIXING

Concrete Mixtures

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixer shall be restored or replaced when any part or sections is worn two and a half $(2^{1}/_{2})$ cm or below than the original height of the manufacturer's design. Mixers and agitators, which have an accumulation of hard concrete or mortar, shall not be used

All concrete shall be mixed for a period of not less than one and a half (11/2) minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed.

The first batch of concrete material placed in the mixer shall contain cement, sand and water in excess to the requirement of mix, to ensure that the drum does not extract mortar from the mix changing its design characteristics. When mixing is to stop for a period of one hour or more, the mixer shall be thoroughly cleaned.

4.2.3 Plant Mixing

At central mixing plant, batches shall be discharged from the weighing hopper into the mixer either directly by gravity or by an elevating container large enough to contain the batch. The plant shall be arranged to ensure that there is no loss of cement during transfer from weighing hopper to the mixer drum. The mixing time shall neither be less than fifty (50) second, nor more than ninety (90) seconds.

The plasticizer, accelerator or retarder or water-reducing admixture, if required, shall be fed separately at the rate recommended by the manufacture, or as established by laboratory trials.

4.2.4 CONVEYING

Concrete shall be conveyed from mixer to the place of final deposit as rapidly as practicable, by methods which will prevent segregation or loss of ingredients and in accordance with ACI304. There shall be no vertical drop greater than one metre except where the use of such equipment is approved in writing by the Engineer-in-Charge, in advance of any use

4.2.5 PLACING

(a) General

(I) Concrete shall be placed only in presence of the Engineer-in-charge or his representative.

- (II) Any concrete which has become so stiff that proper placing cannot be assured shall be wasted and no payment shall be made to the contractor for such wasted concrete, Concrete shall not be placed during rains unless proper protection is afforded.
- (III) Each layer of concrete shall be consolidated to the maximum practicable density so that it is free from pockets of aggregates, and close snugly against all surface of forms and embedded materials.
- (IV) In consolidating each layer of concrete the vibrating head of the vibrator shall be secured to form or allowed to penetrate and re vibrate the concrete in the upper portion of the underlying layer. All concrete shall be consolidated with electric or pneumatic power-driven vibrators having a frequency of not less than 5000 cycles per minute.

TECHNICAL SPECIFICATION

- (V) Special care shall be taken in placing concrete when it has to be dropped from a height, especially when reinforcement is in the way, and every effort shall be made to reduce this drop to the minimum. In any case the drop shall not be more than 5 feet.
- (VI) Ducts, recess, rebates and holes shall be moulded in the concrete during placing at their proper position as shown on the drawing or as directed by the Engineerincharge.

4.2.6 Time Interval Between Mixing and Placing

Concrete mixed in stationary mixers and transported by non-agitating equipment shall be placed within thirty minutes after it has been mixed, unless otherwise authorized. When a truck mixer or an agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be completed within 1.5 hours after introduction of the cement to the aggregates. The concrete shall be placed within 30 minutes after it has been discharged. In all cases, concrete shall be placed and compacted well within the initial setting time.

4.2.7 Placing Temperature

Placing temperature unless otherwise approved by the Engineer-in-Charge shall conform to the requirements herein specified for thin, moderate and mass sections. Concrete shall be placed at temperatures as follows: **a)THIN SECTIONS**:

Concrete for thin sections shall be delivered to the forms at a temperature in excess of 30oC. Except as otherwise determined by the Engineer-in-Charge, sections to which this provision shall apply shall be less than 20 inches (50 cms) in thickness.

b. MODERATE SECTIONS:

Concrete for moderate sections shall have a temperature of not more than 21°C when placed. A moderate section will be one that is greater than twenty inches (fifty centimetres) but less than 40 inches (one metre) in thickness.

c.MASS CONCRETE SECTIONS:

Concrete having a measure of 40 inches (one metre) or more in thickness shall have a temperature not exceeding 18°C.

4.2.8. Placing Concrete through Reinforcement

In placing concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs.

In certain cases, like the bottom of beams and slabs, the congestion of steel near the forms may make placing difficult. In such cases, as decided by the Engineer-in-Charge, a layer of mortar of a composition compatible with the required concrete strength shall be first deposited to cover the surface to a depth of 15mm.

4.2.9 Vibration of Concrete

Recommended Practice given in ACI 309 shall be followed for concrete consolidation.. The duration of vibrations shall be limited to that necessary to produce satisfactory consolidation. Excessive surface working will not be permitted.

4.3.0. EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS

4.3.1 Expansion and Contraction Joints

Expansion and contraction joints shall be provided at the locations indicated and according to the details shown on the Drawings.

Where indicated on the Drawings, expansion joint filler joint sealing compound, GI, Aluminium & Copper sheets shall be installed using materials of the type and quality indicated.

4.3.2. Construction Joints General:

As soon as a lift is completed, the top surface of concrete and reinforcing dowels shall be immediately and carefully protected from any condition that may damage the concrete surface and the dowels.

4.3.3 Cleaning of Joints :

Horizontal construction joints on lifts with relatively open and accessible surfaces shall be prepared for receiving the next lift by cleaning with either wet sandblasting or by air-water cutting.

4.3.4. Vertical Joints:

Vertical construction joints shall be prepared similar to the horizontal construction joints. Where allowed by the Engineer-in-Charge,

4.3.5 Method of Measurement

The measurement shall be taken up to two places of decimal stating the depth and width of joint as per unit mention in BOQ and paid as per rates agreed..

4.4.0 CURING OF CONCRETE

a) General

All concrete including concrete repair work shall be cured by an approved method or combination of methods in accordance with ACI 308. Means shall be provided for the protection of concrete from the sun, drying winds and traffic until the specified curing has been completed.

Horizontal concrete surface cured with water shall be kept wet for at least 14 consecutive days or as specified on drawing immediately following placement.

Unless otherwise specified, the curing of vertical surface shall be done initially by leaving the forms in place, hanging canvas or hessian cloth over the completed work and keeping it wet or by covering plastic sheet or membrane up to the period specified..

4.4.1. Methods of Curing

a.) Moist Curing

TECHNICAL SPECIFICATION

Concrete shall be moist-cured maintaining all surfaces continuously (not periodically) wet for days specified immediately following the placing or until covered with fresh concrete. Water for curing shall comply with the applicable requirements. Horizontal construction joints and finished horizontal surfaces cured with sand shall be covered with a minimum uniform thickness of 5 cm of sand and kept continuously saturated with water.

b) Curing Compound Method

An approved curing compound conforming to ASTM C-309 shall be applied in accordance with the manufacturer's recommendations immediately after any water sheen which may develop after finishing has disappeared from the concrete surface.

4.4.2 REPAIR OF CONCRETE

a) General

Concrete that is damaged from any cause; concrete that is honeycombed, fractured, or otherwise defective; and concrete which, because of excessive surface depressions, must be excavated and built up to bring the surface to the prescribed lines; shall be removed and replaced with dry pack mortar, or concrete, as hereinafter specified. The Contractor shall keep the Engineer-in-Charge advised as to when repair of concrete will be performed **Surface finishes of repaired areas:**

The Contractor shall correct all imperfections on the concrete surface as necessary to produce surfaces that conform to the requirements specified for the adjacent area. Fins and encrustations shall be neatly removed from the surfaces.

4.4.3 FINISHES AND FINISHING

a) General

Allowable deviations from plumb or level and from the alignment, profile grades and dimensions shown on the Drawings or specified. Tolerances are defined as tolerances and are to be distinguished from irregularities in finish as described herein. The classes of finish and the requirements for finishing of concrete surfaces shall generally be as specified herein or as indicated on the Drawings. Finishing of concrete surfaces shall be performed only by workmen who are skilled concrete finishers.

b) Ordinary Finish (OF)

Ordinary finish (OF) applies to surfaces upon or against which fill material or concrete is to be placed.

c) Rough Concrete Finish (RC)

Rough concrete finish (RC) applies to surfaces which are intended to receive tiles, metallic lining or other applications as indicted on the Drawings.

d) Ordinary Slab Finish (OS)

Ordinary slab finish (OS) applies to floor surfaces which are not intended to receive any floor coverings.

Ordinary surface form finish will follow AASHTO-SS-8.12.2. Non-shrinkable mortar will be used.

e) Fair Faced Finish (FF)

Fair Finish (FF) shall be applied to all exposed surfaces of walls and ceilings which are not to be covered by any other finish.

4.4.4 Surface Rendering

All faces of concrete that are to come in contact with back fill or pavement materials, shall be applied two coats of hot bitumen of approved quality, before placing any material around concrete.

4.4.5 Cracks

If cracks, which in the opinion of the Engineer in Charge may be detrimental to the stability, strength and durability of the construction, develop in concrete construction, the Contractor at his own expense shall test the structure. If under such test loads the cracks develop further, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto.

If any cracks develop in the concrete construction, which in the opinion of the Engineer in Charge, are not detrimental to the stability of the construction, the Contractor at his own expense shall grout the cracks with epoxy grout or with other better composition as directed by Engineer In Charge and also at his own expense and risk shall make good to the satisfaction of the Engineer in charge all other works such as plaster, moulding, surface finish, which in the opinion of the Engineer in Charge have suffered damage.

4.4.6 Defective Concrete

Badly executed work not conforming to requirements shall be removed wholly and re-executed at Contractor's cost and shall not be incorporated in the works. No plastering or repairs will be allowed to concrete. Decision of Engineer in Charge will be binding on the Contractor.

4.5.0 READY MIX CONCRETE

4.5.1 1. Scope

This specification covers ready-mixed concrete manu-factured and delivered to a purchaser in a freshly mixed and unhardened state as hereinafter specified. Requirements for quality of concrete shall be as hereinafter specified. This specification does not cover the placement, consolidation, curing, or protection of the concrete after delivery to the SITE.

The values stated in either SI units, shown in brackets,or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents ;therefore, each system shall be used independently of the other.

TECHNICAL SPECIFICATION

The product supplied shall be in compliance with ASTM and ACI specifications.

In the absence of designated applicable specifications covering requirements for quality of materials, the following specifications shall govern: a)Cement

-Cement shall conform to Specification C 150, Specification C 595/C 595M, b.

) Aggregates

-Aggregates shall conform to Specification C 33 spec. C 330 if light wt. conc

C) Water

The mixing water shall be clear and apparently clean.

4.5.2. BATCH TICKET INFORMATION

1The manufacturer of the concrete shall furnish with each batch of concrete before unloading at the site, a delivery ticket on which is printed, stamped, or written, information concerning said concrete as follows

- a) Name of ready-mix batch plant,
- b) Serial number of ticket,
- c) Date,
- d) Truck number,
- e) Name of purchaser
- f) Specific designation of job (name and location),
- g) Specific class or designation of the concrete in conformance with that employed in job specifications,
- h) Amount of concrete in cubic ft (or cubic metres)
- i) Time loaded or of first mixing of cement and aggregates, and
- j) Water added by receiver of concrete and his initials.
- k) Additional information for certification purposes as designated by the purchaser and required by the job specifications shall be furnished when requested; such information as
- I) Reading of revolution counter at the first addition of water
- m) Type and brand, and amount of cement,
- n) Type and brand, and amount of admixtures,
- o) Information necessary to calculate the total mixing water added by the producer. Total mixing water.

4.6.0 TESTING OF COMPRESSIVE STRENGTH

Concrete compressive strength requirements consist of a minimum strength at the age of twenty-eight (28) days and the minimum strength that must be attained before various loads or stresses are applied to the concrete.

The compressive strength of concrete will be determined from test cylinders /CUBE (As specified), which have been fabricated from concrete sampled and tested in accordance with AASHTO T 23 and T 22.

A set of six (6) cylinders /Cube shall be taken from each fifty (50) cu m of each class of concrete or fraction thereof placed each day, three (3) of the six (6) cylinders to be tested after seven (7) days and three (3) after twenty-eight (28) days.

- a) The minimum average twenty-eight (28) days' test result of all samples tested at any time shall be the specified twenty-eight (28) days' strength.
- b) No individual samples tested after 28 days shall show a test result lower than eighty-five (85) % of the required twenty-eight (28) days.

In case, seven (7) days' strength shows less than seventy (70) % of the twenty-eight (28) days' strength (in case of type-I cement), Engineer in Charge may stop further work on that particular portion of concrete, unless twenty-eight (28) days' strength gives satisfactory results

4.7.0 Rejection of Concrete

If above test result fails to comply with the requirements, concrete or that particular pour will be rejected and removed as directed by the Engineer in Charge.

4.8.0 CONCRETE FORM WORK

4.8.1 GENERAL

The work shall include design, erecting, supporting, bracing and maintaining form work so that it will safely and rigidly support all vertical and lateral loads encountered during construction. The extent of formwork is indicated by the concrete work shown on the Drawings.

Unless otherwise specified, no separate measurement or payment shall be made for "Providing Erection and Removal of Formwork" as specified herein, as all cost thereof shall be considered to be included in the Contract unit prices for the various concrete items requiring formwork.

4.8.2 SUBMITTALS

The Contractor shall submit the following to the Engineer-in-Charge for his information/review:

a) FORM WORK SAMPLE

The Contractor shall inform and submit the sample of form work material and supporting scaffolding / wooden supports which he intends to use at site and upon approval the form work shall be used .

b) Shop Drawings

Shop Drawings for fabrication and erection of architectural finished concrete surfaces as shown on the Drawings or specified. Design of formwork for structural stability and sufficiency is the Contractor's responsibility.

TECHNICAL SPECIFICATION

4.8.3. FORM MATERIALS

a) Form liners for Plain Concrete Finish TIMBER/PLYWOOD:

New Plywood 19 mm or timber planks (PARTAL) 25 mm thick with continuous support for edges parallel to framing shall be provided. Timber form shall be will seasoned and free of loose knots.

Re-use of Wood Forms:

Projecting nails shall be withdrawn, concrete cleaned off, re-oiling done and Engineer-in Charge's approval obtained before re-using the wood forms.

The steel formwork surface in contact with concrete shall be free of rust.

b) Form Ties

Form ties shall be snap ties. Sample for Engineer in Charge approval shall be submitted before ordering. Spacing of ties and the rate of placement of concrete shall be consistent with the strength of ties. The Contractor must obtain approval prior to use of any special ties for metal forms.

c) Form Coatings

Commercial formulation form-coating compounds shall be provided that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond, painting or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

4.8.4. INSTALLATION

a) General

Forms shall be so constructed that the tolerances specified in ACI 347.203.1 are met. Openings, offsets, chamfers, blocking and other features as required on the work shall be provided. Easy removal of forms without damage to concrete surfaces shall be provided for.

b) Forms

The formwork shall conform to the shape, lines and dimensions as shown on the Drawings and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete, and shall be sufficiently tight to prevent loss of liquid from the concrete.

c) Form Ties

Form ties shall be provided at exposed surfaces. Ties shall be set in straight rows and evenly spaced. Prior approval shall be obtained if any special ties for metal forms are to be used.

4.8.5 Tolerances In Form Work:-

- Variation from plumb in lines and surfaces of piers, walls and rises, 6mm (1/4") per 3 M (10 ft) but not more than 25mm (1")
- For exposed corners, columns, central joints, grooves and other construction lines, 6mm(1/4") in any bay of 6M(20 ft)
- Variation in cross sectional thickness of slab & walls be between -6mm(-1/4") and 12mm(1/2")
- Variation in footing plan dimensions to be between -12mm (-1/2") and 50mm (2").

4.8.6. REMOVAL OF FORMS

Forms for various parts of the structure shall not be removed before the specified time has elapsed after placing the concrete. Consideration shall be given to the weather and other conditions influencing the setting of concrete, curing, and materials in the mix. The exact time shall be determined by the Engineer-in-Charge and will be dependent on curing conditions and the prevalent temperature.

Form shall be removed with care so to avoid any injury to concrete. Min. specified time is :

Min Period for Form-work Removal

Beams and Slabs	14 days
Columns and Wall Faces	24 hours

24 hours 24 hours

Concrete Pedestal	
Sides of Beams, Caps, and Other Parts	

4.8.7. COORDINATION

Formwork shall be coordinated with the work of other trades as required for installation of inserts, conduit pipe sleeves, drains, hangers, supports, anchors and similar items. Embedment's shall be secured in position before concrete is poured. Sufficient time shall be allowed between erection of forms and placing of the concrete to allow various trades to install their work properly.

4.9 CONCRETE REINFORCEMENT

TECHNICAL SPECIFICATION

4.9.1 GENERAL

The work shall include providing, cutting, bending, fabricating, assembling and placing of all concrete reinforcement including rods and fabric in accordance with Drawings, Specifications and Standards as referred hereunder.

4.9.2 **SUBMITTALS**

The Contractor shall submit the following to the Engineer-in-Charge for his approval/record before execution of work:

 a) Contractor shall submit Shop Drawings for fabrication, bending and placement of concrete reinforcement. ACI 315 shall be complied with showing bar bending schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement and special reinforcement required for openings through concrete structures.
b) Mill certificates or laboratory test reports as required.

4.9.3 MATERIALS

 a) Concrete reinforcement of diameter smaller than 35 mm shall be hot rolled deformed steel bars conforming to ASTM Designation A 615 and shall have a minimum yield strength of 415 MPa

(60,000 psi).

b) Binding wire shall be 1.6 mm dia (16 gauge) soft iron wire.

4.9.4 Deformed Bar

A reinforcing bar manufactured with surface deformations to provide bonding strength when embedded in concrete. The following table showing the different values of deformed bars as per ASTM A-615

4.9.5 Characteristics For the Reinforcing Bar

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a) Tensile Requirements

The strain shall be 0.5 % of gage length for Grade 40 and Grade 60 $\,$ and shall be 0.35 % of gage length for Grade 75 [520 $\,$

Table from ASTM		
Tensile Strength Min MPa (psi)	Steel 280 MPa (Grade 40)	Steel 420 MPa (Grade 60)
	420 (60,000)	620 (90,000)
Yield strength Min Mpa (psi)	280 (40,000)	420 (60,000)
Elongation in 203.2 mm (8 in) min %		
Bar Designation		
10 (3)	11	9
13, 16 (4,5)	12	9
19 (6)	12	9
22,25 (7,8)		8
29, 32,36 (9,10,11)		6

b) Bending Requirements

The bend-test specimen shall withstand being bent around a pin without cracking on the outside radius of the bent portion. The requirements for degree of bending and sizes of pins are prescribed in Table.

	Pin Diameter for Bend Tests		
Bar Designation No	280 MPa (Grade 40)	420 Mpa (Grade 60)	520 MPa (Grade 75)
10, 13, 16 (3,4,5)	3 ½ d	3 ½ d	
19 (6)	5 d	5d	5d
22,25 (7,8)		5d	5d
29, 32, 36 (9,10,11)		7d	7d
43, 18 (14,18)		9d	9d

4.9.6 Test & Retest

For bar sizes No. 3 to 11 [10 to 36], inclusive, one tension test and one bend test shall be made of the largest size rolled from each heat. If, however, material from one heat differs by three or more designation numbers, one tension and one bend test shall be made from both the highest and lowest designation number of the deformed bars rolled

For all bar sizes one set of dimensional property tests including bar weight [mass] and spacing, height, and gap of deformations shall be made of each bar size rolled from each heat.

If any tensile property of any tension test specimen is less than that specified, and any part of the fracture is outside the middle third of the gage length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

4.9.7 EXECUTION

a) Preparation

The Contractor shall furnish, cut, bend, and place all steel reinforcement including rods and fabric, as indicated on the Drawings or otherwise required. All placing and fixing shall be in accordance with Drawings furnished or approved by the Engineer-in-Charge.

b) Cutting and Bending

The Contractor shall ensure that the bars do not get cracked or damaged during bending and fabrication. All bending shall be in accordance with ACI 315 and by approved machine methods. When bending is required, it shall be performed prior to embedding the bars in the concrete. In all such cases, the bars shall be cold bent.

TECHNICAL SPECIFICATION

4.9.7 Tolerances

Cutting for all bars shall be within + 1 inch (+ 25 mm).Bending and placement tolerances for overall or an internal dimension of a bent bar shall be as given in Table 4.7.

	Tolerances	
Description	Plus	Minus
Bending		
Bars upto 1.00 meters long	5 mm	5 mm
Bars 1.00 to 2.00 meters long	5 mm	10 mm
Bars over 2.00 meters long	5 mm	25 mm
Placement		
Concrete cover to formed surfaces	5 mm	5 mm
Minimum spacing between bars 5 mm 5 m		5 mm
Top bars in slabs and beams		
- Members 200 mm deep or less	5 mm	5 mm
- Member more than 200mm but not over 600mm deep	10 mm	10 mm
- Member more than 600mm deep	25 mm	25 m

Table 4.7 Bending & Placement Tolerances

4.9.8 (a) Spacing of Bars

The spacing of bars shall be as shown on the Drawings or as directed in writing by the Engineer-in-Charge. The variation from indicated spacing, provided that the total area of reinforcement is in accordance with the Drawings,

4.9.8 (b) Concrete Cover to Reinforcement

The cover for all main reinforcement shall conform to the dimensions shown on the Drawings and in no case less than ½ inch or diameter of the bar whichever is more. The protective covering shall not be less than, and shall not exceed by more than 6 mm the values specified on the Drawings. Unless otherwise specified the following minimum thickness of concrete cover, exclusive of plaster or other decorating finish, shall be provided in all case: -

- a) For each end of reinforcement bar, not less than 1 inch or twice the diameter of such bars.
- b) For a longitudinal of such bars. In the case of columns with a minimum dimension of 7-1/2 inches or less where bars do not exceed $\frac{1}{2}$ inch diameter, one-inch cover shall be used.
- c) For longitudinal reinforcement bar in a beam not less than one inch or the diameter of such bar.
- d) For tensile, compressive, share or other reinforcement in a slab not less than ½ inches or the diameter of such reinforcement.
- e) For any other reinforcement not less than ½ inches or the diameter of such reinforcement.
- f) In case of works in saline or corrosive conditions a minimum of 1-1/2inches cover over bars, stirrups or links.

4.9.8 (c) Splicing

Except as otherwise shown on the Drawings or specified herein, all splices, lengths of laps, splice locations, placement and embedment of reinforcement shall conform to the applicable requirements of ACI 318. All splices and locations of laps in reinforcement shall be as shown on the Drawings or as directed by the Engineer-in-Charge. Lapped ends of bars may be placed in contact and securely wired or may be separated sufficiently to permit the embedment of the entire surface of each bar in concrete.

d) Supports

All reinforcement shall be secured in place by use of concrete supports. Chairs, spacers, or ties may be of metal or as approved by the Engineer-in-Charge. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operations. Concrete supports shall be manufactured of the same concrete strength as used in the structure to be concreted.

e) Embedded Items

Before placing concrete, care shall be taken to determine that all embedded items are properly placed as required under the Specifications and are firmly and securely fastened in place as indicated on the Drawings or as directed by the Engineer-in-Charge.

f.) DELIVERY AND STORAGE

- i) All reinforcement bundled, tagged and marked with complete identification shall be delivered at Site.
- ii) Reinforcement shall be stored at Site clear of ground and protected from mud and other deleterious materials.

4.10.. MEASUREMENT & PAYMENT FOR CONCRETE

4.10.1 GENERAL

All measurements & payments shall be for completed work within the neat lines shown on drawings unless otherwise specifically directed.

Dimensions of length, breadth and thickness shall be measured correct to nearest cm /inch. except for the thickness of slab and partition which shall be measured to nearest 5 mm.

4.10.2. CAST-IN-SITU CONCRETE

It shall be measured in stages described in the item of work, such as:

- (a) Rafts, footings, bases of columns etc. and mass concrete.
- (b) All other items up to floor two level.
- (c) From floor two level to floor three level and so on.
- (d) R.C.C. above roof level shall be measured along with R.C.C. Work in floor just below.
- **4.10.3.** Measurement shall be taken before any rendering is done in concrete members. Measurement will not include rendering. The measurement of R.C.C. work between various units shall be regulated as below:
 - (a) Slabs shall be taken as running continuously through except when slab is monolithic with the beam. In that case it will be from the face to face of the beam.
 - (b) Beams shall be measured from face to face of columns and shall be including haunches, if any, between columns and beam. The depth of the beam shall be from the bottom of slab to the bottom of beam if beam and slab are not monolithic. In case of monolithic construction where slabs are integrally connected with beam, the depth of beam shall be from the top of the slab to the bottom of beam.
 - (c) The columns measurements shall be taken through.

4.13.1. COMPOSITE RATE

The measurement and payment for the items of the work of Plain & Reinforced Concrete hereof shall be made corresponding to the applicable CSR items as provided in Contract Agreement BOQ or as quoted by the bidder and shall constitute full compensation, for procurement, transportation, performance in all respects and completion of work as specified including the site clearance as approved by the Engineer-in-Charge. No separate payment for form work shall be made but the Reinforcement bar shall be measured and pain separately as per rate quoted in BOQ.

CHAPTER 5 DAMP PROOF COURSE AND WATER PROOFING

5.1 DAMP PROOF COURSE

5.1.1 SCOPE

The work shall include furnishing all labour, material and equipment and performing all services to provide the damp-proofing in foundations and over plinths of Structures as shown on the drawings and/or as directed by the Engineer-in-Charge.

5.1.2. INSTRUCTIONS

Damp proofing shall not be applied when the ambient temperature is below 4 degree Centigrade. The work shall be done by workmen experienced in the application of damp proofing, and the Contractor shall co-ordinate damp proofing operations with other phases of the work to prevent staining or damaging finished work. The Contractor shall repair or replace damaged finished work to the satisfaction of the Engineer-in-Charge. Damp proofing shall be applied as shown on the Drawings.

5.1.3. DAMP PROOFING MATERIALS

a) Damp Proof Course

i). HORIZONTAL DAMP PROOF COURSE

All Horizontal damp proof courses unless otherwise specified in the drawings shall consists of class 'B' cement concrete (3000 psi) 2" (50mm) thick, and shall be laid at required levels as per drawings and instructions of the Engineer. The D.P.C shall be tamped, consolidated, levelled and edges corners made to the requirements of the relevant drawings including finishing and curing complete. Including two float coat of . Bitumen emulsion protective coating of EXPANPROOF-10 by FOSPAK or equivalent confirming to ASTM C-309-93 or BS 6949-1991 applied at a rate of 2Kg / Square Meter

ii). VERTICAL DAMP PROOF COURSE

All vertical damp proof courses unless otherwise specified in the drawings shall consists of $\frac{1}{2}$ " thick cement sand plaster in 1:4, and shall be applied at required elevation as per drawings and instructions by the Engineer, including Bitumen emulsion protective coating of EXPANPROOF10 by FOSPAK or equivalent confirming to ASTM C-309-93 or BS 6949-1991 applied at a rate of 2Kg / Square Meter .

III) UNDER GROUND WATER TANK& OVER HEAD WATER TANK WATER PROOFING :

For all water retaining Structures concrete not leaner than 1:1 ½ :3 Shall be used if not specified on drawing and pore blocking admixture which alters the microstructure of concrete to stop water transport mechanisms and increase durability like Pudlo Produced by DB Group England or Equivalent as specified. By incorporating **PUDLO** into the. concrete mix, it is possible to build. watertight structures, without the need. for membranes or drainage systems @ 2.5 Kg per 50 Kg Bag or as per manufactures recommendation. The internal surface of the wall and base shall be plastered with 1:4 CSM if not specified on drawing by adding water proofing PUDLO @ 5% by Wt of Cement or as specified on drawing. A 3"x3" Chamfer shall be made at all the Wall and bottom slab and wall & wall joints.

The External side of the wall two float coat of . Bitumen emulsion protective coating of EXPANPROOF-10 by FOSPAK or equivalent confirming to ASTM C-309-93 or BS 6949-1991 applied at a rate of 2Kg / Square Meter or as specified.

Iv) ROOF WATER PROOFING

For Flat Roof surface Cold applied bituminous waterproofing membrane **Expanproof* GP** confirming ASTM D412 Product by M/S Fos Pak or equivalent confirming shall be applied in Two Coats minimum thickness 1.0 mm (one mm) per coat but not less than 1.5mm dry thickness of the two coat combined.

INSTRUCTION TO USE

(a) SURFACE PREPARATION

Concrete surfaces should be float finished and free from cavities and projecting nibs. All surfaces shall be dry and free from frost, surface laitance and contamination.

(b) **PRIMING**

Application Smooth transition should be made at wall/floor slab junctions using a sand/cement mortar and internal and external corners at walls and up stands preprotected with Expanproof Corner Pieces prior to the application of the membrane. The membrane should be applied to the substrate having first removed the siliconised release paper, pressing the polyethylene film firmly ensuring that the adhesive bitumen compound bonds continuously to the substrate with no air pockets.

(b) CONSTRUCTION CHEMISTRY

Expanproof GP is a cold applied self-adhesive sheet membrane comprising of a polymer modified bitumen layer internally reinforced with polyester, bonded on to an outer surface of cross laminated polyethylene film. Expanproof* Primer must be applied to the substrate and allowed to dry until it is tack free, prior to the application of the membrane. All surfaces must be re-primed if left for more than 24 hours prior to the application of Expanproof* GP. Allow at least a 75mm edge and a 150mm end lap. All laps should be rolled firmly to achieve a good seal. End laps should be staggered. On vertical or inclined surfaces, the membrane shall be laid from the lowest level upwards. The membrane should be protected immediately after application in accordance with BS 8102:1990 by using Protection Board, or as appropriate with a sand/cement screed.

V) ROOF SCREED

SCREEDING / GRADING ROOF WITH CEMENT CONCRETE 1:2:4

i. Materials

Cement, coarse sand and graded stone aggregate 20 mm nominal size, shall be used as specified thickness in the item and slope as per shown on drawing. The specifications for the materials and method of preparation of concrete shall conform in general to the specification described in Section 4. The grading of aggregates shall be limited between 3/4 inches maximum and 3/16 inches minimum.

ii. Laying

Before laying cement concrete for grading, the level markings to the required slope/gradient shall be made only with cement concrete on the surface of the slab at suitable spacing, so that the mason can lay the concrete to the required thickness, slope / gradient easily in between the two level markings. On getting the level marking approved, the surface should be sprinkled with thick cement slurry and the concrete should be laid carefully, without throwing from height, in predetermined strips.

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Chapter-5 [D.P.C. & Water Proofing]

The mixed cement concrete must be laid in position, within half an hour of its mixing. In case any quantity of -concrete remains unused for more than half an hour the same should be rejected and removed from the site.

iii. Finishing

The minimum thickness of the concrete at its junction with Khurra or parapets shall be 5 cm. or as mentioned on drawing. The concrete shall be rounded at the junction of roof slab and parapet. It is desirable to provide a haunch/gola/filler at the junction of the parapet wall and the roof slab. The finished concrete surface shall present a smooth surface with correct slopes and uniform rounding. The concrete should be free from cracks. Excess troweling shall be avoided.

iv. Thickness

Average thickness shall be 2 inches to 3 inches and as specified.

v. Curing

Curing shall be done either by spreading straw/Hessian cloth over the graded surface, keeping the same wet for full 10 days or flooding the graded area with water by making kiaries with weak cement mortar, for 10 days. Occasional curing by simply spraying water now and then shall not be permitted.

5.1.5 MEASUREMENT & PAYMENT

Length and breadth shall be measured along the finished surface correct to a cm / INCH and the area shall be worked out to nearest 0.01 sqm /SQFT. And payment shall be made as per item mentioned on BOQ of Contract.

Chapter-6 [Solid Concrete Block Masonry]

CHAPTER -6 SOLID & HOLLOW CONCRETE BLOCK MASONRY

6.1 SCOPE

The work under this section of the specifications consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in any floor and at any height in connection with the supply and installation of ordinary cement concrete Solid block/ Fair Faced Hollow Concrete Block masonry work including wall ties, anchors, complete in strict accordance with this section of the Specifications and applicable drawings, and subject to the terms and conditions of the Contract.

6.1.1. MATERIALS

6.1.2. FOR CONCRETE BLOCK

Cement, aggregates and water for concrete blocks shall conform to the requirements as specified in Section 4 for Plain and Reinforced Concrete.

6.1.3. FOR MORTAR

The cement and sand mortar for concrete block masonry shall specified.

6.1.3.1. SAND

Sand for mortar shall comply with the requirements for BS-1200.

6.1.3.2. CEMENT

Cement shall be Ordinary Portland Cement conforming to BS-12.

6.1.3.3. WATER

Water shall be clean and free from any harmful impurity. Where the quality of the water is doubtful, it shall be tested in accordance with BS- 3148. The water shall comply with the provisions of Clause stated in Chapter 4 Plain & Reinforced concrete.

6.1.3.4. MORTARS AND GROUT

Materials for mortar, sand and binding agent and water, shall be mixed by volume or by weight as specified for at least 3 minutes with the minimum amount of water to produce a correctly mixed mortar or grout of workable consistency in a mechanical batch mixer Mortar shall be as strong, but no stronger than the materials it bonds together. Mortars shall be mixed in batches, which can be used within a period before the setting process commences. Once a mix begins drying off, it shall be rejected. No ingredients shall be added to it once the setting process has begun.

6.2. CONCRETE BLOCK MAKING

6.2.1 SOLID CONCRETE BLOCK

The Solid blocks shall be factory manufactured/fabricated and be machine moulded. The block making factory shall be of the standard approved by the Engineer-in-Charge. They shall be operated according to the instructions laid down by the manufacturers. The contractor shall submit samples/literature of various manufacturers for Engineer-in-Charge's

approval. The contractor should note that only blocks supplied by the approved manufacturer(s) shall be allowed to be used in the work.

6.2.2 HOLLOW CONCRETE BLOCK

The Hollow Fair Faced Pigmented, Smooth Finished Blocks for External Wall do not require plaster & paint. shall be from approved manufacturer Envicrete, Banu Mukhtar, Izhar in approved shade and colour and laid as per pattern shown on the drawing. These shall be free of any honey combing or other imperfections or deformations, all edges true and straight, and at right angles with each other and without any chipped or otherwise broken edges. Size 390x190x90mm (Tolerance +/- 3mm). Average Compressive Strength 1000 PSI (+/-5%)

.The contractor shall submit samples/literature of various manufacturers for Engineer-inCharge's approval.

6.3 **PROPERTIES OF BLOCKS**

All Non fair face ordinary Solid blocks shall be of the size and shape required to complete the work shown in the Drawings or as instructed by the Engineer-in-Charge.

The cement, sand and coarse aggregate shall be volume batched and their proportion may be adjusted so as to provide the concrete of the required strength when tested and shall be mixed.

All blocks shall comply with ASTM C-55-03 edition. The compressive strength of various Solid /hollow blocks shall be as follows:

Sr	Type of Concrete	Compressive Strength (Psi)			
#	Masonry	Average of 3 Units	Individual Unit	Block Size	
1.	Solid load bearing Masonry units (ASTM-C-145-85)	2000 psi minimum	2000	6"x8"x12" 4"x8"x12" 8"x8"x12"	
2.	Solid non load bearing Masonry units	600	500	6"x8"x12" 4"x8"x12" 8"x8"x12"	
3	Hollow Fair face, pigmented /Natural Non load bearing Block	1000 psi +/- 5% on net area	1000psi+/-5% on net area	Size of block 390mmx190mmx90mm 390mmx190mmx140mm 390mmx190mmx190mm	
4.	Solid Fair face, pigmented /Natural Non load bearing Block	1500 psi +/- 5% on net area	1500psi+/-5% on net area	Size of block 390mmx190mmx90mm 390mmx190mmx140mm 390mmx190mmx190mm	

A laboratory approved by the Engineer-in-Charge shall carry out the test. The Engineer-in-Charge will require to test samples of blocks periodically and the Contractor shall make necessary arrangements accordingly. The method of sampling for all tests shall be in accordance with ASTM standards.

6.4 ERECTION

Blocks shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at centre of units in alternate courses below. Vertical joints shall be buttered in the entire height of blocks. Each course shall be bonded at corners and at intersections of walls and shall be properly bonded. Courses of block shall be kept plumb throughout and corner reveals shall be true and in plumb.

Standard width of mortar joints for both horizontal and vertical joints shall be 10mm (maximum). Mortar joints in walls shall have full mortar coverage on vertical and horizontal faces between the blocks. Mortar joints on wall including struck joints, shall be thoroughly compacted and pressed tight against the edges of the blocks with proper tools.

Unless otherwise shown on the drawings or specified by the Engineer-in-Charge, the spaces around doorframes and other material or built in items shall be solidly filled with mortar. Spaces around the door and window holdfasts shall be filled in with 1:3:6 concrete. Work required to be built in with masonry including doorframe anchors, wall plugs, and dovetail anchors and accessories shall be built in as the erection progresses.

The block work shall be carried up in a uniform manner and no portion shall be carried more than one meter above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and levelled round each floor.

Walls of blocks indicated, as being non-load bearing shall be constructed on the in situ concrete floor slab unit after the floor formwork is struck and the concrete has obtained sufficient strength to support their-weight. Tooting into load-bearing walls shall not be permitted.

All bolts, anchors, ties, pipe sleeves, flushing metal attachments, lintels and the like required to be built into the work shall be correctly inserted and executed as the work proceeds. Walls or partitions abutting concrete columns or walls shall be securely anchored and tied with metal anchors or ties at not more than 450mm vertical centers. Wall ties cast in with concrete shall be bent down after the removal of formwork and shall be securely jointed into the mortar beds of walling.

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 wherever specified on the drawings or as per the instructions of the Engineer-in-Charge. Weep holes will be formed by oiled rods, removed after the mortar is set, at specified locations.

6.5 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 Engineerin-Charge shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc. shall be included by the Contractor in the unit rate for masonry items. Damage to masonry from scaffolding or from any other object shall be repaired by the Contractor at his own cost.

6.6 TOLERANCES

All block work shall be erected plumb and true to line and level with the maximum variation in any storey height or any length of wall being one mm in one metre. The maximum tolerance in the length, height or width of any single masonry unit shall be \pm 3mm.

6.7 SOLID BLOCK WORK AROUND OPENING OF HOLLOW MASONRY

Around all openings in hollow block masonry, the Contractor shall provide solid block work of same thickness as that of hollow block masonry wall and of width as indicated on the Drawings.

CHAPTER-6 SOLID & HOLLOW CONCRETE BLOCK MASONARY

6.8 CURING AND REPAIRS

All block 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 blocks.

6.9. CAVITY WALL

6.9.1 GENERAL

It 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 50 mm and not more than 115 mm. Each leaf of the cavity wall shall not be less than 75 mm. The space between the leaves either left as cavity or filled with non load bearing insulating and water proofing material.

6.9.2 MATERIALS

The hollow block shall be as specified in this Section. The mortar shall be cement sand mortar as specified in accordance with the provisions of specification 1 :4 CSM. The laying of block masonry for cavity walls shall comply with provisions of specification. Curing and scaffolding shall be as per specifications.

6.9.3 METAL TIES

These may be of galvanized iron, or mild steel bar as specified. 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 or as specified on drawing & details.

6.9.4 BONDING UNITS

Length of the Bonding units 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 $[(2 \times 115) + \text{width of cavity}]$.

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).

6.9.5 SPACING

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.

6.9.6 MEASUREMENTS AND RATE

(a) Block work in cavity walls shall be included and measured with general / Fair Face Block work. The cavity wall shall measured as and paid as per BOQ item (b) The item shall include use of device for keeping cavity clear and forming the requisite weep and vent holes and nothing extra on this account shall be payable

6.10 REINFORCED BLOCK MASONRY

6.16.1 GENERAL

Reinforced BLOCK masonry shall be constructed as specified and shown on drawings.

6.10.1 BLOCK WORK

BLOCK work shall be as specified and conform with the provision for construction of blockwork of this section. The mortar shall be cement sand mortar as specified and shall conform with the provision of Clause of this section

Chapter-6 [Solid Concrete Block Masonry]

6.10.2 REINFORCEMENT

The reinforcement for brick masonry could be 18 gauge hoop irons or mild steel bars as specified. The hoop iron shall be of best quality as approved by the Engineer-in-Charge. Mild steel reinforcement shall comply with the provisions of Section 5 – Plain & Reinforced Concrete. Unless otherwise specified in drawings or schedule of quantities, the reinforcement for normal structures shall be as follows;

Wall Thickness (Inches)	Horizontal Bars (9-5/8") C/C	Vertical Bars (24") C/C
7 – ½	3/8" dia	3/8" dia
9	3/8" dia	1/2"
11	1/2"	1/2"
12	1/2"	1/2"

Refer to the drawings for others wall thickness and special details

- a) Vertical reinforcement at jambs of opening and at ends of walls shall be doubled. Horizontal reinforcement above and below all openings shall also be doubled.
- b) Reinforcement shall be continuous. Bars may be furnished in any convenient length. All splices shall be lapped at least 14" for 3/8" diameter bars and at least 18" for ½" diameter bars and horizontal reinforcement shall be bent around corners.

6.10.3 SCAFFOLDING & CURING

The scaffolding & curing shall conform to applicable provisions of Section

6.10.4 MEASUREMENT

The measurement and rate shall be same as specified in BOQ

6.17 MEASUREMENT AND PAYMENT

Solid Concrete Block Masonry work shall be measured in cubic metres/Cu ft as per unit in agreement unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sq. mtrs and the cubic contents shall be worked out to the nearest 0.01 cubic metres.

Block Masonry Work shall be measured separately in the following stages:

- (a) From foundation to floor one level (Plinth level)
- (b) Plinth (floor one) level to floor two level
- (c) Between two specified floor levels above floor two level

The rate shall include the cost of materials and labour required for all the operations described above except the vertical reinforcement and its encasement in cement mortar or cement concrete. The rate shall also include the following:

- (a) Raking out joints or finishing joints flush as the work proceeds;
- (b) Leaving holes for pipes upto 150 mm dia. and encasing hold fasts etc.
- (c) Rough cutting and waste for block work curved in plan and for backing to stone or other types of facing.
- (d) Embedding in ends of beams, joists, slabs, lintels, sills, trusses et

CHAPTER-7 FLOORING

7.1 SCOPE OF WORK.

The works covered under this section of specifications consists of furnishing all labor, materials and equipment and performing all operations in connection with laying flooring including bases, dados and skirting in strict accordance with drawings and as specified herein and subject to terms and conditions of the contract documents.

7.1.1 SAND FILL.

A uniform layer of granular and screened sand shall be laid to the required thickness over the surface of compacted earth as per drawing & details. The sand layer shall be compacted in the manner required by the Engineer prior to execution of subsequent item.

7.1.2 STONE SOLING.

The quality & thickness of stone material shall be as per requirements and specified on drawing , if not otherwise minimum thickness 150mm (6 inches) shall be adopted, as per drawing & details and shall be approved by the Engineer. The stones shall be laid on edge as approved by the Engineer, the spaces or voids between and around shall be filled with sand

7.1.3 PLAIN CEMENT CONCRETE SUB-BASE.

The base course of lean cement concrete shall be 1:4:8 or as specified on drawing specified shall be laid as per thickness shown on drawing & details or as per BOQ item. The surface of the bed shall be roughened for the grip of the top layer.

7.2 FLOOR FINISHES.

All floor finishes shall be laid on properly cleaned and prepared sub-floors to the thickness as indicated on the drawings and finished to the satisfaction of Engineer. The Contractor shall make sample panels of floors for inspection and approved by the Architect/Engineer before actual flooring works are taken in hand.

7.2.1. PLAIN CEMENT CONCRETE FLOORS.

The concrete ingredients as per specified in Chapter 4 Plain & Reinforced Cement Concrete shall be mixed in a batch mixer for not less than 2 minutes after all ingredients except the full amount of water, are in the mixer The concrete shall be uniform in composition and consistency. Excessive or over mixing or increasing concrete consistency will not be permitted. The concrete ingredients shall be mixed by volumetric measurement in purpose made boxes approved by the Engineer.

The screed may be laid in panels as specified on drawings when the concrete is still plastic, The hardened base should be thoroughly cleaned, wetted, preferably overnight surplus water removed.

7.2.2 TERRAZO FLOORING (IN SITU).

The Contractor shall submit samples of terrazzo flooring required in the various locations and the samples, which Engineer may select for use in the buildings, shall be available for examination and comparison by both the Contractor and the Engineer. The finished floors shall conform in all respects to the characteristics of the samples approved. The size of chips shall be of 3mm to 10mm size and the color will be as selected by the Architect/Engineer.

The Contractor, after tentative color patterns are approved, shall provide sample panels of cast in place terrazzo wear coat and base. The thickness of the wear coat shall be uniform and at no

CHAPTER-7 FLOORING

point shall if be less than 15mm. Finished surfaces of both floors and walls when completed, ground and polished, shall in air cases show uniformly distributed exposed granules or chips, free of undesirable blotches of matrix without marble granules or chips. Uneven distribution in either floor or wall surface will be required to be resurfaced and/or refinished to the satisfaction of the Engineer. All floors shall be adequately cured for a minimum of 14 days after laying by means of sand bunds in panels or as required by the Engineer. During the course of construction of the floors and up to the time of completion of the Project, the Contractor shall protect the flooring from stains and mechanical damage by his workers or by workers of other Contractors/Sub-Contractors.

7.2.2 TERRAZZO TILE FLOORING AND STEPS.

All tiles shall be of size 300x300mm or 200x200mm size as shown on drawings or as mentioned in the Schedule of Quantifies and shall be perfectly leveled square and true to every surface. Tiles shall be minimum 25mm for 300mm size and minimum 20mm thick for 200mm size with a marble mosaic tapping firmly bonded to a base of cement concrete, manufactured by the dry process and machine pressed hydraulically with a pressure of not less than I50 kg per square centimeter. The thickness of topping shall not be less than 13mm for 300x300mm tiles and 10mm for 200x200mm tiles.

The marble mosaic topping shall be of colors as selected by the Architect/Engineer, including sizes of chips, their color proportion and distribution. All tiles shall be of uniform color and liable to rejection due to difference in any of the above specified conditions.

The Tile shall be vibrated to an extent that it releases air to the surface and consolidates the aggregate at the wearing surface. Proportion of cement to aggregate shall not be leaner than 1:2 by weight in topping layer. All tiles shall be cured after manufacture for not less than three weeks, prior to delivery at site, or setting up in floors.

If the Contractor is allowed to use ordinary tiles for stair risers he will have to cut the standard Tiles for which no payment for the wastage or cutting will be made. The tiles before being used shall be thoroughly soaked in water for 10 to 20 minutes and stood on their edges to dry for about the same length of time, Any tiles, which have hair cracks shall be rejected. Should the cracks be noticed after the tiles are fixed in position, such tiles shall be replaced at contractor's cost and risk.

7.2.3 EXECUTION

The terrazzo Tiles will be laid to the required levels and grades over a setting bed of cement mortar comprising of 1 part of cement and 4 parts of sand by specified. The overall thickness of mortar and tile shall be minimum 50mm. The curing period of the setting bed should 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 before the mortar has set. Surplus mortar shall be removed. Floor and wall surfaces to receive the tiles shall be thoroughly cleaned of all dirt, dust, oil and other objectionable matters. Tiles shall be laid out from the center line of each space in on outward direction and the pattern should be made symmetrical with a minimum number of cut tiles. Joints between the tiles shall be of uniform width. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to the straight edges. The Contractor is required to submit his shop drawing before actual laying of the tiles to show in detail how and where tiles pieces are planned to be laid. The Drawing shall be approved by the Architect/Engineer. After seven days the terrazzo tile floors shall be machine ground to a true even surface using various grades of abrasive stones as required and directed by the Engineer.

After the first grinding, the floor shall be grouted with the same color composition as used for its manufacture. The grout shall be of the consistency of thick cream and shall be brushed over the floor to fill in the joints and after 72 hours the grouting coat shall be removed by grinding till a smooth and even surface is obtained. Areas and portion of the floor inaccessible for the grinding machine shall be ground and rubbed by hand. The final glass shall be given by polishing the surface to the satisfaction of the Engineer. The tile floor shall be kept wet for at least 72 hours and no one should be allowed to walk on the tiles during that period.

CHAPTER -7 FLOORING

7.2.4 Terrazzo Tiles on Stairs

The stair risers and treads shall be provided in 3000 psi. Concrete according to exact sizes including the terrazzo topping making allowance for grinding of terrazzo. The nosing shall be flush with the terrazzo toppings, as specified or shown on the Drawings.

Measurement

7.2.5. Measurement of acceptably completed works of Terrazzo Tiles on floor will be made on the basis of net actual area in square feet of floor laid in position to the line, level & grade as shown on the Drawing or as directed by the Engineer.

Payment

Payment will be made for acceptable measured of Terrazzo Tiles floor on the basis of unit rate per Sq feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

7.3 CERAMIC TILE FLOORING AND DADO.

- 7.3.1 The tiles shall be of approved manufacturer. These will be either white or colored as specified in the Schedule of Quantifies or as approved by the Engineer. The tiles shall be free from cracks or crazing, free from twisting and uniform in color and size. Approval of the manufacturer does not relieve the Contractor to carry-out his own checking to ensure that only the best quality tiles are used and all defective tiles are rejected and removed from site immediately.
- 7.3.2 Soaked Ceramic flies shall be laid on cement concrete base of specified grade and the joints filled with neat white or grey cement or as specified including vertical and horizontal covers. The curing period of the setting bed shall be as directed by the Engineer,. The thickness of setting bed shall not be less than 45mm for floor and 12mm for walls or as specified on drawing.. Floor and wall surfaces to receive the files shall be thoroughly cleaned of all , dust, oil and other objectionable matters. Tiles shall be laid out from the centre 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 shall be of uniform width. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to the straight edges.

7.4 PRE CAST CONCRETE INTERLOCK PAVERS

7.4.1 The pre-cast interlock concrete pavers of specified size, shape and Color of approved manufacturer Envicrete, Megnacrete, BanuMuktar or as specified having minimum Compressive Strength 5000 Psi for non traffic area of minimum thickness 60mm and min. thickness 80mm with minimum compressive strength 7000 Psi shall be laid to the required lines, levels and grades over a well compacted setting bed of 100mm thick sand mixed with 37mm down crushed stone over 50mm thick sand cushion. The joints between the paver shall be filled with neat sand.

7.4.2 The laid paver shall be compacted with the compactor as specified by the Manufactures. Care shall be taken that full pavers are used as far as possible. Where this is not possible, the

edge pavers shall be neatly cut with an electric saw and the edges rubbed smooth, in case of patterned pavers, the pavers shall be laid in such a way that the pattern ends symmetrically on two sides.

7.5. MEASUREMENT AND PAYMENT.

Except otherwise specified herein or else wherein the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items or the Bill of Quantities. The cast thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantifies.

Measurement of acceptably completed works of finished floor, dado, skirting, stair finish, etc. will be made on the basis of net finished area laid in position as shown on the drawings or as directed by the Engineer. Exposed edges of tiles, marble, etc. will not be included in the measurements.

CHAPTER -8 PLASTER

8.1 GENERAL.

- 1.1 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 mentioned in B.O.Q /drawing or as directed by Engineer. Internal plaster for the buildings for the internal surfaces; columns, walls ceilings, partitions, etc. shall be cement plaster finished smooth unless otherwise specified. Whereas the areas like lavatory blocks, bathrooms, stores, or such other places where there is possibility of any dampness occurring, the plaster shall be cement plaster finished smooth with cement niru or as specified in the BOQ. Except as otherwise specified, all plaster work shall be carried out in Conformity with acceptable code of practice for internal and external rendering and finishes and as per specification.
- 1.2 Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, sills, doors' and windows' frames and all sorts of inserts and embedded items are fixed in position. It shall be the responsibility of the Contractor to make sure that all such works are 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.

8.2 MATERIALS:

- **8.2.1** Cement: Cement for plaster shall be Portland Cement ordinary, or sulphate resisting cement as specified and shall conform to requirement as described in the specifications & drawing.
- 8.2.2 Sand: Sand for plaster shall comply with the requirements of BS-812, BS-119 and ASTM C-144. It shall comprise natural sand, crushed stone sand or crushed gravel sand. It shall be hard durable, clean and free from adherent coatings such as clay and from any appreciable amount of clay pellet form. It shall not contain harmful materials to adversely affect the hardening, the strength, the durability or the appearance of the plaster or any materials in contact with it. The quantity of clay, silt and dust shall not exceed 5% by weight for sand or crushed gravel or 10% by weight for crushed stone sand.

The grading of sand for internal piaster work and external rendering shall be within the following limits.

Sieve Size MM	Internal Cement Plaster Work & External Rendering	
	%	
5.00	100	
2.36	90-100	
1.18	70-100	

0.6	40-80
0.3	5.40
0.15	0.10

The grading specified above shall be suitable for smooth finishing coats, scraped finishes and for pebble dash or dry dash for textured surfaces, produced by the treatment of the freshly applied final coat with a tool, the coarser particles shall be removed by screening through a 2mm sieve.

- **8.2.3** Water: Water for plaster shall conform to requirements as described in the specifications of concrete.
- **8.2.4 Additives:** Additives for controlling the setting and working characteristics of plaster, or for imparting anti-corrosion, fungicidal or water proofing properties, shall be added to the plaster strictly in accordance with the particular manufacturer's specifications and instructions. Good quality hair or manila fiber in reasonably well distributed proportion may be added to the plaster to assist application and reduce droppings. No additives shall be used except as specified in the Contract Documents.

8.3 **PROPORTIONING AND MIXING.**

- 8.3.1 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 Bill of Quantities or as directed by the Engineer. Mixing shall be continuous until complete and all ingredients are evenly distributed.
- **8.3.2** Only limited water shall be added for proper workability and such quantity of the mortar shall be prepared as that which will 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, Retampering shall not be permitted and all mortar which has begun to stiffen shall be discarded.
- **8.3.3** 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.

8.4 PREPARATION OF SURFACE TO BE PLASTERED.

8.4.1 Concrete surface to be plastered shall be cleaned to remove all grease, 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.

8.4.2 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.

8.5 APPLICATION OF PLASTER.

- 8.5.1 The plaster shall be minimum 12-20mm thick, as mentioned in BOQ and shall not be less than 12mm thick at any internal surface or 20mm at any external surface. The plaster of thickness less than the specified thickness shall be rejected. If the plaster is to be more than 25mm thick, it shall be done in two coats. The surface of first coat shall be made rough before the second coat is applied. 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. The curing/wetting of the plastered surface shall start immediately after the surface is set i.e. 4-5 hours from the time of finishing. No extra payment shall be allowed for jambs, junctions, comers, edges, round surfaces or for more than one layer of plaster required due to any unevenness in the work done by the Contractor. The plaster work 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 3 meter straight edge and plumb bob.
- **8.5.2** Plaster containing cracks, blisters, pits, discoloration or any defects shall not be acceptable. Any such piaster or loose piaster shall be removed and. replaced with plaster in conformity with these specifications and as additionally directed by the Engineer. Contractor shall cut and patch all defective work at his own cost. All damaged plaster shall be patched as directed by the Engineer.

8.6 CLEANING AND PROTECTION.

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

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

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

8.7 TOLERANCES.

Surfaces of plaster work shall be finished with a true plane to correct line and level with all angle and corners to a right angle unless otherwise specified and with wails and reveals plumb and square.

Maximum permitted tolerances shall not exceed 3mm in 2m variation from plumb or level in any exposed line or surface and 1.5mm variation between planes of abutting edges or ends.

8.8 MEASUREMENT AND PAYMENT.

General

- 8.8.1 Except otherwise specified herein or elsewhere in the Contract Document, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantifies.
- **8.8.2** Joints, junctions, jambs, corners, drip course, edges and Rounding.

8.8.3 More than one layer due to any unevenness in the work done by the Contractor.

- **8.8.4** Cuffing and patching of all defective works.
- **8.8.5** Surface preparation, cleaning, providing expanded metal lath and protections as specified.
- **8.8.6** Water proofing agent for water-proof plaster.

8.9 Measurements

8.9.1 Length and breadth shall be measured correct to a cm and its

area

shall be calculated in square metres/ sqft correct to two places of decimal. Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in masonry work.

The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted.

The following shall be measured separately from wall plaster.

- (a) Plaster bands 30 cm wide and under
- (b) Cornice beadings and architraves or architraves moulded wholly in plaster.
- (c) Circular work not exceeding 6 m in radius.

Plaster over masonry pilasters will be measured and paid for as plaster only.

Exterior plastering at a height greater than 10 m from average ground level shall be measured separately in each storey height. Patch plastering (in repairs) shall be measured as plastering new work, where the patch exceed 2.5 sqm. extra payment being made for preparing old wall, such as dismantling old plaster, raking out the joints and cleaning the surface. Where the patch does not exceed 2.5 sqm in area it shall be measured under the appropriate item.'

Deductions in measurements, for opening etc. will be regulated as follows:

(a) No deduction will be made for openings or ends of joists, beams, posts, girders, steps etc. upto 0.5 sqm in area and no additions shall be made either, for the jambs, soffits and sills of such openings. The above procedure will apply to both faces of wall.

Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals, jambs, soffits sills, etc. of these openings.

(i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.

(ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is un plastered, deduction shall be made from the plaster or pointing on the side of the frame for the doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side.

Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

(iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.

(c) For opening exceeding 3 sqm in area, deduction will be made in the measurements for the full opening of the wall treatment on both faces, while at the same time, jambs, sills and soffits will be measured for payment.

In measuring jambs, sills and soffits, deduction shall not be made for the area in contact with the frame of doors, windows etc.

CHAPTER -9 PAINTING AND POLISHING

9.1 SCOPE OF WORK.

The work covered by this section of the Specification, consists of furnishing all materials, plant, labor, equipment, appliances and performing all operations in connection with surface preparation, mixing, painting concrete works, gates, frames, structural steel works, steel pipes, valves, steel and wooden doors, windows, louvers, wait ceilings and all such surfaces as shown on the drawings/or as directed by the Engineer, the scope of this section of specification is covered with detailed specifications as laid down herein.

9.2 GENERAL

(b)

Where the work or term 'point' and 'polish' is used or referred to throughout the specifications, it shall be interpreted to mean and include the surface finish treatment consisting of any, all or some of the following items :-

Sealers, primers, fillers, body and final coat, emulsion varnish, shellac, wall paper paste, stain or enamels as more specifically defined hereinafter as to kind and quality and function for various surfaces and finishes.

All paint, polish and necessary materials incorporated in or forming a part thereof shall be subject to the approval and selection for color, tint or finish by the Architect / Engineer.

9.2.1 Where a 'two color' or tint combination may be selected or approved for the treatment of any particular surface in any space or room, no additional payment shall be made thereof to the Contractor in any instance.

- 9.2.2 Painting of wood work and for plaster surfaces shall be minimum 3 coats work except otherwise specified. Painting of metal surfaces required to be painted, shall be minimum 3 coats work, in addition to the shop protection coats.
- 9.2.3 All paints shall be as manufactured locally and approved by the Engineer and shall be brought on to the site in sealed containers and used without any admixture or adulteration except where recommended in the Manufacturer's printed instructions,
- 9.2.4 Surfaces of stainless steel aluminum, bronze, and machines surfaces adjacent to merci work being cleaned or painted shall be protected by effective masking or other suitable means, during the cleaning and painting operations.

9.3 PREPARATION AND WORKMANSHIP

- 9.3.1 Prior to start of any work the Contractor shall, as a part of his contract, carefully inspect oil surfaces to be painted or finished and notify the Engineer in writing of any defective workmanship, materials, or any other conditions, which in his opinion, will affect the satisfactory execution and /or performance of his work. No work in this section shall be initiated until all such surfaces or conditions have been corrected. The absence of any such notification will be construed as an acceptance by the Contractor of all such surfaces and later claims of defects in these surfaces that may result in finished surfaces being unsatisfactory to the Engineer will not in any way relieve the Contractor from the responsibility and/or accountability under his guarantee. No work should to be done under the conditions that are unsuitable for the production of good results, nor at any time when the plastering is in progress or is drying, or not dry. Neither paint nor any other finish treatment is to be applied over wet or damp surfaces unless specifically required, nor shall succeeding coats be applied until the proceeding coat is thoroughly dry.
- 9.3.2 Before proceeding with any painting or finishing thorough cleaning and removing of all dust from surfaces, which would affect either the satisfactory execution or permanency of the work is necessary.
- 9.3.3 All painting materials are to be applied evenly spread and thoroughly brushed -out only by skilled workers. All workmanship shall be executed in accordance with

the best acceptable practices applying to the class of work and grade, type and kinds of materials specified.

- 9.3.4 Plastered surfaces shall be primed before speckling. After application of primer coat, Contractor shall check all surfaces and do all necessary speckling of cracks, indentations and other imperfections in any approved manner.
- 9.3.5 Wood work that is to have a finish treatment, whether executed as field work or shop finished, shall be smooth and free from raised grain or other surface imperfections that affect its appearance and shall be lightly sanded or steel wool during finishing operations. After filler has been applied, if required all nail holes or other similar blemishes shall be carefully stopped with linseed oil puffy.
- 9.3.6 Shop coats provided by others, where required or necessary, shall have all bare spots touched up by the Contractor, using same materials as used for shop coat, or other equivalent material, if approved by the Engineer.

9.4 MATERIALS.

- 9.4.1 All materials shall be stored and mixed only in spaces assigned for this purpose by the Engineer and all necessary precautions shall be taken to prevent fires by complying with all applicable local fire prevention and safety ordinances. The contractor shall provide galvanized iron pans of suitable size in which all mixing paints shall be placed and no mixing shall be permitted outside of these pans.
- 9.4.2 The basic materials entering into the compounding and/or manufacture of all paints, polishes and other treatments referenced herein shall be of the best grade and quality of their respective kinds for the intended purposes. These shall be the products or formula of recognized and reputable manufacturers of known reliability and integrity subject to the approval of the Engineer and shall conform to the applicable requirements of the British Standard Specifications or approved local standards regarding kind, qualify and finish, Reference herein to specific paint materials is for the sole purposes of establishing a basis of "Minimum Standards" of quality and shall not be construed to be a limit of perfection or quality for any of the materials, ingredients to be furnished or utilized in this work. The Engineer reserves the right to select and / or accept only the best grades of standard products, which in his opinion, will provide a finish of recognized performance and characteristics suitable for their respective surfaces, irrespective of minimum standards reference herein.
- 9.4.3 All materials shall be delivered to premises in their original sealed containers or package bearing the manufacturer's name, label and brand, and be mixed and applied in accordance with manufacturer's directions and /or instructions. The mixing of all paint or other covering finish treatments shall be done in premises as and when, if required, under the supervision and direction of the Engineer.

9.5 PAINTING TO METAL WORK.

- 9.5.1 All metal work shall have, in addition to shop primer coats, minimum three (3) coats of enamel paint or as incorporated in the Bill of Quantifies, in the manner as specified herein.
- 9.5.2 All exposed ornamental and miscellaneous iron and steel shall receive over the shop primer coat, minimum three (3) coats of enamel paints as specified herein or as incorporated in the Bill of Quantities.
- 9.5.3 Galvanized iron not previously shop coated shall receive minimum 4 coats, the first coat to be of an approved galvanized iron primer and minimum three finish coats of enamel paint or as incorporated in the Bill of Quantifies.
- 9.5.4 Where shop coals and/or priming coats are found to be scratched or abraded they shall be touched up with appropriate paint.

9.6 OIL BOUND DISTEMPERING.

- 9.6.1 Distempers shall be of approved quality and make as directed by the Engineer.
- 9.6.2 Before work of distempering is commenced, the surface should be cleaned. The surface then must be sized with a priming coat of petrifying liquid of approved manufacture. Distemper shall be applied quickly and boldly with broad stiff brushes of approved make. The brush is to be dipped and stroked cross-wise info the wails and them immediately stroked up and down. This shall be considered to be one coat of distempering. The distemper shall be mixed in the manner specified by the manufacturer and each coat shall be inspected and passed by the Engineer before the next coat is applied.
- 9.6.3 The Contractor shall carry out as many coats as specified in the Schedule of Quantities in accordance with the above specifications. The number of coats specified is enough for producing the uniform smooth finish and if the finish produced by the Contractor is not up to the satisfaction of the Engineer, the Contractor will be required to apply more coats, as may be required to produce the specified finish without any additional charges.

9.7 SURFACE PREPARATION AND FILLING.

All plaster and masonry surfaces that are to be finished with vinyl emulsion, plastic emulsion or enamel paint shall be prepared as under prior to application of paint finish.

- 9.7.1 **NEW SURFACES:** Rub down the surfaces with a sand paper or carborandum stone to remove any 1case material. Check that the surface is thoroughly dry before painting.
- 9.7.2 OLD SURFACES: For previously painted surfaces especially white washed surfaces, scrape down to the bare surface and ensure that the surface is free from any contaminant like grease, oil, etc. and any loose material or dust is completely removed before painting.

- 9.7.3 **SEALING:** Apply 1 coat of Alkali Resisting Masonry Sealer and allow to dry overnight. Alkali Resisting Masonry Sealer may be thinned with 10-15% good quality mineral turpentine or white spirit if required due to surface absorption.
- 9.7.4 FILLING: Puffy for filling the walls should be made by mixing 4 parts of good quality chalk and one part of Zinc Oxide Powder with Alkali resisting masonry sealer till a smooth knifing paste is formed. Putty should be applied after sealing the walls with Alkali Resisting Masonry Sealer, and after the tilling work is completed and prior to application of the finish paint, the filled surfaces should be dry and properly finished, No filling should be carried out on external surfaces. Each coal of paint shall be allowed to become dry before any subsequent coat is applied. The finished surface shall be free from runs and sags, defective coverage and clogging of lines or angles. Edges of paint adjoining other materials or other colors shall be full and clean cut without overlapping.

The Contractor shall carry out as many coats as are specified in accordance with the above specifications. The number of coats specified should be enough for producing uniform smooth finish and if the finish produced by the Contractor is not up to the requirement, he will be required to apply as many more coats as may be required to produce the required uniform finish, and no payment for the extra coats applied to produce the desired uniformity will be made.

9.8 LACUER POLISHING.

- 9.8.1 Clear polyurethane lacquer used on the work shall be of ICI / Berger or an approved make.
- 9.8.2 The surface to be lacquer polished should be sand papered and a staining compound should be applied if required.
- 9.8.3 When the stain coat dries up the surface should be rubbed down with sand paper. Approved polyurethane lacquer of a proprietary brand shall then be

applied.

The surface shall then be wiped with o dry cloth and the process repeated several times in succession until the surface assumes the desired degree of gloss as approved by the Engineer.

9.8.4 SAMPLES.

Prior to the start of the application of any paint and /or finish treatment otherwise, the contractor shall apply samples of the required finish treatments to specific representative wall and ceiling surfaces or other areas or surfaces where indicated by the Engineer. The sizes of the sample paint and finishes shall be as determined by the Engineer.

9.8.5 PROTECTION.

The Contractor shall protect all the work against damage or injury by his employees or by the materials, tools used in connection with the work of this contract. Any and all work damages as a result of the execution of this shall be repaired at Contractor's expense or if in the opinion of the Engineer it cannot be properly repaired, it shall be replaced with new work by the Contractor without additional compensation. At all times, the general and liberal use of drop cloths shall be a primary requirement for protection purposes.

9.8.6 TOUCHING UP.

At the completion of all work specified herein, all painted work shall be touched up and restored where damaged or defected and the entire work left free from blemishes, to the complete satisfaction of the Engineer.

9.8.7 CLEANING.

The Contractor shall clean all paint, spots, dubs, oil and stain from all floors, wood work, glass hardware, metal work, electrical fittings and all similar items, and leave the work in perfect condition, upon completion in every respect to the satisfaction of the Engineer.

9.9 EMULSION PAINTING

9.10.1 SCOPE

The work include the provision of all materials, labour, plant and equipment and completion of work as specified and approved by Engineer-in-Charge

9.10.2 MATERIALS

Emulsion paints shall be of make and type as specified and approved by the EngineerinCharge.

9.10.3 EMULSION PAINT APPLICATION

For emulsion paint application the specifications laid for distempering under clause 15.5 shall apply.

9.10.4 SYNTHETIC FINISH

Synthetic finishes consist of application of synthetic finishes like Rockwall, Durock Graphic, Cemec or equivalent as specified and approved by the Engineer-in-Charge. The work shall be carried out according to supplier's instructions.

9.10.5 FRENCH POLISH (SPIRIT POLISH)

It is a spirit varnish applied to the prepared wood surface with a polishing pad of soft cloth and not with a brush with quick and light strokes along the grain. The cloth contains absorbent cotton filling. Several coats will be necessary before the desired shine and finish is achieved. The pad may be dabbed with a drop of olive or mustard oil after each coat to allow a smooth working and finish. The wood to be polished is first painted with a filler composed of 5 Lb. of whiting mixed with 1/2 gallon of methylated spirit and then sand papered, when dried. Fillers can also be made in any of the following ways:

- i) Whiting mixed with water.
- ii) Linseed oil and bee's wax (3:1) boiled. ii) Plaster of Paris either in water or raw linseed oil.

French polish is worked upon the surface of hard wood to obviate the effect of grain.

9.10.6 WAX POLISH

The surface of wood work is smeared with wax polish and rubbed with a soft flannel to a fine polish after 24 hours of its application. Wax polishing is mostly used for polishing the cement concrete floors.

9.10.7 PAINTING IRON WORK (NOT UNDER WATER)

In order to protect metallic products from corrosion, surface treatment is extremely essential, and painting is one of the many methods employed for this purpose. In addition, it improves the appearance of the article or structure.

PREPARING IRON WORK FOR PAINTING-

It is essential to remove all rust, scale and dirt and have the surface absolutely cleaned before painting. Special attention is paid to the cleaning of corners and re-entrant angle. Usually anyone of the following methods is employed depending upon the nature of surface to be cleaned:-

- 1) Loose dust is removed by bristle or wood fiber.
- 2) Rust scale and perished old paints are burnt off by the application of flat oxyacetylene flame and then rubbed off with wire brushes and scrapers,
- 3) Oil and grease can be removed by gasoline (petrol) or benzene, excess of which shall be wiped off from the surface.
- 4) Old paint can be loosened by applying a solution of country soda and fresh slaked lime in equal parts.

No chemical of any kind will be allowed to be used for cleaning the metal.

PRIMING OR UNDER COAT:

Priming coat can be a mixture of pure linseed oil and dry red lead in the proportions of 1 gallon of oil to 33 Lbs. of red lead. It is applied by brush or spraying machine immediately after cleaning the surface of the metal when it has completely dried up. If this coat is spoiled by rain within 24 hours of its application, it is removed and another coat is applied.

SECOND AND SUBSEQUENT COATS:

The second coat is applied when the priming or first coat has thoroughly dried and set i.e. after about four days. It may be red oxide paint or paint with aluminum or graphite base (red oxide paint may consist of 6 Lbs. of red oxide paint, 11b of lamp black and 1 gallon of boiled linseed oil). The third coat is applied when the second coat has dried completely. It may consist of 7 Lbs. of red oxide paint, and 1 gallon of boiled linseed oil. For less important iron

works or for roof coverings red oxide paint can be made up of the following constituents.

- a) Red oxide powder dry 10 parts by weight
- b) Raw linseed oil 4 parts by weight
- c) Boiled linseed oil 1 parts by weight
- d) Turpentine 1 parts by weight

One gallon of this paint will cover about 400 square feet of surface in two coats. Standard paints available in market should be used as specified and approved by the EngineerinCharge.

9.10 SCHEDULE OF MEASUREMENT OF PAINT AREA.

Irrespective of prime coats and number of paint coats applied to exposed painting surfaces, area of column, walls, projections, ceilings and other surfaces (except gates, doors,
windows and ventilators) shall be measured as per actual paint surface area for single time only and paid in accordance with quoted rate of Bill of Quantities

CHAPTER -10 GLASS AND GLAZING

10.0 SCOPE OF WORK.

The work covered under this section of the Specifications consists of furnishing all labor, equipment, scaffoldings and providing glass, gaskets, sealants, compounds and accessories required for performing alt operations in connections with the installation and setting of glass, glazing and glass blacks and butt jointed glazed partitions complete in every respect in accordance with the Drawings or as directed by the Engineer. The scope of this section of specifications is covered with detailed specifications as fold down herein.

10.1 GENERAL.

- 1.1 The glazier must examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed. Do not proceed with the glazing until unsatisfactory conditions have been corrected in a manner acceptable to the Glazier.
- 1.2 The Contractor shall submit two samples of each type of glass required. These samples shall be of 300mm x 300mm size or as directed. He will also submit lengths of installed (mock-up) glazing materials together with samples of glazing sealants and glazing gaskets.

10.2 DELIVERY, STORAGE AND HANDLING

1.1 Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces, and shall exercise exceptional care to prevent edge damage to glass.

10.3 MATEIRALS,

1.1 Plain and Tinted Glass: Glass shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to fit the rebates so as to have a uniform clearance round the panels between the edges of glass and the rebates.. Glass shall be of plate or float type, in thickness and size as shown on the drawings or Bill of Quantities. All glass shall be of such quality that surface deterioration' will not develop under normal conditions of use. Glass shall have parallel surfaces and without physical impurities.

10.4 Glazing Sealants and Materials.

10.4.1 General: Provide color of exposed sealant/compound indicated or if not otherwise indicated, as selected by Architect from manufacturer's standard

colors, Comply with manufacturer's recommendations for selection or hardness, depending upon the locations of each application, conditions at the time of installation, and performance requirements as indicated. Select materials, and variations or modifications, carefully for compatibility with surfaces contacted in the installation.

10.5.0 INSTALLATION OF GLAZING.

- 1.1 Glazing work shall comply with the recommendations of the glass and glazing materials manufacturers.
- 1.2 Examine each piece of glass and discard and replace glass with edge damage or face imperfection.
- 1.3 Cure glazing sealants and compounds in compliance with manufacturer's instructions, to obtain high early bond strength internal cohesive strength and surface durability.
- 1.4 No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass.
- 1.5 While glass operation is in progress, great care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good, at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be re-fixed at Contractor's expenses.

10. 6. PROTECTION AND CLEANING OF GLAZING.

Remove all smears, labels and excess glazing sealant, leave clean inside and outside and free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with new glass of no additional expense to the Owner. All glazed surfaces shall be washed clean both inside and outside prior to final acceptance.

10.7 MEASUREMENT AND PAYMENT.

General: No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities. The cost thereof shall be deemed to be included in the quoted unit rate of the relevant items of the Bill of Quantities.

- **10.7.1 Measurement:** Measurement of acceptably completed works will be made on the basis of net actual area in square meter / square feet of glozing material provided and installed in position as shown on the drawing or as directed by the Engineer.
- **10.7.2** Payment: Payment will be made for acceptable measured quantity of glazing material on the basis unit rate quoted in the Bill of Quantifies. The unit rate shall include the cost

of glazing, wastage, sealants and compound for fixing the glass, all hardware fittings as per manufacturer's recommendations or as shown on the drawings. Payment shall constitute full compensation for all the works related to the item.

CHAPTER -11 WOOD CARPENTRY AND JOINERY

11.1 SCOPE OF WORK.

The work covered by this section of specifications consists of providing all labor equipment and materials including performance of all operations in connection with fixing and installation of all wood work and mill work, construction, assembly and surface finish treatment and building in of all cabinet type items, complete in every respect and all related items support, etc., of wood or metal and incidentals, associated wood work appurtenances, the application of all Finish Hardware in connection with finished wood work, strictly in accordance with the requirements and drawings, as specified herein or as required by the Engineer and subject to the terms and conditions of the contract.

11.2 GENERAL REQUIREMENTS.

- **11.2.1** All materials specified herein shall be the products of one mill as for as possible. Only first class cabinet type workmanship will be admissible in execution of this work, performed by artisans skilled in this trade, so as to provide cabinet work of the highest grade, quality, finishing, fixing and installation as per drawings.
- **11.2.2** Care shall be exercised to avoid strong contrasts in color and graining of finished wood for all wood surfaces.
- 11.2.3 All cuttings, framing and fitting shall be done as required for accommodation of work of other trades. Use of wood chips, or other shrinkage material for leveling or plumbing will not be permitted in any form. Mortise and tennon joints, shall be set in an approved type of glue with wedges and/or pinned. No wood work in the building shall be allowed until such time plastering is entirely dry. As for as practicable, all wood work shall be assembled in shop, painted and finished throughout before fixing/installation in the building.
- **11.2.4** In addition to machine sanding, all interior, trim, paneling and wood work shall be smoothened by hand, using ZERO No. sandpaper to give all wood

work the required smooth surface for exposed finished treatment and free from machine and tool marks, abrasions, raised grains and other undesirable defects. All wood work shall be fitted to plaster or other finished work in a careful manner so as not to injure these surfaces in any way. Where plaster or other work is damaged or disturbed, it shall be made good and/or restored to its original conditions at the expense of the Contractor.

- **11.2.5** The whole of the timber shall be of good qualify, properly seasoned, "free from large, loose or dead, knots, or tight knots, the diameter of which exceeds one quarter of the width of the exposed face, or one inch whichever is less, or injurious open shakes" and shall not contain sap wood and having a moisture content of not more than 15 percent, nor less than 12 percent of the dry weight at the time of fixing.
- **11.2.6** All work shall be accurately set out and properly framed together with close fitting mortise and tennon joints accurately cut and carefully fitted and wedged solid in the best and most substantial manner. The joinery work shall be started after the commencement of the construction of the building but not wedged up until required, for fixing in position within the building. No lathery shall be wedged or built into position until it has been accepted and approved by the Engineer.
- **11.2.7** Door frames built into the structure before the surrounding carcass is built shall be set plumb & true and shall be adequately braced and protected against damage during subsequent building operations.
- **11.2.8** All timber shall be of first class soft wood /deodar) except those specified in the Bill of Quantities and as shown on the drawings.
- **11.2.9** Plywood used for doors, paneling and other similar works shall be shown on the drawings or 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. The veneer shall be of the required thickness and quality including base veneer and shall be impregnated with on approved adhesive and machine compressed. Such machine pressed veneered wood shall be fixed on all sides of the inner core wood (soft wood of approved qualify) after it has been treated with water resistant hot setting glue.

11.3.0 DOOR AND WINDOW FRAMES,

11.3.1 The door and windows frames shall be of the first class soft wood or hard wood as specified in the Bill of Quantities and description of works. These shall be fabricated to the exact sizes and dimensions as provided in the drawings, where the door frames are not to have any sills, the vertical length shall be embedded in the floor. The Contractor shall also fully protect door and window frames from damage or injury during construction and shall replace the damaged or injured frames at his own cost, the frames must have primary coat painted on or before

fixing. All framing members shall be properly mortised, tennoned and all joints properly wedged and glued and pinned. The door and window frames shall be secured in place by means of galvanized steel anchors bent up against the back of the iambs and screwed in place and built into the masonry as if is being constructed. There shall be one such anchor near the top and bottom of each jamb not over 90 cms intervals between the top and bottom anchors, Frames shall be secured to the anchors by means of two counter-sunk screws per anchor.

11.3.2 Wherever the drawings and Bill of Quantities require door and/or frame of metal, these shall be constructed of prime quality galvanized steel of 16 swg unless otherwise specified. The width and shape shall be as indicated on drawings. The frames shall be recessed at the point of location of hinges and shall have integral reinforcement to allow the butt hinges, pivot hinges, door closers and other finish hardware to be screwed on, The door frames shall also have a provision to allow recessed installation of door lock strike plate with a back up boxing to keep concrete away from the lock strike plate. The number and type of anchors shall be as per wooden frames. These anchors must not be welded onto the inner side of the exposed surface of the frames as indicated in the drawings. Under no circumstances must the Contractor manufacture the metal frames prior to approval of a sample by the Architect/Engineer. The protection of the metal frames from the plastered surface if shown on the drawings must be uniform throughout the project.

11.3.3 Preservatives

All portions of timber built into or against or close to masonry or concrete, and all junctions or rafters, purlins, beams and wall plates shall be given two coats of hot solignum, creosote or other wood preservative approved by the Engineer-InCharge.

11.4 FLUSH WOOD DOOR SHUTTERS.

11.4.1 The door leaf has to be flushed type on both sides manufactured as approved. It shall be of well-seasoned solid core black board. Flush door shall be screwed to the frames by means of butt hinges. Hinges where provided shelf be countersunk in the order for veneered leaves shall intimate the Engineer and also a sample of the leaf of the proposed manufacturer, Completed doors shall be sound, rigid and free from defects and warp. All edges shall be aligned and smooth, Joints shall be close fittings, hardwood doweled or mortised frames and of strength to maintain the structural properties of the members connected. All adjoining faces and edges shall be flush and smooth. Edges shall be rectangular and solid. If a lipping is required on the edges of the flush door shutter, this shall be of the required size and shall be recessed and glued and nailed info the edge frame of the shutter.

11.4.2 GLAZED DOORS AND WINDOWS.

All doors and windows Leaves shall be cut out and framed together as soon as possible after the commencement of the works and stacked in the shade for seasoning. These ore not to be wedged and glued for four months where possible and where the contract time permits. If it is not possible, these should be wedged and glued just prior to being hung. Any or all portions, in which defects appear, shall be replaced by the contractor before final gluing up the same. All tennons at the final assembly of the doors (top and bottom) shelf be glued and wedged. Immediately after gluing, the frames shall be tightly clamped and so Jeff till the glue has set. Unless otherwise specified, leaves are to be hung on hinges of the size and numbers required. The hinges shall be countersunk info the frames as well as in the leaf, the recesses being cut of the exact size and depth of the hinges. No subsequent packing shall be allowed.

11.5 WOODEN HAND RAIL.

The wooden hand-rail shall be in accordance with the dimensions and shape shown in the drawings. If shall be fixed to the balustrades with counter screws at maximum 250mm centers or with bolts in an approved manner and the top neatly covered in with an appropriate wood stopper. The wood shall be carefully selected and shall be free from all knots in addition to conforming to the specifications for wood work section.

11.6 WOODEN CABINETS.

All cabinets including fittings and fixtures shall be as approved and shall be of best quality.

- **11.6.1** The Contractor shall submit a finished sample of each type of cabinet including all lettings and fixtures and the same shall be got approved from the Engineer before fabrication. Samples of materials to be used in cabinets together with specifications and literature shall be supplied to the Engineer for his approval. The color shade shall be as approved.
- **11.6.2** All cabinets shall be installed in position by the skilled workmen. The Contractor shall inspect delivered cabinets and related parts for indication of location, size required by field measurements, finishing hardware and similar preliminary works. Verify locations for installation, required floor and wall finishes, painting and all other related work. Unsatisfactory conditions shall be repaired. Concealed fasteners, all joints surfaces shall be smooth and even. Doors and other moving parts shall exactly fit in the frame. Refit, as necessary to ensure proper and easy operations. Refit, if necessary, all cabinet hardware, test for proper operation, remove

for painting and other finishing and properly replace in position with all fittings and accessories. All work shall be thoroughly protected from damage at all times by suitable methods approved by the Engineer, Adjacent work shall similarly be protected from damage. Any damage or disfigurement shall be immediately made good at Contractor's expense.

11.7.0 WOOD SKIRTING/DADO AND PANELLING.

Wood skirting/dado and paneling shall be provided where shown on the drawings and the schedule of finishes. These shall be installed in position conforming to detailed drawings and as per direction of the Engineer. Shop drawings and sample shall be submitted to the Engineer for approval. In the event of non-conformance to specifications and drawings, the work shall be rejected by the Engineer and the Contractor shall remove and replace the rejected work by new work as per specification,

Surfaces shall be prepared in the manner as directed by the Engineer for clear polish finish or as specified.

11.8 HARDWARE.

Hardware shall be of best qualify and make, strong and fine finished according to the weight/dimension, material as per specified hardware schedule. The Contractor shall obtain prior approval from the Engineer for quality, shape, pattern and brand of all hardware materials by providing samples and catalogue 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 info respective lacks and upon acceptance of the work keys shall be tagged and delivered to the Engineer.

11.9 MEASUREMENT AND PAYMENT.

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities, All finished hardware/fittings in carpentry and joinery works.

CHAPTER -12 ALUMINUM WORKS

12.1 SCOPE

The work under this section of specification includes furnishing all labor, equipment, appliances and materials and performing all operations in carrying out the work of natural,

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anodized and powder coated aluminum windows, doors, ventilators and louver with fly proof shutters and aluminum false ceiling of polycarbonate sheet on swimming pool. All related items such as sealants, rubber gasket for glazing, netting, rollers, latches, fastenings, glazing, anchor bolts and all items supplied by other trades and customarily built in and/or installed in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

12.1.1 APPLICABLE STANDARDS

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

ISO (International Organization for Standardization 6612

Windows & Doors - wind resistance tests.

6613 Windows & Door - Air permeability test.

BSI (British Standard Institution)

1227 Hinges

4873 minum alloy windows.

12.2 SUBMITTALS

a. Shop Drawings

The contractor shall submit shop drawings which shall show full construction details, quantities and locations, fastenings and attachment to adjacent construction and materials. Shop drawings shall be submitted at the proper time to allow for checking, revisions and to permit manufacturer's product delivery and start of site work to suit the building programme.

b. Samples.

Prior to execution of work and sufficiently in advance, the Contractor shall submit representative samples of finished Doors, windows and ventilators, anchoring mechanism, embedded parts, fastenings, glass panes, accessories and other materials for the Engineer's approval.

c. Manufacturer's Certificate

The Contractor shall on request get certificate signed by the manufacturer stating that each lot has been sampled tested and inspected and has met the requirements in accordance with these specification and the same shall be furnished to the Engineer. d. **Guarantee**

The manufacturer shall furnish his standard written guarantee against leakage of rain water, excessive infiltration of dust, air and all defects in materials, workman ship covering all the work under this section.

12.3 PRODUCT DELIVERY AND STORAGE

12.4

12.4.1 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.

12.4.2 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.

12.5 MATERIAL

All the sections used for Doors, windows, ventilators & fly screens shall be of best quality aluminum products such as equal and unequal angles, channels, tubes, corrugated strips, moldings etc.; in accordance with international standards conforming to ASTM B 308 & B221.

12.6 Frames

The frames of aluminum doors, windows, ventilator, louvers and fly proof shutters shall be formed from rolled, strip or extruded aluminum and be at least 2mm thick deluxe section. Fastenings bolts and screws shall be made from hardened aluminum.

12.7 Fasteners shall be stainless steel of a type selected to prevent galvanic action

with the components fastened. Gaskets shall be vinyl glazing channel gasket to

commercial standard CS230-60.

- **12.8** Hardware as required shall be manufacturer's standard hardware of aluminum, stainless steel or other corrosion resistant materials and shall blend in design with the frame finishes.
- **12.9** Joint sealant shall be approved elastomer.
- **12.10** Fittings and fixtures shall be as per approved samples.
- **12.11** Joint sealant shall be approved elastomer.

12.12 Finished Coating

General

The finished coating shall be as stated on the Drawings and applied strictly in accordance with the manufacturer's instructions.

The color of the coating shall be selected from available ranges if not stated if not stated in the drawing and or bill of quantities. The Contractor shall offer samples for approval prior to the final selection and the manufacture of these elements.

12.11.1 Anodized coating

The aluminum anodizing shall comply with BS 3987 and be integral color hard coat anodizing 550kp/mm² hardness, minimum 25 microns thick.

The color of anodizing shall be as described on the drawings. Samples of color including limits of color variation shall be submitted to the Engineer for his approval before work commences. The Engineer reserves the right to reject the products of any supplier who cannot guarantee a reasonable limit of color variation, the acceptable limit of variation being at the Engineer's discretion.

12.11.2 Polyester Powder coating

All aluminum works shall be finished in colored electrostatic polyester powder coating as per DIN standard 53151, 53153, 53156 or equal and approved to RAL Color subject to the Consultant's approval.

12.11.3 Coating Thickness

As and when instructed by the Consultant, the Contractor shall provide certificates from independent laboratories that the minimum thickness as stated in these Documents has been applied to the aluminum sections. Failure to provide such information shall result in the complete installation being rejected and replaced at the Contractor's expense.

12.11.4 Dissimilar Materials

All aluminum surfaces that are to be in contact with cured concrete, mortar, steel and other metals shall have the contact surfaces protected wherever they may entrap moisture or corrosive elements. Metals that are to be in contact with mortar or concrete shall be protected with a two coat bituminous coating.

Prime paint steel parts of anchors, anchor inserts, reinforcement, supports, and all parts after field welding or blotting with zinc chromate. Minimum dry film thickness of 1 mil for zinc chromate.

12.13 FABRICATION

12.12.1 General

All nuts, bolts, washers and screws used for assembly and fixing shall be of adequate strength for their purpose within the design and shall be stainless steel grade 18/8. All sealants used in the assembly of, and in the fixing of cladding and window framing, shall be non-setting to allow thermal movement without detriment to those joint sealants used for peripheral caulking and shall be one part silicone sealant and shall conform to BS 4245. All spliced joints between mullions will be sealed with an approved silicone product, compatible with other sealants and packing used.

All ironmongery which is to have the same finish as the frames and shall be approved by the Engineer.

At all opening of windows and doors and where there are louvered screens and doors, a fly screen shall be provided to the approval of the Engineer, constructed following the principles and specifications as described elsewhere in this specification.

Glazing sections shall be set in special heat resisting PVC and of channel type. Separate glazing sections on each side of the glass will not be permitted.

The following table indicates the basic requirements for window construction. The weights of framing make no allowance for beads, glazing bars, opening light framing, coupling mullions or transoms.

Classifi- 1. Catio n	Min. weight Of basic Frame Kg/m run	Max. superficial Area of window In m2	Max. Dimension Either way Mm	Remarks
Light	0.60	1	1500	
Light	1.00	3	2000	
Medium	1.50	5	2500	
Medium	2.00	9	3000	
Heav	y 2.50	12	3500	
Heav	y 3.00	12	3500	With door

12.12.2 Sliding Windows and doors

Weather stripping - high density acrilan wool weather pile shall be used. There should be double brushes at every contact between shutter and frame sections for complete insulation. These should be present consistently throughout the unit between the inside and the outside and no portions without it are permitted.

The rollers for sliding shutters for both windows as well as doors shall be of the adjustable type. The adjusting screws must be accessible in the assembled state of the shutters and a vertical adjustment of 7 mm should be possible.

All sections for sliding windows and doors should be hollow section and the cross section dimensions of the sections should not be less than 60 x 40 mm.

The outer frame must be suitable for accommodating sliding fly screens as required.

The handle-latch set should have all visible surfaces finsihed as the aluminum sections. The handle must have a proper grip. A small projecting flange or recess in the shutter sections cannot be accepted to serve as handles. The latching mechanism should not be surface mounted but should be concealed within the sections.

Sash rails of vertical sliding windows are to be of tubular box sections with corner joints of outer frames and sashes interlocked, and the balance mechanism is to be an approved proprietary product.

12.12.3 Side hung windows, doors and ventilators

All windows and doors should be weather-stripped with heat resistant PVC sections. The weather protection should be achieved by a positive compressive action against the PVC section and should not depend on external contact with the PVC section. At every contact between two profiles two weather-stripping section should be provided to complete weather protection.

The bottom sections for hinged doors must be capable of being adjusted vertically if necessary. The gap between the bottom section and the floor should be covered with a pair of special splay-type PVC sections.

The shutter sections for both windows as well as doors shall be hollow section type and shall be overall size 57 x 45 mm and door sections shall be overall size 81 x 45 mm (including flanges).

The shutters of the windows and doors should be assembled with concealed corners of high rigidity. Hinges should be concealed within the sections.

Hinges shall be anodized aluminum with stainless steel pins and nylon washers. Handles shall be anodized aluminum finished to match the aluminum sections and mounted with self-lubricating nylon washers.

A mortise cylinder rim automatic deadlock of high quality with double pin tumbler is to be used.

Windows shall have anodized aluminum handles, color as framing and a latching mechanism securing the shutter to the frame both at the top and bottom. Fitting where required:

- a. Single action door closer concealed in the head bar of the outer frame and mounted on an adjacent pivot at the threshold and deadlock fitted.
- b. The left hand leaf of double doors with flush bolts at head and sill with deadlock fitted to the right hand leaf.
- c. Escape doors to have panic bolt assembly with vertical elements concealed in the stile and door closer as in (a).

12.12.4 Fly screens

Fly screens shall be fitted to all opening leaves of windows or sliding doors, consisting of a separate metal sub-frame in with aluminum mesh fly wire. The Fly screens shall be adequately secured with suitable clips, set screws or turn buckles and shall be removable for maintenance purposes. Fly screen doors shall consist of similar section to metal casement doors and shall be fitted with removable panels of fly wire.

The aluminum frame to the Fly screen shall be finished to match the framing of the window or sliding door. Color and type of mesh to Engineer's approval.

12.12.5 Aluminum Doors, Windows and Ventilators

12.12.5.1 Measurement & Payment

Measurement of acceptably completed works of aluminum doors, windows and ventilators will be made on the basis of net actual area in square feet provided and installed in position as shown on drawings or as directed by the Engineer. Payment will be made for acceptable measured quantity of all finished aluminum doors ,windows and ventilators on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

CHAPTER -13 MISCALLENOUS WORKS

13.1 FALSE CEILINGS

13.1.1 GENERAL

A typical dropped ceiling consists of a grid-work of metal channels in the shape of an upside-down "T", suspended on wires from the overhead structure. These channels snap together in a regularly spaced pattern of cells.

13.1.2 MATERIALS

i) Gypsum Board False Ceiling Standard Gypsum Board ½" thick unless otherwise indicated on the Drawings, ends square cut, tapered edges as manufactured by US Gypsum or approved equivalent and of approved pattern, size and thickness as per approved shop drawings.

ii) Lasani Board /MDF False Ceiling

Lasani Board / MDF false ceiling shall be of the approved manufacturer and of approved pattern, size and thickness as per approved shop drawings.

iii) Plaster of Paris False Ceiling

The Plaster of Paris false ceiling comprise of POP tiles 1/2" thick size 2'-0"x2'-O" or as shown on the Drawings, reinforce with hessian-mat.

iv) Dampa AL-15

Suspended aluminum false ceiling shall be standard products offered by the manufacturer / supplier DAMPA grid system shall be 0.5mm thick aluminum strips. They shall be profiled units available in standard foil and a pad of mineral wood 12mm thick. The approved manufacturers shall be DAMPA. The type of ceiling used shall be DAMPA AL-15 perforated.

v) Hangers

Hangers shall be of 5/8"x1/8" M.S. flat. It shall be the responsibility of the Contractor to get the sample of hanger approved by the Engineer-in-Charge.

vi) Angles and Tees

Angles and Tees shall be of Aluminum section 1.6mm of approved pattern as per shop drawings approved by the Engineer-in-Charge.

13.1.3 SUBMITTALS

The Contractor shall submit the following for approval of Engineer-in-Charge.

- The shop drawings 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.
- Samples of false ceiling panels, suspension system, and accessories including sealant, furring and runner channel etc.

13.1.4 DELIVERY AND STORAGE

- Material shall be delivered in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating.
- Material shall be stored in original protective packaging to prevent soiling, physical damage or wetting.

• Cartons shall be stored in the installation area, opened at each end to stabilize moisture content and temperature, for 48 hours prior to installation.

13.1.5 QUALITY ASSURANCE

Installer Qualifications: Engage an experienced Installer who has successfully completed false ceilings similar in material, design and extent to those indicated for this Project

Fire Performance Characteristics: Provide these ceilings that are Identical to those tested for the following fire performance characteristics, per ASTM test method indicated below, by Underwriters Laboratories, Inc. (UL) or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of acceptable testing and inspection organization.

Surface burning characteristics: tested per ASTM E84 and complying with ASTM E1264 for Class A products.

Flame spread: 25 or less

Some developed: 50 or less

Single Source Responsibility for Ceiling Panels: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

Single Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress in the Work.

Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including lighting fixtures, HVAC equipment, fire-suppression system components, if any, and partition systems.

13.1.6 TOLERANCES:

Deflection:

Suspension system components, hangers and fastening devices supporting light fixtures, ceiling grilles, and acoustical panels, maximum deflection 1/360th of the span.

Deflection test: ASTMC635.

Field Constructed Mock-Up: Install acoustical ceiling in designated area. After the acceptance of the Engineer-in-Charge, retain mock-up as a standard of quality for entire acoustical panel ceiling installation.

13.1.7 MEASUREMENT:

Length and breadth of the False Ceiling shall be measured correct to a cm and the surface area worked out in square metre of the finished work.

No deduction shall be made for openings of areas upto 40 square decimetre. No extra payment will be made for any extra material or labour involved in forming such openings. For openings exceeding 40 square decimetre in area, deduction for the full opening will be made, but no extra will be paid for any extra material or labour involved in forming such openings.

13.2 KITCHEN CABINET

All wooden kitchen cabinet works shall be fabricated by approved subcontractor/manufacturer and shall be of best quality.

A) Shop Drawings

The details of these items shown on the drawing are tentative and show basic configuration and design of these items.

The contractor shall submit detailed shop drawings of these items on the basis of tentative detail shown on the drawings including all fitting, fixtures and hardware for the proper execution of kitchen cabinet for the approval of the Engineer before fabrication.

B) Installation All the works shall be installed in position by the manufacturer's skilled workmen specialized in the job. Works shall be executed in accordance with approved shop drawings and or as directed by the Engineer.

All work shall be thoroughly protected from the damage at all times by suitable methods approved by the Engineer. Adjacent works shall similarly be protected from damage. Any damage or disfigurement shall immediately made good at contractor's expense.

13.2.1 MEASUREMENTS AND PAYMENT:

Length and width of the cabinet shall be measured to the nearest cm in closed position covering the rebates of the frames but excluding the gap between the shutter and the frame.

Area is calculated to the nearest 0.01 sqm.

The payment for the items of the work shall be made corresponding to the applicable items as provided in Contract Agreement and shall constitute full compensation, for procurement, transportation, performance in all respects and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

CHAPTER – 14 PLUMBING, SANITARY, PIPINGS, FITTINGS & INSTALLATIONS

14.0 SCOPE

The work shall include, furnishing and supplying as required all labour, materials, fittings, fixtures, accessories, equipment and services for the execution, completion, testing and commissioning of plumbing, sanitary installation & Gas fitting works as shown on drawings, specified herein or as directed by the Engineer-in-Charge.

14.1 PLUMBING, SANITARY PIPING, FITTINGS & INSTALLATIONS

14.1.1 SUBMITTALS

The Contractor shall submit samples of materials such as fittings, fixtures and accessories to be incorporated into the works to the Engineer-in-Charge for approval.

14.1.2 SOIL, WASTE AND VENT PIPES

All soil, waste and vent pipes and fittings shall be UPVC , The range includes traps, push-fit waste systems, solvent weld systems, soil and vent systems and a full range of floor gullies. **Specification as:**

Specific gravity1,4 g/cm³InflammabilitySelf-extinguishingSpecific heat1,00 Kj/kg 60 °C long term, 100 deg C short term

Thermal conductivity	Coefficient of heat conduction = 0, 16 W/m °K (or °C)
Co-efficient of linear expansion	0, 08mm/m K (or C)
Vicat softening point	79 ºC
Impact strength	2-5 mJ/mm ²
Modulus of elasticity	Emod=3000 N/mm ²
Poisson's ratio	0,39
Tensile strength	45 N/mm ²
Elongation at break	=>80%

Pipe shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds.

PVC pipes exhibit excellent resistance to a wide range of chemical reagents in temperatures up to 50 0 C.

14.1.3 INSTALLATION

Installation shall comply with the latest installation instructions published by the Pipe manufacturer and shall conform to all applicable plumbing, and building requirements. Buried pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668. Solvent cement joints shall be made in a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564. The pipe shall be protected from chemical agents, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds.

- All soil waste and vent pipes and fittings shall be installed plumb and true to lines and grades shown on the drawings or as directly by the Engineerin-Charge.
- ii) Where installed vertically, pipes shall be supported from wall by metal clamps of approved type and make at each floor just below the Horizontal branch pipe connection and at intermediate levels.

The spacing of vertical and horizontal pipe supports shall be 1.5 mm to 3 mm respectively and dia of steel support shall be 13 mm.

- Pipes passing through walls, floors or roof shall be placed in metal sleeves of approved design. The annular space between the sleeve and pipe shall be at least 15 mm. The space shall be packed with approved filler and shall be sealed at both ends with approved sealant.
- iv) Drainage pipes shall be installed with a slope of not less than 1% unless specifically indicated otherwise on the drawings. Drainage pipes installed underground shall be minimum 2" diameter. Before installing any pipe, it shall be internally cleaned from dirt, debris, etc, by passing through it a cleaning cloth.
- Pipes shall be installed in a neat manner with runs parallel and branching or changes in direction at 90 or 45 degrees. Change in direction and size, branching and jointing of pipes shall be made with regular pipe fittings (elbows, tees, reducers etc...). Pipe bending shall not be accepted. All elbows shall be long radius. All drainage fittings shall be long radius sweep type.

- vi) Sleeves shall be supplied and installed wherever pipes cross slabs, walls, partitions, etc, Sleeves shall be cuts of galvanized steel pipes having an internal diameter of not less than 1 1/2" (4cms) larger than the outside diameter of the bare sleeved pipe or the insulated sleeved pipe.
- vii) Floor sleeves shall protrude about 3/4" (2cms) above finished floor level and shall be flush with finished walls. Gaps between sleeves and pipes shall be filled with non-flowing plastic or waterproof mastic filler or paste.

14.1.4 STORAGE & HANDLING

14.1.4.1 PIPES

Handling Care should be taken when handling pipe and fittings. Excessive scratching or scoring harms the appearance and can also affect the joint sealing. Take extra care when handling pipe and fittings in wintry conditions. Cold weather reduces the impact strength of plastics. Use nylon belt slings, or forklifts with smooth forks, for mechanical unloading of block bundles. Metal slings, hooks or chains must not come into contact with pipes (see Figure A). Load and unload loose pipe by hand. Avoid using skids. When loose pipes have been transported one inside the other, always remove the inner pipe first.

14.1.2 STORAGE

Always store pipe on a reasonably flat surface free from sharp projections.

BLOCK BUNDLES

Block bundles can be stored up to 3m high without extra side supports or bearers. Block bundles will remain free-standing when cut. Take care when releasing bundles as the straps are under considerable tension and may flail when cut. Loose Pipes Loose pipe requires side supports at least every 2m. These supports should consist of battens at least 75mm wide. Ideally, support loose gutter or pipe uniformly throughout its entire length. If this is not possible, place timber supports at least 75mm wide at 1m maximum centers beneath the pipe different size pipe separately, or, if not possible, stack with larger diameters at the bottom. Maximum stack size 7 layers or 2m high . Stack Socketed Pipe with sockets protruding and placed at alternate ends to ensure pipe is evenly supported.

14.1.3 FITTINGS

Store fittings supplied in plastic bags away from direct sunlight. If this is not possible, open bags to prevent a build-up of temperature. Fittings in cardboard packaging (e.g. Fire Stop Seals and Air Admittance Valves) should be stored under cover until required. Store degreasing cleaners, silicone lubricant, solvent cement and fillers in a cool place away from any heat source and out of direct sunlight.

14.1.4 JOINTING :

For jointing there are two types adopted as follow :

14.1.4.1.RUBBER RING JOINTS

The rubber ring joint is integrally moulded on one end of the pipe. The joint incorporates a factory fitted rubber sealing ring which is retained in position by a polypropylene lock ring. The opposite (spigot) end of the pipe is chamfered and has a "depth of entry" mark near the end. Each joint is capable of handling some expansion and contraction as well as

angular deflection. The seal ring is designed to provide a watertight joint at high and low pressures.

14.1.4.2 SOLVENT WELD JOINT

Solvent cement jointing is a welding process and not a gluing process. If done correctly, separation will not be possible after the curing period. Jointing of pipe should be an interference fit between the components before solvent cement is applied. There are different solvent cements available for applications. Be sure to use the correct cement and that it has not "dried out" prior to use.

14.1.5 TRAPS AND CLEANOUTS

14.1.3.1 FLOOR TRAPS

Traps shall be of self-cleaning design, provided with water seal. Traps of the specified size used for underground installation shall be UPVC confirming specification EN 1329 & EN 1401 as under :

14.1.3.2 Floor Drains - Type FDV, FD

Supply and install all floor drains wherever shown on drawings and as specified . Floor drains are to be bottom outlet for FDV, and horizontal outlet for FD, of type suitable for connection to UPVC non-pressure pipes, or approved equal.

14.1.4 FLOOR CLEAN OUTS

Supply and install all clean-outs wherever shown on the drawings and as specified herein. Each clean-out shall be of the same material and dimension as the pipe shall conform with the following requirements:

a. For pipes exposed or in false ceilings, clean-outs shall consist of a threaded cap screwed onto pipe end.

b. Floor **FCO** and wall clean-outs **WCO** shall consist of capped wide elbows ending under a chrome plated bronze tile 20 x 20cms with screwed cover or .

All cleanouts in the sewerage system shall be closed with brass screw caps. All brass screw caps shall be extra heavy and not less than 3 mm thick. Each screw cap shall have solid square or hexagonal nut not less than 25 mm high, with a minimum diameter of 38 mm. The body of the clean out ferrule shall be at least equal in weight and thickness as of the caulking ferrule for the same size of pipe as shown in the following table:

14.1.6 Roof Vents and Vent Caps

Supply and install all roof vents and vent caps wherever shown on the drawings and as specified herein.

a. Vent cap shall be full size of stack connected to it and provided with cap. UPVC with hooded vent cap. b. Vent shall be provided with an extension nipple for fixing onto the vented stack.

14.1.7 INSTALLATION OF TRAPS, DRAINS AND CLEAN OUTS

- i. Floor traps shall have openings for connection of inlet pipes from fixtures. The invert level of inlet pipes shall be at least 25 mm above the trap weir level.
- ii. Floor traps shall be well set in position so that there is no leakage at the joint between trap and the floor. The requirements specified above for floor traps are equally applicable for floor drains except that no water seal is required and it shall be of the specified size.
- iii. Roof drain shall have strainers extending at least 10mm 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 watering by use of proper flashing material.

iv. Clean outs shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of clean outs shall be flush with the floor when located in open area. They may not be flush with the floor when installed near wall and levels are not deep enough to make them flush.

Clean out shall be so installed that there is a clearance of at least 300 mm for pipe less than 75 mm diameter and at least 450 mm for pipes of 75 mm and larger diameter for the purpose of rodding. Permanent finishing material shall not be placed over clean out plug.

Clean out in open areas shall be placed in concrete boxes with access cover of heavy duty 300 x 300 mm size. Clean out near wall shall be embedded in concrete, and excepting cast iron pipe used with cleanout all other work of ferrule, plug, concrete work, frame and cover etc. shall be included under clean out item.

v. Gulleys shall be fixed on concrete foundation 300 mm square and not less than 150 mm thick. A brick curb in cement mortar about 75 mm high from the ground level shall be built round top edge of gulley in such a manner that surface water shall not be allowed to enter the gulley. It shall be used for waste water only before entering into the manhole.

14.1.7 MEASUREMENTS

Traps, Vent Caps and Cleanouts shall be measured in numbers as per BOQ

TRAPPED FLOOR TRAP



- The floor gully is manufactured in robust ABS and complies with the relevant sections of BS 4514.
- Minimum 70mm deep-water seal providing maximum protection against seal loss due to evaporation and siphonage. Prevents possibility of foul air escape.
- Redesigned boss shoulders eliminate the use of adaptors for inlet connections.
- Can be used with both imperial and metric sized pipework.
- Accepts either plastic or stainless steel tile and grating.
- Simply extended by using 110mm plain ended pipe.
- The gully will not rust or corrode and is unaffected by domestic detergents.
- High temperature resistance.
- The unique design allows for the gully to be reduced in height when installed in shallow floor slabs.
- Manufactured as per approved manufacturer.

CHAPTER -15 WATER SUPPLY 15.0 PRESSURE PIPE FOR POTABLE WATER SUPPLY 15.1.1 PRESSURE UPVC PIPES AND FITTINGS Page 238 of 346 Supply and install all pressure UPVC pipes and fittings as specified& shown on Drawing as herein.

- All pressure UPVC pipes shall be of extruded unplasticized Polyvinyl Chloride to BS 3505 class E or UPVC pressure pipes conforming to Pakistan Standard PS 3051 : 1 991 or approved equal International Standards. Fittings shall be of same material and pressure as pipe.
- b. All joints shall be of the solvent weld joint.

15.1.2 Polypropylene Random (PPR)

Polypropylene pipe shall be of high grade polypropylene random (PPR), to comply with DIN 16962 appropriate to the service working pressure. The tube shall be provided in straight lengths form.

Joints and fittings shall be welded type, of the Saul material and type of the tube. Fittings shall consist of gunmetal bodies coated with polypropylene suitable to be welded to the tube at one end and to receive a threaded coupling at the other end.

Welding shall in all cases be carried out by skilled craftsmen who are in possession of a current certificate of competency issued by an approved authority. Specimen welds, representative of the thickness and diameter of the joints and the condition of site welding, shall be submitted as required by the Engineers in request of every craftsman employed in such work.

When the general hydraulic tests of the completed systems are carried out, each weld shall be lightly hammered whilst pressure is maintained. If any leaks occur, the portion of the weld near the leak shall be cut out and re-welded. Should a considerable portion of the welded joints made by a particular operative be found to be defective due to faulty workmanship, all such welds shall be cut out and re-welded by another operative whose work has proved satisfactory.

All expansion loops shall be proportioned such that the total stress set up in the material of the pipe wall; taking into account the components due to internal pressure, torsion and bending; is taken up in the geometry of the changes of direction.

All expansion loops shall be generally inserted in the pipe lines in such a manner that cold draw to extend of one-third of the anticipated expansive movement is taken up. Such conditions shall be agreed on the site with the Engineer at time that erection is taking place.

Expansion loops shall be factory fabricated of similar materials to the pipe work

15.1.3 PIPE HANGERS AND SUPPORTS

General Requirements

- a. Supply and install pipe hangers and supports to properly carry weight of pipes and accessories without sagging as specified and required.
- b. Hangers and supports shall be designed and tested to sustain a load 8 times the actual supported load, and shall be easily adjustable.
- c. Hangers and supports shall be steel with smooth flat bearing surfaces and shall allow free movement of pipes due to expansion and contraction without any deformation. Hangers and supports for UPVC Pipes shall be of material, type and spacing strictly in accordance with manufacturer's recommendations.
- d. Hangers and supports on insulated pipes shall have galvanized steel sheet protection saddles or shields, 3mm thick, 30cms long to fit outside diameter of insulation and cover 180° of arc.
- e. Pipe anchors and guides shall be 3/4" diameter U-bolt.
- f. Piping to be independently supported of equipment and located at adequate intervals to avoid air pockets and dirt traps. All branching shall be directly supported.
- g. Spring cushions shall be used where pipe is subject to considerable vertical movement or vibration.
- h. Insulated hot pipes shall be supported on a clevis hanger or pipe clamp lined with protection shields.
 - j. The contractor shall submit shop drawings for all types of supports showing construction details.
 - k. Hangers and supports locations shall be shown on shop drawings.

The following shall be used as a guide line. Manufacturer's recommendations shall be strictly followed:

Pipe Diameter	Maximum Support Spacing		<u>Minimum Size</u>	
	<u>Horizontal</u>	<u>Vertical</u>	<u>of</u>	
	<u>Pipes (cm)</u>	<u>Pipes (cm)</u>	<u>Hanger Rod</u>	
1/2"	60	120	10 mm	
3/4"	70	140	10 mm	
1"	75	150	10 mm	
11/4"	80	160	10 mm	
11/2"	90	180	10 mm	
2"	105	210	10 mm	
3"	135	270	13 mm	
4"	150	300	16 mm	
6"	180	360	16 mm	
8" and larger	215	360	16 mm	

15.2.0 GAS UTILITY SERVICES

SCOPE

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The work for piped utility services in buildings shall include furnishing of all labour, plant, equipment, materials and services and supplying, installing, testing and commissioning of cold and hot water supply and gas supply systems in the buildings as shown in the drawings, required as per specifications and or directed by the Engineer-in-Charge.

The gas pipeline and fittings shall be carried out strictly complying with the regulations of Gas Authority. Where required, the Contractor shall be responsible for their acceptance certificate for gas connection.

15.2.1 SUBMITTALS

The Contractor shall submit samples of fittings, fixtures and accessories to be incorporated into the works.

15.2.2 G.I. PIPES

 i) The galvanized iron pipes shall conform to BS specifications No. 1387 for "Steel tubes and Tubulars, suitable for screwing to BS-21 pipe threads". ii) All screwed tubes and sockets shall have threads in accordance with BS-21. In order to prevent damage to the leading thread, the end of the sockets shall be chamfered internally.

iii) A complete and uniform adherent coating of zinc shall be provided for galvanized iron pipes.

iv) Every tube shall be tested at the manufacturer's works to a hydraulic test pressure of 5 MPa and shall be maintained at the test pressure sufficiently long for proof and inspection.

 v) 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-socket screwed ends.

15.2.3 MEASUREMENT

G.I. Pipes shall be measured in Running Meters correct to cm.

15.2.4 FITTINGS AND SPECIALS

15.2.5 G.I FITTINGS

- i) Malleable Iron Galvanized Fittings (i.e. coupling, elbows, tees etc.) for G.I pipes of diameter lower than 75 mm shall conform to BS-143/BS-1740 and shall be at least same thickness and quality as G.I. pipe.
- ii) Cast Iron Threaded Flanges for joining G.I pipe of dia 75 mm and above shall conform to BS-

4504.

iii) Cast Iron Flanged Fittings for G.I. pipe 75 mm and above shall conform to BS-2035, a working pressure 122 meters of water.

15.2.5 MEASUREMENTS

Cost of G.I fittings and Specials is included in cost of Pipes

15.3.0 SANITARY FIXTURES 15.3.1 WASH BASINS

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The wash basins shall be glazed earthen ware in sizes and colours as specified and as per shown on drawing. The wash basins shall be of specified make as approved and the following shall generally be provided at the time of manufacture;

- A slot for the overflow shall be 6.3 cm (2.5") long and 13 mm (0.5") deep so designed as to facilities cleaning.
- Soap tray or sinking shall be provided as to drain into the basin.
- Tap holes shall be square to fit pillar taps shall be bevelled around the opening. They shall be so situated as to allow supply pipes to be clear of waste and vent pipes and shall have enough space to prevent the users striking the head on the tap.
- Waste hole shall have a minimum diameter of 6.3 cm (2.5"). The outlet shall be bevelled or rebated. The hole shall be square in shape and each side shall be 2.86 cm (1-1/8") length.
- Plug chain stay hole shall not be lower than the over flow slot. Back skirting shall be true to receive splash back.
- Stud slots shall be monolithically cast with the wash basin. These shall receive the brackets on the inside of the basin, shall be so situated that the brackets remain 5 cm (2") away from the face. These shall not exceed 13 mm (1/2") in dia 8 mm (5/16") in height and shall be 13.5 cm (12") from the back of the basin to the centre of the side.

b) Brackets

The length of the brackets shall be such as to enable 10 cm (4") embedding in the wall or fixed to the wall with the help of screws. Bracket shall be of painted iron on white porcelain enameled. c) Pillar Taps

Pillar taps shall be manufactured from gun metal and shall be chromium plated. These shall be of screw type with jam nut. Internal dia of the tap shall be 13 mm (1/2").

d) Plug and Chain

Plug shall be of rubber. The diameter of the plug shall be such as to fit snugly in the waste hole. The chain shall be of brass, chromium plated, one end fixed to the plug and the other held in the chain stay hole.

e) Combined (Mixes) Supply and Waste Fitting

This shall comprise of 13 mm (1/2") combine taps with discharge nozzle and 3.17 cm (11/4") pop up waste. Waste outlet shall be screwed 3.17 cm (1-1/4") to B.S pipe male. All of these fittings shall be of gun metal with chromium plating.

f) Waste Pipe

This shall be either of PVC, nickel or C.P Brass and shall have diameter to fit at the bottom of the waste fitting flange. Its length shall extend from the bottom of waste flange to the floor.

g) Pedestal

Pedestal shall conform to the corresponding specifications of wash basin for composition, manufacture and quality. It shall be completely recessed at the back for the reception of supply and waste pipes. It shall be such that the basin is tightly and adequately supported and shall be so arranged that the height from the floor to the top of the rim of basin is 79 cm

(31"). The Wash Basin shall be supplied complete with fittings and accessories as specified.

h) MIRROR (LOOKING GLASS)

One beveled edge glass mirror of first class quality and make as specified securely fixed on bard board packing required to be fixed on the wall for wash basin shall be at least 6 mm thick and shall be of requisite dimensions.

i) KITCHEN SINKS a) Sinks

Kitchen sink shall be stainless steel or glazed earthenware of approved make, single or double bowl with integral drain board. The sizes of the sinks shall be either 61 cm x 45 cm x 25 cm (24"x18"x10") or 51 cm x 101 cm x 25 cm (20"x40"x10") or 51 cm x 122 cm x

25 cm (20"x48"x10") or 82.5 cm x 4.5 cm x 2.5 cm (33"x18"x10").

b) Brackets

The Brackets shall be either of such a length as to enable 10 cm (4") embedding in the wall or shall be such as to be fixed to the wall with the help of screws. The bracket shall be of painted iron or porcelain enameled.

c) Pillar Taps

Pillar taps shall be manufactured from gun metal and shall be chromium plated. These shall be of screw down type with jam nuts. Internal diameter of the taps shall be 13 mm $(1/2^{"})$. **d) Plug** The rubber or vulcanite plug shall fit in the waste pipe.

e) Waste Fitting Flanges

The waste fitting flanges shall be 85 mm (3-3/8) diameter, the tail 87 mm (3-1/2") long, screwed with 37 mm (1-1/2") B.S parallel thread and the sliding flange of back-nut of 81 mm (31/4") diameter.

f) Waste Pipe

This shall be either of PVC, nickel of C.P Brass and shall have diameter to fit at the bottom of the waste fitting flange. Its length shall extend from the bottom of waste pipe flange to the floor.

15.3.2 WATER CLOSETS

a) European Type Water Closets

The W.C shall be pedestal type white glazed earthen ware or of color as specified durable non-absorbent material with a water pool of good effective seal not less than 5 cm (2"). There shall be no sharp angles, the surface shall be so rounded as to be easily cleaned. The closets shall be of syphonic action or washed down type or as directed by the Engineer-in-Charge. Four holes 6 mm (0.25") shall be provided in the pedestal for fixing the W.C to the floor.

b) Indian Type Water Closets (Orisa Type W.C)

The water closets shall be of glazed earthen ware of color as specified nonabsorbent durable material. There shall be no sharp angles, the surface shall be so rounded as to be easily cleaned. The closets shall be embedded below the flow in lean concrete with its stop level with the floor. The foot rest shall be either integral part of the W.C or shall be provided separately in which case shall be of the same material as the pan.

c) Trap

The trap P or S for European type W.C shall be self- cleaning with a minimum water seal of 50 mm

(2") and made of the same materials as the pan. For squatting type W.C it shall be of cast iron.

d) Seat

The seat for the European type W.C shall be of approved quality backlite plastic seat with lid hinged and fixed to the closets by pillar bolts. The hinged device and pillar and nuts shall be of non-corrosive material. The pillar bolts shall be 6 cm (2-3/8") long and shall be held securely by the nuts underneath the pan seat plugs. The backlite seat should have rubber buffers securely fixed to the under-side to prevent damage to the pan. The seat cover shall be of the same material as that of the seat. The backlite cover shall have rubber buffers.

e) Flushing Cistern

i) Low Level Flushing Cistern

The low level cistern shall be of 10 liters (2.9 gallons) capacity. It shall be either of glazed earthen ware or PVC as approved by the Engineer-in-Charge, complete with all internal fittings. The bottom of the cistern shall be 30 cm (2.5 feet) above ground level.

The inlet to the cistern shall be controlled by 13 mm (1/2") ball wall and 13 mm (1/2") stop cock both made from gun metal or brass. The cistern shall be silent filling with an over flow arrangement.

The cistern shall be supported on M.S or C.I cantilever brackets and painted with approved enamel paint with 10 cm (4") support in the wall or it may be attached to the wall with the help of rowl plugs.

The flush pipe shall be 30 mm (1-1/4") G.I or PVC painted with approved paint. Moulded rubber cone shall be provided for connection with the pan.

ii) High Level Flushing Cistern

High level cistern shall be manufactured from cast iron or pressed steel. It shall be painted with corrosion resisting paint. It shall discharge at the rate of 9 liters in 5 seconds.

The inlet to the cistern shall be controlled by 13 mm (1/2") ball wall and 13 mm (1/2") stop cock both made from gun metal or brass. The cistern shall be silent filling with an over flow arrangement 5 ft. - 6 inches from top of pan to bottom of cistern unless otherwise.

The cistern shall be supported on M.S or C.I cantilever brackets on wall at 5 ft. 6 inches from top of pan to bottom of cistern unless otherwise shown on drawings or approved by the Engineer-in-Charge and painted with approved enamel paint with 10 cm. (4") supports in the wall.

The flush pipe shall be 30 mm (1-1/4") G.I or PVC painted with approved paint. Moulded rubber cone shall be provided for connection with the pan.

The flush shall be operated by pulling a chain handle preferably by a thin rod with as few joints as possible.

a) Soil Connection

Ordinarily in case of European type W. C the closet shall have trap above the floor and the connection with the soil pipe through an external wall.

b) Size of Closet

Ordinarily the closet shall be 40 cm (16") on shorter side. For schools, nurseries 35 cm (14") 30 cm (12") and 25 cm (10") be adopted as per instructions of the Engineer-in-Charge.

c) Connection of Water Closet with Soil Pipe

If the trap is of earthen ware, it shall be connected with the water closet with 1:2 cement sand mortar joint. If the trap is of cast iron, it shall be connected with gaskets and 1:2 cement sand mortar joint.

d) Connection between Trap and Soil Pipe

Soil pipe is the pipe leading from trap to manhole.

If the trap is of earthen ware and the soil pipe is of cast iron then it shall be connected through C.I piece the joints between earthen ware and C.I piece be as per para (h) above. If the trap is of C.I it shall be connected with C.I soil pipe with ordinary lead metallic joint through a C.I connecting piece.

15.3.3 TOILET ACCESSORIES

a)TOILET PAPER HOLDER

The toilet paper roll holder shall be wooden/ plastic with either glazed earthenware or CP brass or plastic brackets and screws etc and shall be fixed in the wall adjacent to water closet. **b)SHOWERS**

A shower head shall consist of corrosion resisting cast or fabricated sheet metal rose having perforations and shall be adjustable to give varying degrees of spray. Shower unit shall be complete with or without hot and cold water mixing arrangements and stainless steel rigid or flexible pipe extension and an additional low down water trap.

C) TAPS, COCKS AND MUSLIM SHOWER

All the taps, cocks and muslim shower shall be of brass, gun metal or other equally suitable corrosion resisting alloy conforming to BS 1010 and shall be chrome plated. The nominal size specified shall be the nominal bore of the seating. The water area of the way throughout the body shall be not less than the area of a circle of diameter equal to the nominal size of tap/cock/muslim shower. Washers for cold water cocks shall be of specially selected leather, rubber asbestos composition or other equally suitable material.

Washers for hot water cocks shall be of good quality fibre, rubber – asbestos composition or other equally suitable material. Every tap/cock shall be tested, complete with its component parts, to a hydraulic pressure of at least 1.96 MPa (284.4 psi). During test it shall neither leak nor sweat. The connecting pipe of muslim shower shall be of C.P Chain or of make approved by the Engineer-in-Charge.

d.) TOWEL RAIL, SOAP DISH& TUMBLER HOLDER

The towel rail shall be ³/₄ inches round or square C.P brass or stainless steel rod with end brackets and screws of similar material. Soap dish shall be straining type heavy duty glazed earthen ware, chromium plated stainless steel or plastic complete with screws. Tumbler holder shall be of glazed earthen ware, chromium plated, stainless steel or plastic complete with screws. Tooth brush holder with tooth paste dish shall be of glazed earthen ware, chromium plated stainless steel or plastic complete with screws etc

e) ABLUTION TAP/ SPRINKLER

Adjacent to the water closet, a water connection of ½ inch diameter for ablution will be either a C.P brass water tap or a water sprinkler with flexible pipe armoured with stainless steel strip.

f) GLASS SHELVES

Glass shelves may be provided below the mirror above the wash basin. The length of the shelf shall depend on the size of the mirror its width shall be 5 inches (130 mm) & thickness

6 mm and shall be held by 2 Nos. CP brackets. The shelf may be provided with CP railing.

15.4 MEASUREMENTS

All fixtures shall be measured in numbers

15.5 VALVES

A. General Requirements

Supply and install, wherever shown on the drawings and as specified herein, all valves and specialties. In addition to valves proper, this section is applicable to the strainers, safety valves, automatic air vents, float valves, etc,

The drawings indicate locations of major valves only. This does not limit the Contractor's responsibility to supply and install all valves and specialties specified separately under equipment or systems and in full compliance with the requirements of this section and the following stipulations:

- a. Valves shall be designed for a working pressure of not less than 125 psi steam working pressure rating and 200 psi cold water non-shock pressure rating unless otherwise specified.
- b. Valves 2" diameter and less shall be bronze, threaded ends.
- c. Valves 2 1/2" diameter and larger shall be cast iron, flanged ends.
- d. Valves on fire service pipes are to be of the indicating type.
- e. Unless specifically stated otherwise, valves shall be of the same size as the pipes on which they are installed.

Whenever the pipe size on which valves are to be installed is larger or smaller than the equipment connection provided, an enlarger or reducer shall be first installed at the equipment connection to the required pipe size, after which the valves can be installed

- f. A conical union shall be supplied and installed with each threaded valve.
- g. Install silent check valves on pump discharge pipes.
- h. Approved Manufacturers: As per specified or approved equal.

B. Gate Valves

Supply and install, wherever shown on the drawings and as specified herein, all gate valves.

Each gate valve shall conform with the following requirements:

- a. Bronze gate valves shall have bronze body and trim and shall be non-rising stem, screwed bonnet and solid wedge disc.
- b. Cast iron gate valves shall have cast iron body and shall be inside screw, non-rising stem, bolted bonnet, wedge disc and bronze trimmed.

C. Globe Valves

Supply and install, wherever shown on the drawings and as specified herein, all globe valves.

Each globe valve shall conform with the following requirements:

- a. Bronze globe valves shall have bronze body and trim and shall be inside screw, rising stem, screwed bonnet and renewable composition disc.
- b. Cast iron globe valves shall have cast iron body and shall be outside screw and yoke, rising stem, bolted bonnet, renewable bronze disc and seat ring and bronze trimmed.

D. Check Valves

Supply and install, wherever shown on the drawings and as specified herein, all check valves.

Each check valve shall horizontal or vertical lift, non-slam type and shall conform with the following requirements:

- a. Bronze check valves shall have bronze body and bronze trim and shall be screwed bonnet and renewable composition disc.
- b. Cast iron check valves shall have cast iron body and shall be bolted bonnet, renewable bronze disc and seat ring and bronze trimmed.
- c. Silent check valves 2" diameter and under shall be non-slam, spring loaded, screwed, with bronze body, seat and disc, 18-8 stainless steel spring with body having 300 psi working pressure rating.
- d. Silent check valves 2 1/2" diameter and above shall be non-slam, spring loaded, flanged, with cast iron body, bronze seat and disc, 18-8 stainless steel spring, with body having 250 psi working pressure rating.

e) Strainers

Supply and install, wherever shown on the drawings and as specified herein, all strainers.

Each strainer shall conform with the following requirements:

a. Strainers 2" diameter and under shall be bronze body, 150 psi steam working pressure, screwed, "Y" type with 20 mesh stainless steel screen and screwed end-cleaning cap with 1/2" tapped hole for blow down valve.

b. Strainers 2 1/2" and larger shall be flanged, cast iron body, 125 psi steam working pressure "Y" or basket type with 20 mesh stainless steel screen and bolted end-cleaning cap with 3/4" diameter tapped hole at bottom for blow down valve.

f) Float Valves

Supply and install, wherever shown on the drawings and as specified herein, all float valves.

Each float valve shall conform with the following requirements:

- a. All bronze construction including levers and arms suitable for 150 psi cold water working pressure.
- b. Balancing piston type flow control mechanism.
- c. Adjustable bronze rod.

d. Copper float.

g) Safety Valves

Supply and install, wherever shown on the drawings and as specified herein, all safety valves. Each safety valve shall conform with the following requirements:

- a. Bronze body and trim, suitable for 150 psi steam working pressure.
- b. Adjustable, spring loaded relief mechanism testing arm.
- c. Spring pressure adjusted locknut.
- d. Relief outlet for piped connection.

Setting of safety valves shall be at 125% of the system operating pressure. After adjustment, the adjusting screw shall be locked by an adequate lead sealed wire.

h) Expansion Joints

Supply and install, wherever necessary and as specified herein, all expansion joints.

Expansion joints shall be installed on piping to relieve expansion stresses and shall be located at all structural expansion joints and on all straight runs of pipes at 30 meters intervals.

U-bends expansion joints may be accepted under certain conditions after written Engineer's approval.

Each expansion joint shall conform with the following requirements:

- a. Pack less bellows type, monel metal for pressure pipes services suitable for 150 psi steam working pressure.
- b. Packing type for gravity piped.
- c. Expansion joints shall have screwed flanged or welding ends as required for the pipe size and system served.

I. Automatic Air Vents (AAV)

Supply and install, wherever shown on the drawings and as specified herein, all automatic air vents.

Each automatic air vent shall be completed as specified herein:

- a. Cast iron body.
- b. Standard float.
- c. Single lever orifice vent.
- d. Vent test cock.
- e. Isolating valve.

J) Hose Bibs (HB)

Supply and install, wherever shown on the drawings and as specified herein, all hose bibs.

Each hose bib shall conform with the following requirements:

- a. All brass, chrome plated construction.
- b. 3/4" threaded end connection with serrated hose bib nipple for 3/4" hose connection.

K) Flexible Connections

Supply and install, wherever shown on the drawings and as specified herein, all flexible connections.

Flexible connections shall be installed on all pipe connections to rotating equipment. Each

flexible connection shall conform with the following requirements:

a. Seamless bronze tubing with annular corrugations covered with high tensile bronze braid suitable for 200 psi cold working pressure. Screwed ends for pipes 2" diameter and smaller and flanged ends for pipes 2 1/2" diameter and larger.

15.6 MEASUREMENTS

Float Valve, Level Controller, Flow Switch, Fire Hydrants shall be measured in numbers

15.7 INSTALLATION OF FIXTURES

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Stamp & Signature

- 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 painted so that there is no chance for dirt or vermin to collect.
- ii) Where practical, all pipes from fixtures shall be run to the nearest wall.
- iii) Where 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.
- iv) 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 center to any side wall. No urinal shall be set closer than 300 mm from its center to any side wall or partition nor closer than 1200 mm center to center. No wash basin shall be set closer than 100 mm to the side wall or partition nor closer than 600 mm center to center.
- v) The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow.
 - vi) All cuttings and holes shall be made good.

16.0 SEWERAGE

SCOPE

The work covered by this section of the specifications consists in furnishing all reinforced concrete pipes, plant, labour, equipment, appliances and materials and in performing all operations required for installing and testing the sewer pipes in strict accordance with the specifications of this section and the applicable drawings and subject to the terms and conditions of the contract.

16.1.0 RELATED WORKS SPECIFICATIONS

- Section 3 Earthwork
- Section 4 Plain & Reinforced Concrete

16.1.1 SEWER LINES

MATERIALS

All materials used in the manufacture of reinforced cement concrete pipes for use shall conform to ASTM Designation C-76-03 or latest revision .

16.1.2 NON-REINFORCED CEMENT CONCRETE PIPES

The non-reinforced cement concrete pipes shall conform to ASTM C-14, latest revision Class II equivalent. Pipe ends shall be thus tongue and groove or bell and spigot. The physical dimensions shall be as described in applicable provisions of ASTM C-14.

16.1.3 REINFORCED CONCRETE PIPES

16.1.4 CLASSES OF PIPE

The reinforced cement concrete pipes to be furnished and installed shall be of the strength

Class II or specified otherwise on the Drawings.

Following technical criteria shall be adhered to:

Class of Pipe : Class-II

Concrete Strength : 4000 Psi (Cylinder Test)

The design requirements for these classes of reinforced cement concrete pipes shall be as described in ASTM Designation C-76, Table 1 to 5 for the respective strength classes. Unless otherwise called for in other parts of these Technical Specifications or as ordered, all reinforced cement concrete pipes shall comply with the Wall-B design requirements as set forth in said Table 1 to 5 of ASTM Designation C-76-82 or latest revision.

For pipes smaller than 12 inches dia BSS 556, Class-L shall be strictly followed:

16.1.5 BASIS OF ACCEPTANCE

Acceptance of reinforced cement concrete pipes will be on the basis of three edge bearing and material tests as per ASTM Designation C-76-79 or latest revision and inspection of manufactured pipes for defects and imperfections. The Contractor shall bear the cost of such tests and pay fees etc., and also pay for the carriage of such samples and all other expenses contingent to tests.

16.1.6 PIPE DIMENSIONS

The internal diameters and wall thicknesses of reinforced concrete pipes under this contract shall be as set forth in ASTM Designation C-76-82 or latest revision in Tables 1 to 5 for "WallB" pipes as required and shown on the Drawings.

For Class II Pipes, the Wall Thickness for various dia pipes is as under:

12 inch dia pip	be :	2.00
		inch
15 inch dia pip	be :	2.25
		inch
18 inch dia pip	be :	2.50
		inch
21 inch dia pip	be :	2.75
		inch
24 inch dia pip	be :	3.00
		inch

16.1.6 CERTIFIED DRAWINGS AND DATA SHEETS

The Contractor shall submit in triplicate, for approval by the Engineer-in-Charge certified drawings and data sheets as required to provide complete information on all concrete sewer pipes, dimensions, type and dimensions of pipe ends, joint details proposed concrete design mix for each different strength class of reinforced pipe and any other information needed to demonstrate full compliance with these specifications.

No concrete sewer pipe shall be delivered to the work site until the Engineer-in-Charge has formally approved the certified drawings and data sheets and until all test requirements called for in the respective ASTM Standard Specifications C-76 or latest revision have been met.

16.1.7 JOINTS FOR CONCRETE PIPE SEWERS

The joints for concrete pipes shall be as specified and could be as follows:-

a) Rubber Gaskets Joints

Rubber gasket joints shall be used for either tongue and groove or bell and spigot pipes.

Rubber gasket joints shall be made using specially designed rubber gaskets, made to fit the applicable tongue and groove or bell and spigot pipes and adequately tested under operating conditions.

The rubber gasket joints shall conform to all applicable requirements of the latest revision of ASTM Designation C443, entitled "Joints for Circular Concrete Sewer and Culvert pipe, using Flexible Watertight Rubber Type Gaskets" except that the test pressure need not exceed 10 feet of head at which the complete sewers shall meet the infiltration or exfiltration limits set forth hereinafter.

b) Cement Mortar Joints

Cement mortar may be used where called for. This type of joint will normally be permitted only for sewers laid above the water table. Bell and spigot joints with cement mortar shall be made as follows:

The first pipe shall be in place to the established line and grade. The interior surface of the bell (socket) shall be thoroughly cleaned with a wet brush, and a sufficient layer of stiff mortar shall be applied to the lower portion of the bell.

Tongue & groove joints with cement mortar shall be made as follows:

The first pipe (downstream) shall be in place to the established line and grade with groove upstream. The groove of the first pipe shall be thoroughly cleaned with a wet brush and a layer of soft mortar shall be applied to the groove in the entire lower half of the pipe.

The Portland cement mortar used for making joints shall consist of one part cement and one part clean sand, thoroughly mixed dry with sufficient water slowly added to give proper consistency. The mortar shall be promptly used after it is made.

16.1.8 INSTALLATION

a) Handling of Pipes

Concrete sewer pipes shall be handled with special care at all times during the manufacture, while transporting to the site of work, and while installing. Each pipe shall be carefully inspected before being laid and no cracked, broken or defective pipe shall be used in the work. Chipping of the tongue and groove or bell and spigot pipe ends, which in the Engineerin-Charge's opinion may cause defective joints, shall be sufficient cause for the rejection of any concrete pipe.

b) Excavation and Backfill

The excavation and backfill for sewer installations shall be as specified in applicable

provisions of Section 3 - Earthwork and will be paid for under separate contract items

as classified.

C) Laying of Sewers

Neither any sewer pipe nor the bedding shall be laid or placed till the alignment of the sewer and its levels and gradients have been carefully checked and tested with the trench excavation and found correct.

Each length of sewer pipe shall be checked for cracks and defects before placing in the line. Defects which in the opinion of the Engineer-in-Charge indicate imperfect placing, shall make, the pipe liable to rejection. Each pipe shall be placed carefully to line and grade and in close contact with adjoining pipe. These specifications require rejection of the work, if the sewer invert varies as much ½ inch from the proper elevation. As shown on Drawings, the bottom of the trench must be shaped to fit the pipe barrel, with holes left for the bells. If excavation has been carried below the correct grade, refilling must be
done with satisfactory materials as approved by the Engineer-in-Charge at no extra cost. The concrete pipe joints shall be of the type specified above and shall be made in accordance with the aforesaid specifications.

When laying is not in progress, the open pipe shall be closed with a tapered wooden plug to keep out foreign matter.

16.1.9 TESTING OF SEWER LINES

a) General

All sewer built shall be tested for infiltration or ex-filtration as specified below. The tests shall be made at times selected or approved by the Engineer-in-Charge. Sections of the completed sewer shall be isolated and measurements of the infiltration or ex-filtration shall be made by approved method. The contractor shall furnish all labor, material and equipment required for making the tests with no extra compensation over and above the agreed contract prices for the laying of sewer lines. **b) Infiltration Test**

The sewers which are constructed with the ground water level above the invert level of the pipe shall be tested for infiltration after the sewers have been installed and backfilling has been substantially completed. The tests and measurement shall be performed by the Contractor in the presence of the Engineer-in-Charge as follows in accordance with ASTM C 969-02.

Conduct testing from manhole to manhole or between more than two manholes. The length of main tested shall not exceed 700 ft

- i) Stop all dewatering operation and allow the groundwater to return to its normal level. Infiltration testing shall not be used unless the groundwater level is at least 2 ft above the crown of the pipe for the entire length of the test section.
- ii) Plug all pipe outlets discharging into the upstream manhole. iii) Measure the groundwater elevation and determine the average head over the test section. iv) Measure infiltration leakage at the outlet of the test section. Because leakage allowances are small, measurements are best made by either timing the filling of a small container of known volume, or by directing flow into a container for a specified time and measuring the content, or by using small weirs.
- v) If the measured rate of leakage is less than or equal to the allowable leakage in accordance with (d) hereafter the section of sewer tested is acceptable.
- vi) If the test section fails, it is not prohibited that it be repaired and retested in accordance with this practice.
- vii) The allowable leakage limit including manholes is 500 gallon/ inch of internal diameter (mile of sewer) (24 h) when the average head on the test section is 6 ft or less.
- viii) The average head on the test section is the head above the crown of the pipe at the upstream manhole plus the head above the crown of the pipe at the downstream manhole divided by two.
- ix) When the average groundwater head on the test section is greater than 6 ft. the allowable leakage shall be increased in proportion to the ratio of the square root of the average groundwater head to the square root of the base head of 6 ft.
- x) Manholes shall be tested separately and independently or with the pipeline with the allowance of 0.1 gallon (ft of diameter) (ft of head) (h). If building or house leads are connected to the main line being tested, allowance shall be made for permissible leakage in such leads.

c) Ex-filtration Test

i) Conduct testing from manhole to manhole or between or between more than two manholes.

The length of main tested shall not exceed 700 ft. ii) Determine the groundwater elevation at both ends of the test section. If the groundwater level is less than 2 ft above the crown of the pipe measured from the highest elevation of the sewer, the ex-filtration test shall be used.

- iii) Plug all pipe outlets discharging into the upstream manhole and the test section outlet. Fill the sewer line with water.
- iv) At the upstream manhole the test head shall be established as minimum of 2 ft above the crown of the pipe, or at least 2 ft above existing groundwater, whichever is higher.
- Allow the pipe to remain saturated for a period long enough to allow water absorption in the pipe, a minimum of 4 h and up-to a maximum of 72 h. After the absorption period, refill the pipe to the required test head.
- vi) Measure the leakage loss over a timed test period. The minimum test period shall be 15 min and the maximum shall not exceed 24 h.
- vii) If the measured rate of leakage is less than or equal to the allowable leakage in accordance with (d) the section of sewer tested is acceptable.
- viii) If the test section fails, it is not prohibited that it be repaired and retested in accordance with this practice. The groundwater elevation shall be re-determined prior to a second test and the test head adjusted, if necessary in accordance with (iv).
- ix) For ex-filtration testing the allowable leakage limit including manholes is 500 gal. (in. of internal diameter) mile of sewer) (24 h) when the average head on the test section is 3 ft or less.
- x) When the average head on the test section is greater than 3 ft. the allowable leakage shall be multiplied by the ratio of the square root of the average test head and the square root of the base head of 3 ft.
- xi) Manholes shall be tested separately and independently or with the pipeline with an allowance of 0.1 gal. (ft of diameter) (ft of head) (h).

d) Allowable Infiltration or Ex-filtration

The calculated amount of infiltration or ex-filtration over a 24 hour period shall not exceed 500 gallons per inch of pipe diameter per mile of sewer which rate shall be applied to the actual sewer size and length tested to determine the allowable infiltration or ex-filtration over the 24 hour period.

If the measured infiltration or ex-filtration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs so as to reduce the leakage to less than the permission maximum stated above.

e) Cleaning of Sewer Lines

The Contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer-in-Charge prior to handing it over to the Owner.

16.2.0 MEASUREMENT

The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately.

Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

16.2.1 UN PLACTICIZED POLYVINYL CHOLRIDE PIPES

The UPVC pipes to be furnished and installed shall be of the Class B to Class E, as specified on the Drawings. The design requirements for these classes of UPVC pipes shall be as described in Pakistan Standard Designation PS 3051 or British Standard BS 3505.

16.2.2 CERTIFIED DRAWINGS AND DATA SHEETS

The Contractor shall submit in triplicate, for approval by the Engineer-in-Charge certified drawings and data sheets as required to provide complete information on all concrete sewer pipes, dimensions, type and dimensions of pipe ends, joint details proposed concrete design mix for each different strength class of reinforced pipe and any other information needed to demonstrate full compliance with these specifications.

No concrete sewer pipe shall be delivered to the work site until the Engineer-in-Charge has formally approved the certified drawings and data sheets.

16.2.3 PRESSURE TESTING

It is recommended to test the pipeline in accordance with PS standards 3051 and BS 3505.

16.2. 4 MEASUREMENT

The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed. The length shall be taken along the centre line of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately.

Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

16.2. 5 MANHOLES

16.2.6 MATERIALS

Portland cement concrete, and other materials shall meet the specified requirements of the relevant sections of the specifications, listed under clause 25.2 and elsewhere as necessary. Cast iron frame shall conform to the specifications as per B.S.S. 497, Manhole steps shall be of galvanized mild steel.

16.2.7 CONSTRUCTION REQUIREMENTS

Manholes shall be constructed built on 1:2:4 concrete base slab and as specified. The cover slab shall be 1:2:4 reinforced cement concrete, fitted with cast iron frame which shall have reinforced cement concrete cover as shown in the drawing. Reinforcement and concrete shall conform to the requirements or Section 4 – Plain & Reinforced Concrete. The outside and inside of the walls shall be plastered (½ inch thick) with 1:3 cement sand mortar and two coats of hot PB-4 bitumen shall be applied outside. At the bottom of manholes for sewers, a proper channel as per Drawings, shall be constructed in the whole length of the manhole along the centerline of the sewers, to lead the sewage from one sewer to the other. Galvanized mild steel steps shall be installed at 12 inches interval inside the manhole during the construction of the manhole walls. Cutting holes

into the wall for the steps after construction will not be permitted. Top rung shall be 18 inches below the manhole cover and the lowest not more than 12 inches above the benching (floor).

Depth of manhole shall be from invert level of sewer to the top of manhole.

Where specified cast iron manhole covers conforming to the dimensions and weights as shown on drawings shall be used.

16.2.8 DROP MANHOLE

The Contractor shall construct drop manholes wherever shown in the drawings or ordered by Engineer-in-Charge. The Contractor shall make the drop connection as shown on the drawings or ordered by the Engineer-in-Charge.

16.2.9 MEASUREMENT

The manhole covers shall be enumerated under relevant items.

Manholes shall be enumerated under relevant items. The depth of the manhole shall be reckoned from the top level of C.I. cover to the invert level of channel. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.

CHAPTER-17 ELECTRICAL WORKS

17.1 GENERAL

17.1.1 SCOPE

The work shall include furnishing of all labour, materials, equipment tools and plants as required and providing the internal electrification and other works as specified consisting of but not limited to conduits and pipes, wires and cables, wiring fixtures, lighting system, power distribution, fans, fittings, earthing system. The Contractor shall execute the works as shown on the Drawings specified herein and or as directed by the Engineer-in-Charge, and shall be responsible for proper functioning, testing, commissioning and satisfactory operation and performance during the maintenance period.

The Tender drawings, Specifications and bills of Quantities are to be considered as supplementing each other to jointly define and describe the Scope of work.

17.1.2. CODES AND STANDARDS

The work shall conform to the requirements of the following Codes and Standards, unless otherwise specified:

BS 31-79	Steel conduit and fittings for electrical wiring.
BS 3505-82	Un-plasticized PVC pipe for cold water services
BS 4607-71 (P- 2)	Rigid PVC conduits and Conduit fittings
BS 4752-77	Circuit breakers
BS 6004-84	Specification for PVC insulated cables for electric power and lighting.
BS 6360-81	Specification for conductors in insulated cables and cords
BS 6500-84	Specification for insulated flexible cords and cables
CP 1013-65	Earthing

17.1.3 QUALIFICATIONS

- a) The Electrification Works shall be carried out by licensed workmen authorized to undertake such works under the provisions of Electricity Act, 1910 and the Electricity Rules 1937, as adopted and modified by the Government of Pakistan from time to time and registered with Pakistan Engineering Council PEC under relevant Category.
- b) The installation in general shall be carried out in conformity with the Electricity Rules 1937, and the latest edition of British/Pakistan standard.
- c) Any defective electrification work carried out by the Contractor shall be rectified or made good by the

Contractor.

d) The electrical works shall keep pace with the civil works and the works of any other specialist contractor. The Engineer-in-Charge shall be kept informed about the programme and the progress of work so that there is no hindrance in the progress of work at Site.

17.1.4 SUBMITTALS

The Contractor shall submit for approval of the Engineer-in-Charge:

a) All drawings of equipment, appliances, fixtures and accessories that are to be furnished under the Contract. These shall include detailed electrical drawings, wiring diagram, foundation details, etc. for all electrical switchgear, fuse gear and all other systems.

Drawings and data for each equipment to be furnished before commencement of fabrication and manufacture. The drawings to be supplied by the Contractor shall be as follows.

- b) Manufacturer's installation, operation and maintenance manuals wherever applicable.
- c) Specimens of all wiring accessories, fittings, fixtures, conduits, pipes, wires, cables and all the materials to be incorporated into the Works along with specifications of each.

17.1.5 GUARANTEE

The Contractor shall furnish written guarantee against performance of each equipment. Such guarantee shall be for replacement and repair of a part or whole equipment which may be found defective in material or workmanship. The guarantee shall cover a minimum period of 12 months after commissioning of the equipment.

17.1.6 SHOP DRAWINGS

The Contractor shall provide following shop drawings for approval of the Engineer, well in time before commencement of work :

- a.) Complete Conduit route between Distribution panels.
- b.) LT Panel and distribution boards
- c.) Equipment lay outs in Electrical and IT Room, including incoming and out going race ways & Connections.
- d.) External Routes of LV and ELV services including Conduits and Man holes /Chambers.

17.1.7 RECORD / AS BUILT DRAWING

The Contractor Shall submit the as built drawing in triplicate with Soft Copy for which no additional

payment shall be made. The drawing shall provide an accurate and complete record of the work as

installed.

17.1.8 CLEARING & PROTECTION

After Completion of the Project, the Contractor shall clean the exterior surface of equipment and fixtures including Concrete and Paint residue.

The Contractor shall protect the completed work from damage through out the contract period. Deliver all the equipment & panels with Standard factory finish or as specified.

17.1.9. TEST, ACCEPTANCE & CERTIFICATES

All tests necessary and directed shall be performed before final acceptance of work in

presence of the Engineer.

17.2 PRODUCTS

17.2.1 CONDUIT PIPES

a) PVC Conduit Pipe

The conduit for wiring of lights, socket outlets and other systems shall be made of PVC conforming to BS 3505 Class-0 electrical grade.

The conduit shall have following wall thickness and standard weights:

Pipe dia.	Weight / metre	Wall thickness
20 mm	0.111 kg	1 to 1.3 mm
25 mm	0.148 kg	1.1 to 1.4 mm

Bigger diameter PVC pipes shall conform to BSS 3505 and shall be Class-B which can withstand pressure of 6 Kg/ Sq.cm.

b) Steel Conduit Pipe

Steel conduit shall conform to BS 31. The conduit shall be enamelled with good quality noncracking and non-flaking black paint. Pipe bigger than 25 mm in dia shall be MS galvanized both inside and outside and shall conform to BS 31.

c) Flexible Pipe

Flexible conduit shall be spiral interlocked type made of steel strip construction and coated with

zinc. d) PVC Pipe and Accessories

The PVC pipe shall be rigid. All pipes shall be electrical grade, unless otherwise stated on drawings or bill of quantities. The buried PVC pipe should be able to withstand the external load acting upon it by continuous movement of heavy duty vehicles such as trucks. Cranes, forklift, etc. Where pipe change direction, manufactured smooth bends shall be used. Bending of pipes by heating or otherwise will be allowed in special cases only where bends cannot be installed as approved by the Engineer-in-Charge. The use of sharp 90-degree bends and tees will not be allowed. The bends shall conform to same specifications as given for PVC conduits for joining of pipe all precautions and procedures recommended by manufacturer shall be followed.

17.2.2 CONDUIT ACCESSORIES

- a) Junction boxes shall be of the similar quality and properly sized to perfectly matched with the sizes of the conduit to which these are installed. Each junction box shall be provided with one piece cover which shall be fitted on the box with chromium plated screws.
- b) Conduit accessories such as switch boxes, socket outlet boxes, pull boxes and inspection boxes shall be made of 16 SWG sheet steel having dust proof covers. All boxes shall have required number of conduit entry holes and earth terminals for connecting E.C.C. 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.
- c) Manufactured smooth bends shall be used where conduit changes direction. Use of sharp 90 degree bends and Tees is prohibited. Bends shall have enlarged ends to receive the conduit without any reduction in the internal diameter of the PVC pipe.
- d) All accessories e.g. boxes, couplings, bends, solid plugs, bushes, reducers, checknuts etc. shall be equal in quality to the specified conduit.
- e) Where inspection boxes occur in floor slabs a special non-ferrous metal floor trap shall be required.

17.2.3 LT. CABLES

a) The Low Tension cables shall be manufactured to the requirements of B.S. 6004, B.S. 6500, B.S. 6346 or VDE 0271 and rated at 250/400, 300/500, 450/750 and 600/1000 volts as the case may be. The cables shall be manufactured by M/s Pakistan Cables limited, Fast Cables, Pioneer cables or M/s

Newage Cables limited or equivalent as approved by the Engineer-in-Charge.

- b) The conductors shall be annealed copper conductors single or standard, circular or shaped as the case may be, conforming to B.S. 6360.
- c) The conductors specified for use in the cables shall be of at least 98% IASC conductivity.

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- d) 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.
- e) On all multi core cables proper markings for core identification shall be provided according to B.S. Specifications.
- f) Power cables shall be multicore cables, insulated and sheathed, armored or unarmored as required.
- g) Complete identification of the cable shall be embossed on the final over-sheath of the cable at every metre length.
- h) All flexible cables shall have multi-stranded copper conductors insulated with PVC insulation. Where flexible cables are liable to rough handling, they shall have PVC sheath.
- i) The following tests if required shall be carried out by the manufacturers:
 - -Dielectric Strength Test
 - -Instantaneous and long time break down strength test Temperature rise test High voltage test.

Test certificates covering all these tests shall accompany the cables supplied by the Contractor.

After carrying out the tests as laid down in these Specifications both ends of the cables shall be scaled at the manufacturer's works. **17.2.4 WIRING ACCESSORIES**

a) Switches

i. ONE-WAY SWITCHES - INDOOR TYPE:

Switches for controlling light and fan points shall be single pole, rated for 5 Amps, 250 Volts A.C. The body of the switches shall be of Bakelite with white face plate suitable for flush mounting on a sheet steel outlet box. The switches shall be piano type having silver tipped contacts and shall operate with snap action. Switches manufactured by an approved manufacturer (M/s CLIPSAL, LEGRAND, BOCH or equivalent approved by the Engineer-in-Charge shall only be used.

- a. Unless otherwise specified, wherever switches control only the light points, these shall be plate type gang switches installed on common outlet boxes.
- b. Where specified metal front plates shall be used with single switches, the plate shall be finished in golden matt colour or as otherwise directed by the Engineer-in-Charge.
- c. For locations where switches and fan regulators/Dimmer are installed together, single switches shall be grouped and fixed on 4 mm thick plastic sheet screwed to a sheet steel box of appropriate dimensions. Except for switches controlling light points, all single switches for fans, sockets, etc., shall have identification symbols on the operating levers.

ii. TWO-WAY SWITCHES – INDOOR TYPE:

Two-way switches for control of lights shall be of same make and specifications as for One-way switches except these shall be of use to control light circuit from two different locations.

SCREWS:

The fixing of switch plate on outlet boxes shall be by means of flat head countersunk galvanized screws with the head of the screw finished flush with the surface of the plate.

SWITCHES - OUTDOOR USE/WEATHER PROOF:

The switches shall be pole rated for 5 Amps, 250 Volt with cast iron or steel body and gasketed cover. The conduit entry hole in the body shall have long threads to provide watertight fitting. Sealing compounds for water-tight connection shall be used at conduit entry in the body of the switch. **b)** Switch-Socket Outlets

Switch socket units shall be combined 2 and 3 pin 5 Amp or 3 pin 15 Amp 250 Volt A.C. molded type with switch and socket on white face plate conforming to the requirements stated above for switchesindoor type. The outlets shall be heavy duty type suitable for mounting on sheet steel outlet box. The 3 pin 15 Amps sockets shall have shrouded live contacts and be designed such that the earth pin of 3 pin plug is engaged to socket earth before mating of live contacts.

Where metal plate switches are installed, the outlets shall also be provided with front plate of similar design as the switches.

In general use of 2 pin 5 Amp 250 Volts socket outlets shall be avoided. Where such outlets are specifically required, these shall conform to the Specification of switches and/or switch socket outlets as applicable.

The 2 pin/5 Amps, 250 Volts sockets outlet, if required for mounting on board in the given areas, shall be of the same shape and dimensions as the piano switches installed with it.

The switch – Socket Outlets shall be of CLIPSAL, LEGRAND, BOCH or other equivalent approved by the Engineer-in-Charge.

c) Outlet Box

The outlet boxes for installation of switches, fan regulators/dimmer and socket outlets shall be 16 SWG sheet steel or of PVC as specified having appropriate dimensions. The box shall have suitable arrangement for receiving the conduit. An earth terminal shall be provided for connecting the earth wire.

The outlet box shall be given two coats of anti-rust red oxide paint.

d) Ceiling Rose

The ceiling rose shall be suitable for 5 amps 250 volts single phase A.C. It shall have white plastic molded base plate, copper or brass terminals for wiring with 2.5 sq.mm cable. The ceiling rose shall have a cover with cable inlet hole.

The ceiling rose shall not embody any fuse terminal as an integral part of it.

e) Switches for Group Control of Lights

The switches for group control of lights shall conform to the same specifications as stated for miniature circuit breakers in section "*Distribution Boards*" of these Specifications. However, these shall not be provided with over-current protections. The switches shall be installed on sheet steel box with front plate and where stated in the Drawings.

f) Push-Button Station for Remote Control of Lights

These shall comprise of momentary contact ON - OFF push buttons, which shall control lights through contractors in L.T. Switch Boards/Distribution Boards. The push buttons shall have manufacturer furnished front plate suitable for mounting on an appropriate size sheet steel outlet box.

g) Lamp Holder

- All lamp holder shall be 2 pin type and suitable for 5 watt to 200 watt 250 volts incandescent lamp.
 Lamp holder to be used with wall bracket shall be of brass pendant with good quality of porcelain assembly for connection cable and holding lamp.
- iii. The holder of hanging lights shall be of backlite with ½" nipple to provide grip to the cord connected to the holder.
- iv. For incandescent lamp 500 watt and 1000 watts screw type brass holder with good quality of porcelain assembly shall be used. The top of the holder shall have the porcelain nipple for isolating the cable from holder.

h) Screws

i. For fixing switch plates on the metallic boxes brass machines screw flat head not less 4 mm thick shall be used.

To cover the junction/pull boxes with plastic/MS Cover galvanize machine screw 5mm shall be used.

17.3.0 ELECTRICAL FIXTURES

17.3.1 FANS

a) Ceiling Fans

Ceiling fans shall be capacitor type, Energy Saver 55~60 watts, five speed suitable for 250 volts single phase 50 Hz. The air displacement shall be 330 cubic metre per minute for 1422 mm (56") sweep. The fan motor shall be capacitor type and bearing shall be groove type to give noiseless operation.

Fan dimmers rated for 100 W, 250 Volts of approved make (PAK fans, GFC, Millat or as approved by the Engineer-in-Charge could be used.

The fan hook shall be made of 16 mm diameter mild steel rod. It should be in the form of a loop about 75 mm long and about 50 mm wide. The rod should be bent to have at least 200 mm extension on both sides for tying to reinforcement steel of slab. The fan and Dimmer shall be the first quality product from an approved manufacturer as above.

b) Wall Bracket Fans

Fan motor shall be capacitor type and bearing shall be groove type to give noiseless operation. The fan regulator shall be built-in type with high grade steel laminations and shall have five speed marks and one "OFF" mark. The fan shall be of an approved make.

c) Exhaust Fans

Exhaust fans shall be direct driven type complete with motor, angle iron frame, back draft dampers and mounting accessories. Blades shall be of steel and factory adjusted for pitch. Blades of back draft damper shall have a link rod and the design shall be such that damper remains in full open position without rattling when the fan is operating.

17.3.2 LIGHTING FIXTURES

a) Incandescent Light Fixtures

The glass globes/shades/diffusers of the incandescent light fixtures shall be of first class quality glass free from any air bubbles or voids. The glass shall generally be of opal white colour unless otherwise specified.

Surface mounted fixtures shall have white stove enamelled sheet steel body. It may also be satin brass or aluminium anodized finish as required. The fixing holes shall match the outlet box. Wall bracket light fixtures shall have back plates with matching holes of the outlet box and decorative finish as required.

All light fixtures shall have bi-pin brass lamp holders and LED Bulbs of approved type and make and shall be from an approved manufacturer conforming to BS 161. Light fixtures clear or frosted, shall have a minimum useful life of 1000 hours.

b) Fluorescent light Fixtures

All the light fixtures shall have LED lamps of the wattage specified. The fluorescent lamp shall be either 600 mm - or 1200 mm and the colour shall generally be day light, cool day light and/ or warm white with an average output pf 2600 lumens + (5%) for 1200mm and 1030 lumens (+ 5%) for 600mm. The fluorescent lamps shall be from an approved manufacturer conforming to BS 1853 and having a minimum useful life of 5000 hours.

The manufacturer shall be called upon to guarantee a trouble free life of 3 years, effective from the date of Completion Certificate.

The internal wiring of the light fixture shall be carried out at manufacturer's factory with heat resistance wires of size not less than 1.5 mm square.

The louvers of light fixtures shall be made of anodized aluminium and/or moulded plastic. The diffusers shall be made of acrylic perspex with a minimum sheet thickness of 3 mm.

The body of the light fixture shall be white or grey stove enamel as required. The industrial reflector shall have white stove enamel finish inside and grey / green stove enamel finish outside.

Appropriate-sized bushed entry holes and fixing holes shall be provided. The thickness of the sheet steel used in the fabrication of the body and reflector shall not be less than 20 gauge.

The materials for louvers and paint of metal parts shall not deteriorate due to ultra-violet radiation from lamp with a minimum guarantee of 5 years. Pendent type fixtures shall have 2 Nos. 13 mm dia chromium plated pendent tubes for suspension or as per detail shown on the Drawings.

17.4.1 MAIN LT. SWITCH BOARD

a) General

The LT. switchboard shall be indoor type, free standing, self supporting, floor mounted, totally enclosed, sheet steel clad, dust and vermin proof, completely wired, factory assembled and suitable for operation on 3 phase 4 wire system, 415 V, 50 Hz, AC supply. The board shall be suitable for installation and capable of front attendance. The switchboard shall comprise of multi panels suitable for housing air circuit breakers, moulded case breakers or load break switches as shown on the Drawings. The switch board shall be designed to suit service conditions and ensure security and safety during operation, inspection, operation, cleaning and maintenance. The switch board shall be designed and tested to International Electro Technical Commission (IEC) recommendations. Each panel shall withstand a voltage of 2000 volts insulation level for one minute power frequency test. The switchboard shall be divided into panels and panels divided into compartments to accommodate the required number of circuit breakers of fuse switches, bus bars, instrument transformers, protective relays metres, etc.

b) Air Circuit Breakers

The Air Circuit Breaker (A.C.B) shall be triple pole of specified rating, fixed type, 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 duty for the rated current for indefinite period of time under service conditions. The circuit breaker shall have specified breaking capacity.

The A.C.B. shall conform to BS 4752. The contacts of the A.C.B. shall be heavy duty, spring charged and silver plated. Replaceable electric arc 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:

- Making capacity, breaking capacity and short time current tests.
- Mechanical and electrical life endurance tests.
- Temperature rise test.
- Power frequency withstand test. Milli volt drop test.

c) Meters

The following instruments shall be included in the main switchboard unless otherwise specified: -1 - KWH metre

- 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 96 mm or 144 mm Square dial which shall have prominent black graduations on white surface. The instruments shall be manufactured and tested in accordance with IEC Publications 51 or B.S. 89 Part 1. d) Moulded Case Circuit Breakers

The moulded case circuit breakers (MCCB) shall be triple pole and of the rating specified on the drawings. The MCCB shall be fixed type, having trip-free, manually operated mechanism and on/off/trip position indicators. The MCCB 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 related 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 rupturing capacity of 35 KA (or as specified) and shall be manufactured and tested to IEC Publication 157-1 Part I or BS 4752 or BS 3871 Part I.

The MCCBs shall be of BOCH, CLIPSAL, LEGNOL or equivalent approved by the Engineer-

inCharge. e) Load Break Switches

The load break switches shall be on load type having quick make and quick break mechanism with spring loaded handles and ON/OFF visual indications. The load break switches shall be designed for continuous operation on rated current, rated voltage and rated frequency to BS 5419. The contacts shall be heavy duty made of silver plated copper having 98% I.A.S.C conductivity. When the operating mechanism is in "OFF" position, the fuses shall be completely disconnected. If the handle is metallic it shall be properly earthed. Electric arch chambers with replaceable arch chutes shall be provided.

The load break switches shall be of BOCH, CLIPSAL, LEGNOL or equivalent approved by the Engineerin-Charge.

f) HRC Fuses

The HRC fuses shall be manufactured and tested to BS 88. A supplement of 100% spare fuses of each size shall be supplied with the switch-board.

The fuse carriers and bases shall be made from moulded phenolic compound and/or porcelain.

g) 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, air insulated having minimum clearance of 80 mm between phase to phase and 25 mm 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 159. Bus bars and bus bar connections shall also conform to BS 159.

h) Enclosures

The enclosures shall be fabricated from 3 mm thick high grade sheet steel and shall be designed to house all the live parts which shall be accessible through front doors. The enclosures 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 grey enamel. Enclosures for each panel shall be provided with designation labels as directed by the Engineer-in-Charge.

i) Earthing

The switchboard shall be effectively earthed at two points by means of a copper strip of suitable crosssection bolted to connections near the bottom of the switchboard.

j) Accessories

Designation labels, lifting lugs, foundation bolts, interconnecting nuts, bolts, washers, thimbles, lugs, levelling shims, cable glands and/or cable end boxes for all the sizes of incoming and outgoing cable shall be supplied with the switchboard.

17.4.2 SUBMAIN BOARDS

The sub-main boards 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 the Drawings. The rupturing capacity of each component for sub-main boards shall be as specified.

All other details and specifications as provided in sub-section 17.4.1 shall be applicable.

17.4.3 DISTRIBUTION BOARDS

a) General

The distribution boards (DBS) shall be either free standing, cubicle type or wall mounting type suitable for surface and/or recessed mounting. Each distribution board (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 gasketted, 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. Two coats of top quality synthetic emulsion or stove enamel paint in battleship grey colour shall then be applied. All exposed parts of the dbs shall be covered with 5 mm thick bakelite sheet. A load distribution chart shall be provided in each db showing the areas fed by each circuit and a suitably sized pocket inside the front door shall be provided for the purpose. Each db shall be delivered complete with all instruments, accessories, rating plates as approved by the Engineer-inCharge.

Suitable cable entry glands shall be provided as required for floor mounted boards 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 gasketted compartments.

b) Components

The main components e.g. moulded case circuit breakers, load break switches, HRC fuses and instruments that are required for db's as shown on the Drawings shall be the same as described in subsection 30.2.7.

c) Miniature Circuit Breakers (MCB)

The incoming line shall have triple pole mcb's suitable for use on 415V 50 Hz, AC whereas the outgoing line shall have single pole or single phase mcb's for use on 220V, 50 Hz, AC. The ratings shall be as shown on the Drawings and/or as directed by the Engineer-in-Charge.

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 BS 3871 and shall have a rupturing capacity of 7.5 KA. The final circuit mcb, on the outgoing, shall however, be rated 5 KA. The mcb's shall be manufactured by an approved manufacturer whereas the distribution boards shall be manufactured by any approved manufacturer.

17.5.0 EARTHING SYSTEM

a) General

The earthing system shall consist of earth electrodes, earth connecting points, earthing leads, earth continuity conductors and all accessories necessary for the satisfactory operation of the associated electrical system. The earthing system shall also comply with the requirements of CP-1013.

b) Earth Continuity Conductor

The earth continuity conductor (ECC) shall be green or green/yellow coloured PVC insulated copper wire of sizes indicated on the Drawings. The ECC shall comply with the specifications as given for single core cable in Section 30.2.3. For bonding of miscellaneous metalwork, the size of ECC shall be as specified. All sockets, lugs, thimbles etc., shall be provided for a complete earthing installation. **c) Earth Electrodes**

The earth point shall comprise of a 600 x 600 x 5 mm electrolytic copper plate, tinned for protection against corrosion. The edges of the copper plate shall be chamfered. The plate shall have holes for connecting each earthing lead or tape to earth terminals. The terminals shall comprise of 16 mm dia. copper bolts and nuts and double spring washers. 13 mm dia G.I. Pipe with a tee at the top end shall be provided for watering purpose during dry season.

d) Earth Connecting Point

The earth connecting points shall comprise of tinned copper bar, rectangular in shape, having dimensions of 350x50x6mm, if not otherwise specified. Terminals for connection shall be arranged as required.

The terminals shall have brass or tinned copper bolts, nuts and washers for protection against corrosion. A hole shall be provided in the centre of the copper bar for fixing to the wall by means of 10 mm dia nut and bolt using brass or tinned copper washers.

e) Earthing Lead

The earthing lead shall connect the earth electrode to the earth connecting point. It shall be of round hard drawn bare electrolytic copper wire of the size shown on the Drawings.

f) Earthing by Earth Rods

The earth rod shall be of mild steel and shall be protected against rusting by a thick exterior layer of copper (not less than 0.33 millimeter), permanently molten or electrolytically deposited on a high strength steel core which shall provide rigidity for easy driving without bending.

g) Earth Rod Dimensions

The earth rod shall have a nominal dia of 16mm with chamfered head of $2mm \times 45$ chamfer. The overall length of earth rod shall be 3000 + 5mm.

17.6.0 LIGHTING PROTECTION SYSTEM

a) Applicable Standards/Codes

Latest editions of the following standards and codes shall be applicable for the material specified within the scope of this section.

BS 6651	:	Protection of structures against lightning
CP 326	:	Protection of structures against lightning (code of practice).
IEC 1024-1	:	Protection of structures against lightning

b) Material

i) General

The installation of lightning protection system shall comprise; -Lighting arrestors - Down/Roof conductors.

- Testing terminals
- Earth electrodes ii) Air Terminals

The Air Terminals for lightning protection system shall be solid copper to ensure good corrosion resistance. The thread should be roll formed for maximum strength, with a bronze nut. The terminal

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base and the plate type test clamp shall be cast gun metal, designed with appropriate section thickness, mechanically strong, corrosion resistant with low electrical resistance. All other accessories for fixing of air terminals to the concrete surface and/or roof conductor/down conductor shall be of copper or brass, as approved by the Engineer-in-Charge.

iii) Down/Roof Conductors

The down/roof conductors for lightning protection system shall be bare copper conductor of sizes as per approved shop drawings. All connections between metal work on the roof shall be with the same conductor sizes and material as for roof conductor. All accessories for fixing of copper conductor to concrete surface shall be of copper or brass as approved by the Engineer.

iv) Testing Terminals

For each down conductor, a testing point shall be provided. It shall be installed 1.5 meters above the finished floor level or as convenient for testing purposes and as directed by the Engineer-inCharge. The testing terminals shall have removable connections.

v) Earth Electrode

The earth electrode for lightning protection system shall comprise 3 meter long, 14 mm dia. copper clad or galvanised steel rod having flat head at drive end and pointed conical tip at the driven end. The tip shall be hardened to facilitate driving. At the top of the pipe, a clamp for bolted connections shall be provided suitable for connection to the down conductor.

a) Air Terminals

The Air Terminals shall be installed on the roof as per approved shop drawings. The terminal base shall be firmly secured to the concrete surface. It should be ensured that air terminals and/or roof conductors/down conductors shall be firmly fixed together, so that electro dynamic or accidental mechanical forces will not cause any damage to the clamping. The materials used shall withstand the electromagnetic effects of lightning current and predictable accidental stresses without being damaged.

The Contractor shall submit the fixing arrangement for the approval of the Engineer-in-Charge. b)

b.) Roof Conductor

The roof conductors shall be installed on the roof as per approved shop drawings. The copper conductor shall be firmly secured to the concrete surface by means of copper or brass clamps of approved design at a maximum interval of 1000 mm.

The roof conductor shall be connected to the copper rod by means of copper clamps. The clamp to be tightly fixed to the rod and brazed to ensure low resistance path to earth. The contact surface between copper clamp and conductor shall be cleaned, silver painted, brazed after bolting and provided with a coat of anti- corrosive paint after installation.

c) Down Conductors

The down conductor shall be installed along the shortest possible route from roof to earth electrode. It shall be secured on the surface of wall by means of clamps at a maximum interval of 1000 mm. In general, bends shall be avoided along the routes of down conductor and maximum possible bending radius will be provided at turns. All joints between conductors shall be electrically and mechanically strong and effective. Straight joints in the down conductor shall be bolted. The joint shall be given a coat of anti -corrosive paint after connection. All accessories such as nuts, bolts, washers, solder, paint etc. shall be furnished by the Contractor.

For each down conductor a removable terminal shall be provided for testing purpose at approximately 1.5 meter height. The location of testing terminals are not shown on the drawings. The Contractor must ensure that testing terminals are installed so as to facilitate testing. The testing terminals shall be bolted type and made in accordance with the specifications for straight bolted joints. The connecting earth lead from testing terminals to earth electrodes shall be continuous

without any joint. All metal work, pipes etc., at the roof and within 2 meters along the route of down conductor shall be bonded to the lightning protection system. The bonding shall be effective and approval of the Engineer-in-Charge shall be obtained for the bonding method.

d) Earth Electrode

In case the soil conditions at site permit, the earth electrodes may be installed by hammering the electrode in soil, until the top of the pipe is about 300 mm below the proposed ground level. If hammering down is not possible due to site conditions, a pit shall be first excavated in bare ground upto the required depth and electrode shall be installed upright in the pit. The excavated pit shall be backfilled in layers of 500 mm, each layer tamped and compacted. At the ground level an inspection chamber of cement concrete shall be constructed having dimensions as shown on the drawings. The inspection chamber shall have a cover supported on angle iron frame. The cover shall be approved by the Engineer-inCharge and shall finish flush with the ground level.

17.7 Fire Alarm System

17.7.0 GENERAL

17.7.1 RELATED DOCUMENTS

A. Manuals, brochures, technical submittals and general provisions of the Contract, including general and Special Conditions, apply to this Section.

17.7.2 SUMMARY

A. This section includes the intelligent addressable fire alarm and detection system for ensuring safety and asset protection.

17.7.3 SUBMITTALS

- A. Submit the product information for approval and final documentation in the quantities listed.
- B. Documents for Approval:
 - 1. Bill of material
 - 2. Technical specifications of all the material
 - 3. Connectivity diagrams
 - 4. Any variance (in case of deviation from the given specifications)
- C. Final Documents: Record documentation to include:
 - 1. Documents listed above.

- 2. Recommended spare parts list for start-up support
- 3. Instruction manual
- 4. Testing Certificates

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm with at least 15 years experience in manufacturing fire alarm detection system.
- B. Supplier is to have a local service team with available spare parts in Lahore, Pakistan.
- C. Service personnel are to have at least 10 years in the installation, start-up and servicing of the said system.

1.6 WARRANTY

A. The manufacturer's standard warranty shall in no event be for a period of less than 36 months starting from beneficial use of the equipment. Submittals received without written warranties as specified will be rejected in their entirety. Maintenance during reliability period shall also be covered in the warranty section.

17.7.2 SCOPE OF WORK

17.7.2.1 GENERAL

The contractor shall supply and test the complete fire alarm system as described herein and as shown on the plans. The system shall include Intelligent Addressable main control panel, Addressable smoke sensors, Multi/heat sensors, wiring, termination, electrical boxes, and all other necessary material for a complete operating system.

The supplier has to verify that complete installation shall confirm to the applicable sections of NFPA72, NFPA-71, EN-54 and BS-5839.

The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of storing, and downloading while the system is in operation, a second set of operating software resident in the control panels as backup in case primary operating software is corrupted. In addition, the system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operation shall be stored in a nonvolatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.

Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate changes in, for instance, sensing of normally open contact devices to sensing of normally closed contact devices or from sensing of normally open contact devices to sensing a combination of current limited and non-current limited devices on the same circuit.

The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of creating an event history of 600 events.

The activation of any system smoke detector shall initiate an alarm verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If within one minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described in the sequence of operation. If no second alarm occurs within one minute the system shall resume normal operation. The Alarm verification shall operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The Alarm verification operation shall be selectable by zone.

A manual evacuation switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, all alarm functions service conditions including the time of each occurrence.

The system shall have a single key that will allow the operator to display all alarm, troubles, and supervisory service conditions including the time of each occurrence.

The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

The system batteries shall be supervised for disabling and enabling all circuits individually for maintenance or testing purposes.

The panels shall be capable of networking upto 99 more nodes as nodes as and when required without modification of hardware except adding network cards.

17.7.2.2 SEQUENCE OF OPERATION

Upon actuation of any manual station, or automatic detector or sprinkler flow switch, or air conditioning and ventilation duct return and exhaust air smoke detector. The system is to operate as follows:

On the Main Panel the green normal LED is to extinguish and the red alarm LED is to light. The first line is to display the user specified message indicating the floor and zone that initiated. The first line is to display the user specification message indicating the floor and zone that initiated the alarm. The second line of the LCD is to indicating real time, number of messages waiting, type of alarm, zone of alarm and time the alarm occurred. Red LED corresponding to the zone in alarm in the main panel shall also be lit.

The alarm indicators on the FACP and repeater panel to continue to flash until the alarm is acknowledged. If a subsequent alarm is received after acknowledgment, the alarm is to sound again. The operator is to acknowledge the alarm by pressing a dedicated button and the buzzer is to silence provided that isn't an additional alarms the operator is to acknowledge all pending alarms before the buzzer is to silence. To reset the system the device is to be cleared first then the reset button is to be pressed.

The alarm shall consists a "slow whoop" alarm tone, for ten second. The tone shall repeat continuously (unless manually silenced) until the alarm initiating device is restored to normal and system reset. The silencing of an alarm condition is not to prevent the resounding of alarm devices if a subsequent condition occurs. A time delay feature is to be provided to sound a general evacuation alarm automatically throughout the building if the initiating alarm condition is not

responded to within a predetermined time. Visual indication at the panels, corresponding to activated voice alarm circuits is to illuminate.

17.7.2.3 POWER REQUIREMENTS

The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 230VAC power in a normal supervisory mode for a period of 24 hours with 30 minutes of alarm operation at the end of this period. The system shall automatically transfer to the stand-by batteries upon power failure. All battery charging and recharging operations shall be automatic. Contractor shall submit standby and alarm power calculations in support of the selected battery size. The batteries used for the system shall be maintenance free type.

17.7.2.4 FIRE ALARM CONTROL PANEL

The control panel shall be Intelligent Addressable type of adequate point capacity with 20% spare and the construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and display essential to operation during a fire alarm condition.

A local audible device shall sound during alarm, trouble or supervisory conditions. The audible device shall sound differently during each condition.

The following primary controls shall be visible through a front access panel:

- Eighty character liquid crystal display.
- Individual red system alarm LED.
- Individual yellow supervisory service LED.
- Silent Walktest with History Logging

The system shall be capable of being tested by one person. While in testing mode the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm. The panel shall also be capable of giving an alert alarm in case if any addressable device is not in operation or requires maintenance.

17.7.2.5 MULTIPLE ADDRESSABLE PERIPHERAL NETWORK

The system must provide communication with initiating and control devices individually. All of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:

- Alarm
- Trouble
- Open
- Short
- Device missing/failed
- Automatic environmental compensation.
- Variable Sensitivity setting
- Day & Night mode of operation
- Automatic dirty sensor indication

All addressable devices shall have the capability of being disabled or enabled individually.

Each loop to have a minimum capacity of 200 devices with detector & control modules in any combination. System that require factory reprogramming to add or delete devices are unacceptable. Each loop to have 25% spares available. Vendor to increase the no. of loops, if required.

Each addressable device must be uniquely identified by an address code interred for each device. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact. The system must verify that proper type device is in place and matches the desired software configuration.

17.7.3 -ADDRESSABLE DEVICE TYPES

17.7.3.1 GENERAL

The system control panel must be capable of communicating with the types of addressable devices specified below. Addressable Devices will be located as shown on the drawings. The system shall identify when a smoke sensor becomes too dirty to operate properly. It shall also identify sensors which are almost dirty which need cleaning before they drift beyond their selected sensitivity. In short, a review of the front panel display or the printed status report quickly identify sensor that need cleaning.

Sensitivity of the sensor shall a programmable, photoelectric shall be variable from 0.2 to 37 percent and ionization sensitivity from 0.5 to 1.7 percent. It shall also be possible to programme for timed, automatic sensitivity selection such as less sensitive during working hours and more sensitive when quite.

The panel shall provide the following features:

- Individual sensitivity selection for each sensor
- Peak value logging allowing accurate analysis for sensitivity selection
- Automatic, once per minute individual; sensor calibration check to verify sensor integrity
- Display of sensitivity directly in per cent per foot
- Multi-stage alarm operation
- Ability to display and print detailed sensor information

17.7.3.2 ADDRESSABLE SENSOR BASES

The addressable sensor bases shall contain integral addressable electronics that constantly monitor the status of the detachable photoelectric, ionization or heat sensors. Each sensors output shall be digitized and transmitted to the control panel every four seconds.

It shall be possible to use different sensor types with the same base. The base shall have integral LED for power-on (pulsing), or alarm or trouble (steady on). The bases shall be available with connections for remote LED alarm indicator or connections for supervised remote replay. The sensor bases shall be size not more than 125mm diameter.

Address of the device shall be set in the base using dip switches so that removal or replacement of the sensor head will not affect the operation of the system. Device addressed through software or address set in the sensor head are not acceptable. Soft addressable sensors are also will be acceptable subject to compliance with other requirements of the specifications.

17.7.3.3 ADDRESSABLE OPTICAL SMOKE SENSORS

Optical sensor shall use a stable, pulsed infra red LED light source and a silicon photodiode receiver to provide consistent and accurate low power smoke sensing. Seven levels of sensitivity shall be available for each individual sensor, ranging from 0.2% to 3.7% per foot of smoke obscuration. It shall be possible to select and monitor the sensitivity at the control panel.

The head be designed to allow 360 deg. Smoke entry for optimum response to smoke from any direction. A built-in screen shall keep insects from entering the smoke chamber.

17.7.3.4 ADDRESSABLE OPTICAL HEAT SENSOR

The addressable type heat sensor shall be self restoring and provide a combination of rate and fixed temperature rate compensated sensing. It shall have low thermal mass to accurately and quickly measure the local temperature at the fire alarm panel.

It shall be possible to select the rate of rise temperature detection for either 15 °F or 20 °F per minute. Fixed temperature sensing and shall be programmable to operate at 135 °F or 155 °F. It shall be possible to program these sensors as a utility device to monitor for temperature extremes in the range from 32 °F to 120 °F (optional).

17.7.3.5 INTELLIGENT OPTICAL MULTI SENSOR

The Addressable Multi Sensor gathers analog information from one photoelectric fire sensing element and one heat sensing element and converts it into digital signals. The sensitivity of the Device shall be variable. The Addressable code for the Device shall be electronically programmed and stored in the Sensor and be non-volatile. The programming of this code shall be facilitated by a digital electronic hand held Device.

•	Sensitivity	variable
•	Operating voltage	24VDC
•	Standby Condition	≤100µA
•	Alarm Condition	≤7mA
•	Transmission Method	Digital Communications
•	Maximum Humidity	93% RH- Non Condensing (at 40∘C)
•	Temperature range	-10∘C - + 50∘C
•	Smoke Sensing Element: Photo	electric - Light Scattering Principle
•	Heat Sensing Element: Fixed	temperature alarms at 135°F (57°C) ambient 3.6

17.7.3.6 ADDRESSABLE PULL STATION

They shall be manufactured from high impact red lexan. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations shall be double action type requiring smashing glass and pulling a lever to initiate an alarm.

The device shall integral electronics for constantly monitoring the status of the device and communicating the same to the control panel. Address of the device shall be set by dip switches in the associated electronics.

17.7.3.7 ADDRESSABLE DEVICE SUPERVISION

All devices shall be supervised or trouble conditions. The system control panel will be capable of displaying the type of trouble condition (open, short, device missing, failed). Should a device fail it will not hinder the operation of other system devices.

17.7.3.8 NOTIFICATION APPLIANCES

Notification appliances shall include visible, audible or Audible / visible as shown in the drawing. Audible appliance shall be loudspeaker or dc vibrating bells and the visible appliance shall be strobes. The sounders must be capable of projecting the pre-recorded voice messages. The prerecorded messages shall be in various languages i.e English , Urdu or any other as specified by the end user.

17.7.3.9 STROBES WITH SOUNDER (SINGLE UNIT)

Strobes shall be suitable for wall or ceiling mounting as shown in the drawings. Xenon flash tubes shall be 24VDC powered from the panel. Visible output shall be 30 candela. The reflective design shall provide light output in key axis directions allowing vertical or horizontal mounting. The unit shall be of red finish with white 'FIRE" lettering . Flash rate shall be 1 Hz.

17.7.4 INTEGRATION

Fire Alarm system shall be integrated with Emergency Voice Evacuation system, Access control system and Building Management system for sequential operations and status monitoring.

17.8 DATA & VOICE SYSTEM

17.8.0 GENERAL

17.8.1 DESCRIPTION:

A. The Work shall consist of furnishing and installation of voice and data communication cabling as shown on the drawings and specified herein.

17.8.2 REFERENCES:

A. ISO – International Standards Organization

ISO/IEC 11801 Information Technology – Generic Cabling for Customer Premises

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B. IEC - International Electrotechnical Commission

- IEC 60603-7 Connectors for Electronic Equipment Part 7-1 & 7-7
- IEC 60332 Test on electric cables under fire conditions
- IEC 60754 Tests on Gases Evolved During Combustion of Material from Cables

EIA/TIA 568-B.3 Optical Fiber Cabling Components (ANSI)

IEEE - Institute of Electrical and Electronic Engineers

ICEA S-83-596 Standard for Fiber Optic Premises Distribution Cable

1.3 SUBMITTALS:

С

- A. General: Submit the necessary complete sets of documentation indicating type, size, rating, style, catalog number, Manufacturers names, photographs and / or catalog data sheets for all items to ensure compliance with Specifications. This documentation shall be subject to the approval of the Owner Representative and no equipment shall be ordered without his approval for all equipment and devices, which are shown on documents (drawings, BOQ, etc). During technical submittal stage, contractor shall submit all required technical document for study and approval.
- B. Product Data: Submit manufacturer's technical product data, including:
- 1. Compliance sheet to the specification with cross reference to related items in data sheet, point by point, indicating deviations, if any, with reasons for such deviations, also indicate any extra features / specifications.
- 2. Complete one-line riser diagram(s) showing all system components
- 3. Complete description data including UL listing or any equivalent standards for all system components
- Provide all system related calculations supported by manufacturer specific software and perform all necessary calculations validating the shop drawing system distribution and related installations.
- 5. Complete description and data including related standards for all system components.
- 6. Submit Wi Fi Coverage patterns and accordingly modify, add, relocate wi fi outlets to provide full coverage of the building enabling VOIP over Wi Fi network in all building areas.

C. Shop Drawings: Provide shop drawings & Composite drawings showing equipment, device locations, labeling, part number and connecting wiring of the systems, including riser diagrams, rack elevations etc. Shop drawings shall include, but not be limited to the following:

- 1. Installation details for all system components. Installation details drawings shall show all accessories used in installation such as back boxes, glands, washers, etc.
- 2. Complete Grounding details as per system manufacturer requirements.

D. Manuals: Submit complete manufacturer Installations, maintenance and operation manuals including spare parts list for each system component, including furnished specialties and accessories. Include this data, product data, and shop drawings in the manuals in accordance with other relevant documentation.

1.4 WARRANTY:

A. The manufacturer must guarantee to the End User that the products referenced within the specific Warranty Modules (Class E System) when correctly installed in accordance with installation guidelines for a duration of 20 years

B. All components including the patch cords have to be produced by the same cabling system manufacturer to ensure warranted performances and applications against the standards.

1.6 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: The items provided under this contract will be from manufacturers that have a minimum of 5 years experience in producing the types of systems and equipment specified.

B.Installer Qualifications: Specialist subcontractor with at least 5 years of successful installation experience with projects utilizing data system similar to that required for this project. Subcontractor shall be subject to approval of Engineer.

PART 2 – PRODUCTS

2.1 SYSTEM DESCRIPTION:

A. The voice and data communication cabling shall consist of horizontal and backbone cables and connecting hardware to transport data (including LAN/WAN) and voice (telephone) system signals between related as shown on drawings. Numbers of outlets shall be as shown on drawings and documents. The Data Local Area Network (LAN) Sub-Contractor shall coordinate his work with telephone equipment SubContractor(if any).

- C. The Data Network will perform all switching and routing functions for voice, video and data services and applications. The network shall serve all IP based services such as VOIP, IP CCTV, IPTV, etc, as applicable.
- D. The Core Switches will be located at the heart of the network and shall provide very fast switching, intelligent high performance platform for deploying numerous concurrent intelligent services without degrading the overall performance of the network. The core switches shall perform various functions using various service modules for wan interfaces, security firewalls...etc. Core Switches should support MPLS and act as P-Routers.
- E. Connectivity between DC Switches and Core Switches should be based on 40G/ per BOQ/Risers.
- F. Connectivity between Core Switches and Distribution Switches should be based on 40G/ per BOQ/Risers.
- G. Access Switch: Access Switches will be located per per BOQ/Risers/Dwgs.

P. The maximum allowable horizontal cable length is 90 m. This maximum allowable length does not include an allowance for the length of 4.9 m to the workstation equipment. The maximum allowable length does not include an allowance for the length of 4.9 m in the horizontal cross connect.

Q. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

R. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

2.2 GENERAL:

A. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be of latest technology/version available at the time of installation, and has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and standards specified.

2.3 HORIZONTAL CABLING:

A. Horizontal Distribution Cable:

- 1. Horizontal distribution cable shall be Category 6.
- 2. The cable shall be a four, thermoplastic-insulated, individually twisted pairs of copper conductors; No.23 AWG, color-coded; enclosed in PVC jacket or a material.
- 3. Cable shall be designed to support the IEEE 802.3 1000Base.
- 4. All pairs must have impedance of 100 Ohms, with a tolerance of +/- 15

Ohms. In the construction of the cable cross-talk performance shall be maintained using a C3 (Central dielectric Cross-talk Cancellation) member set between the 4 pairs.

- 5. Insulators in standard Blue/White, Orange/White, Green/White, Brown/White colors must cover the conductors.
- 6. Cable shall be of latest technology/speed manufactured and available at the installation time.
- 7. Cable shall be used for horizontal run between data, voice (telephone), clock and security system outlets and floor communicable cabinet.
- 10. Meet the following electrical characteristics per consultant's recommendations (if any):

Max DC Resistance (@ 20° C) <8.5 Ω /100m

Characteristic Impedance

(no impedance averaging allowed) 1-100 MHz: 100 ohms ± 15%

100 - 750MHz: 100 ohms ± 22%

Nominal Velocity of Propagation (NVP)

LSOH – 67%

11. Provide the following 100m, 4-connector topology performance (std ref. values in grey cells):

2.4 BACKBONE CABLING:

A. Data Backbone: This backbone will link the Switches located in the Floor Distributors (FD) to the

Data network server through the Building Distributor (BD).

1. Optical Fiber Cable: The cable shall be suitable for connector manufacturer termination processes (LC, SC or ST connectors). Fiber splicing method should be used for termination of Fiber Cables using fiber pigtails manufactured by the same vendor.

Construction: Tight buffered with water blocking Aramid/Glass yarn reinforcements or tape and shall be suitable for indoor or outdoor use making it ideal for short campus links without the use of transition joints. The cable strength member shall be glass yarn laid longitudinally between the fibers

and the inside wall of the outer jacket. The cable shall be dielectric construction, i.e. with no metallic content. The cable shall be a dry construction i.e. with no gel content. The jacket material shall be waterproof LSZH with a minimum fire performance of IEC 332 part 3C.

- 2. Single Mode Fiber Optic Cable
- The Cabling system must be designed and installed according to ISO 11801 OS1 for indoor use, and ISO 11801 OS2 for outdoor use, compliant and should also meet EN50173 2nd editions and TIA/EIA 568B3. The Cable shall have 6 or 12 or 24 cores, 9.2/125 μm universal distribution cable with improved performance.
- b. Low Smoke Zero Halogen LSZH Jacket that does not give off toxic fumes in case of fire and offer flame propagation retardant properties.
- c. Shall contain a Rip Cord applied longitudinally under the cable jacket for easy cable jacket removal.
- d. Shall contain a lightweight Central Strength member located in the middle of the fibre bundles.
- e. Shall contain both colour-coded buffered fibres as well as colour- coded buffer tubes.
- f. Cables shall have length markings in 2 ft. increments.
- g. Fibre will be available in strand counts of 4, 6, 12, 24, 36, 48, 72, 96, 144 and 288.
- h. Shall meet these minimum performance parameters per standards specified above.

3. Optical Fiber Patch Panel:

a. Optical fiber Patch Panels shall be mounted in 19" frames of the cabinets. The patch panels shall be equipped with a mechanism that ensures the retention and support of incoming cables. An Earth Key shall be provided within the patch panel to earth any metallic part of the cable. The patch panel shall be designed with a sliding mechanism enabling front side installation and maintenance work to be carried out without having to remove the entire panel.

b. The patch panel shall provide facilities to recess the front connector plate deeper than the front of the 19" rails of the cabinet. This will provide sufficient bend radius for the patch cords once connected to the panel. This shall also prevent damage to the patch cords when the cabinet doors are closed.

c. Direct Termination of the connectors on to the fibers as well as splicing of pigtails shall be possible. The Patch Panel shall provide management for 1m of fiber per link after breaking the fibers out from the cable. The Patch Panel shall support the connector type specified for this installation. For multimode fiber links, these can be LC, SC and ST. The panel-mounted couplers shall be protected on the front presentation side of the patch Panel for safety purposes.

4. Optical Fiber Patch Cords

a. The Fiber adapters will be connected to the active equipment by means of duplex patch cords 2LC2LC, 2 SC-2 SC or 2 ST-2ST as per client site standard.

b. The patch cords consist of 50/125 microns fibers and a LSHF-FR jacket. The SC or ST connectors shall comply with the International standard IEC 74-13. The patch cords should be available in lengths of 2 and 5 meters.

c. To avoid mix of patch cords built around different types of fiber, cords produced with LASERoptimized fiber will be used for both OM1 and OM2 optical fiber cables. When using OM3 optical fiber cables, patch cords produced with the same OM3 fiber have to be installed.

d. Fiber cables shall interface and connect to fiber interface unit at both ends as part of the fiber contractor work.

2.5 CABINETS:

A. The metal cabinets shall have a footprint of 800x1000 mm. In the frames 19" components can be mounted by means of the standard cage nuts. The front door consists of a metal framework with hinges and a central perforated panel. The side panels and the panel in the back have to be equipped with a hinge on the left or the right in order to facilitate the access to the equipment. A 42 U cabinet is preferred providing enough space for active equipment.

B. For an orderly cord storage and easy to manage installation, the following accessories shall be used:

- Closed 1 or 2 U patch guides between the patch panels;
- Lateral cable rings installed at both sides of the frames. The patch rings can be removed very easily by rotation and have to be located on the front rails of the 19" frames in the cabinets.

The cabinets should be supplied with:

- Provide power strip with 8 * 240VAC BS 1363 electrical sockets, No ON/OFF switch, 3meter power cord and commando socket (male) at the end. Female commando outlet to be provided by the electrical contractor.
- Provide seismic kit, casters, leveling feet, and bolt down stabilization bracket for each cabinet.
- Provide Horizontal/Vertical Cable Management. 1 RU of cable management per 24 port patch panel and 1 RU above and below per 48 port patch panel.

C. Earthing has to be achieved .The cabinet and frame assembly when installed will also serve as equipotential plane so that damaging external EMI currents can be drained off. To this end, the intercabinet connections shall also be made off by extending the earth connection from cabinet to cabinet in a suite of cabinets. The suite of cabinets shall be connected to the grounding network of the building.

D. The Earth key of the cabinet must be connected to the protective earth. The dimension of the earth conductor is 6mm². If no or only a poor protective earth system is present in the building, a separate earthing to the main earth terminal of the building is required. The dimensions of the conductor should then be 16mm².

3.1 INSTALLATION:

- A. The entire system shall be installed by specialist subcontractor approved by the Engineer.
- B. Installation shall be in accordance with the approved drawings and manufacturer's written instructions.
- C. System components and appurtenances shall be installed in accordance with ISO/IEC 11801, manufacturer's written instructions and as shown on drg. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables.

- D. Horizontal Distribution Cable: The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
- E. Riser and Backbone Cable: Vertical cable support intervals shall be per manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.
- F. Data Outlets: As a minimum each jack shall be labeled as to its function and a unique number to identify cable link. Minimum of 6 inches of slack cable loosely coiled into the data outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.
- G. Unshielded Twisted Pair Patch Panels: Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.
- Fiber Optic Patch Panels: Patch Panels shall be mounted in equipment racks with sufficient ports to accommodate the installed cable plant plus 10 percent spares. A slack loop of fiber shall be provided within each panel. Loop shall be

900 mm in length. The outer jacket of each cable entering a patch panel shall be

secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically

manufactured for that purpose.

3.2 ELECTRICAL SAFETY:

A. Separation of telecommunication circuits from the building electrical system and electrical equipment shall conform to the latest publications of Articles 800-3 (a) and 820-13 of National Electric Code (NEC) / per consultant's recommendations.

B. An earth or ground shall be provided and extended to the termination box and connected to each station protector. The earth or ground shall be installed and bonded in accordance with Article 250, 800 and

820 of National Electric Code (NEC)/ per consultant's recommendations.

3.3 TESTING (per consultant's recommendation):

A. General: After installation of entire system and prior to acceptance of work, manufacturer's standard tests shall be conducted in the presence of the Engineer to show proper operation of each equipment and the system entirely. The manufacturer of the cabling system shall provide copper (Data) and optical fiber testing procedures that clearly describes the tools and settings to be used to ensure correct measurements of the system. The result of testing shall meet or exceed the requirements of ISO/IEC 11801, latest edition and ISO/IEC TR 24750.

B. Testing of Class E: 100 % of the installed horizontal links shall be tested. The testing procedure has to comply with the standard ISO/IEC 11801: 2002 for Class E, according to the procedure for "Channel or Permanent Link". The measurements shall be done using Level III testing equipment. Channel testing shall be preferred. Channels shall be tested to support 10 G 500 MHz

The complete test results of all the installed links or channels shall be collected in a certification file.

C. Vertical Fiber Testing: The procedure shall comply with the ISO/IEC 14763-3 standard. The ISO/IEC 14763 standard specifies the implementation and operation of customer premises cabling. The part 3 of this ISO document (14763-

3) Details test procedures for optical fiber cabling designed in accordance with ISO/IEC 11801:2002 and installed according to the recommendations of ISO/IEC 14763-2 (Planning and installation of customer premises cabling).

For Multimode fibers, the test procedure is based on the use of the "one-jumper method" specified by Method 2 of IEC 61280-4-1. This procedure is used for testing links for which the connector loss is a significant portion of the total link attenuation. This is the case for LAN premises links.

For Single mode fibers, the test procedure to be applied is the same and is based on the use of the "one jumper method" specified by Method 1a of IEC 61280-4-2.

Fiber-optic Tests applied to links and exclude equipment and work area cord.

OF Attenuation testing is used to verify the initial performance of the installed link. All 100 % of the installed OF links have to be tested and must pass the acceptance criteria.

The attenuation of the link is measured using the insertion loss method. This method uses an optical source and an optical power meter to compare the difference between two optical power levels.

When testing multimode optical fiber links with a Light Source and a Power Meter, this measurement kit has to be capable of operating at ...

- 850nm and 1300nm for multimode fibers (OM1, OM2 & OM3)
- 1310nm and 1550nm for single mode fibers (OS1)

The test scenario with a Light Source and a Power Meter shall be one of the following for each link:

- Single direction @ 850nm and @ 1300nm for multimode fibers
- Single direction @ 1310nm and @ 1550nm for single mode fibers

The use of certification tool is recommended. Those tools are capable of producing a report logging the time of the test the link identification under test, the link length, the attenuation at the window tested and the acceptable link attenuation. The report shall also identify in which direction the testing was implemented.

17.9.0 CCTV System

1.0 IP BASED CCTV SYSTEM

1.1 SCOPE OF WORK

The scope of the work includes the installation, testing and commissioning the complete CCTV system as described herein and as shown on the plans. The system shall include NVRs, PTZ cameras, Dome Cameras, Box type cameras, PTZ controller, LCD screens, wiring, termination, electrical boxes, and all other necessary material for a complete operating system.

1.1.1 FIXED DOME / BOX TYPE IP COLOUR DAY/NIGHT CAMERA

The fixed camera should have the following features:

- Directly IP based without requirement of encoder.
- Day / Night camera. Should switch automatically to monochrome mode (black and white) at night.
- Imaging Device 1/3 inch complementary metal oxide semiconductor (CMOS) or charge Coupled Device (CCD) with wide dynamic range (WDR)
- Image Control with Automatic white balance (AWB), automatic back light compensation (BLC), automatic gain control (AGC)
- Iris setting should be auto/manual with definitions for sharpness, image quality and also time stamp and camera ID.
- Minimum Illumination should be:

Color mode: F1.4 @ 0.1 lux (.01 fc) Black and white mode: F1.4 @ 0.04 lux (0.004 fc)

- Vari-focal CS mount lens 3.5mm to 50mm required
- Supported Video Compression should be H.264 and Motion JPEG (MJPEG)
- 704 x 576 @ 25 fps PAL (minimum required) 1920 x1080 @ 25 fps PAL (maximum required)
- Should support dual Video Streaming with both streams originating independently from the camera
- Should support multicasting
- Should support Power over Ethernet (PoE) 802.3af

- Should provide at least two digital inputs and two digital outputs for hardwire integration.
- Camera should provide 802.1X authentication
- Camera should support at least 128 bit encryption using hardware-based Advanced Encryption Standard (AES)
- Multiple user access levels with password protection.

1.1.2 PAN/TILT/ZOOM DAY/NIGHT INDOOR/OUTDOOR COLOUR DOME CAMERA

The PTZ Camera should have the following features:

- The camera should be IP based.
- The camera should be true outdoor model suitable for use in Pakistan.
- It shall be a discreet camera dome system consisting of a dome drive with a variable speed/high speed pan/tilt drive unit with continuous 360° rotation.
- Imaging device should be 1/3 inch CCD and support both color and monochrome black and white. With 540 TVL horizontal resolution.
- Should provide 27x optical zoom and 12x digital zoom (minimum) with auto focus feature
- The camera should provide high-quality MPEG-4, MJPEG or H.264 compressed images.
- The camera should provide images @ 4CIF i.e. with a resolution of 704x576 pixels in PAL mode.
- The supported frame rate should be 30ips or 25ips in PAL mode.
- The camera should support two simultaneous streams
- Should support Day/Night mode and should switch automatically to monochrome mode at night with below 1 lux sensing at variable shutter speeds.
- Should provide super quick, 400° per-second pan and 200° per-second tilt speeds with 256 preset positions. Each pre-set position should support the programmable camera settings such including selectable auto focus modes, iris level, Low Light limit, and backlight compensation for each preset.
- Should support wide dynamic range (128x) appropriate for high contrasting environments
- Should support Automatic focus, automatic Iris control, gain control horizontal and vertical aperture control.

- Should be installed in a High-impact, weather-resistant dome enclosure
- Camera must provide at least 7 Inputs and 2 outputs that can be programmed individually. Inputs should be able to trigger an alarm condition. Outputs should be able to drive an external device.
- Should support intelligent privacy masking by providing 8, four-sided user-defined shapes, each side with different lengths; window blanking setting to turn off at user-defined zoom ratio; window blanking set to opaque gray or translucent smear; blank all video above userdefined tilt angle; blank all video below user-defined tilt angle.
- Should support at least 8 user-defined programmable patterns including pan/tilt/zoom and preset functions, and pattern programming through control keyboard or through dome system onscreen menu
- Should support a web interface utility for 5 simultaneous users when using MJPEG/MPEG-4 in uni-cast mode. When configured in multicast mode (MPEG-4), the camera should support an unlimited number of users.
- Should support On-screen display for time, date and location. The position of the display and text should be user definable.
- Should support On-screen display of compass heading and user-definable compass setup so as to indicate direction that the camera is looking in.
- Should support multi level password protection.
- Should support Secure Sockets Layer (SSL) 128 bit encryption

1.1.3 VIDEO MANAGEMENT AND RECORDING SYSTEM

The Video Surveillance Management platform should be optimized for applications to view, store, and manage real-time and recorded video in a networked environment. The system should use an open suite of URL-based programmatic interfaces to communicate with applications. The system shall provide a highly scalable and reliable platform to enable customized, network-based surveillance applications. The Video Surveillance Management platform shall include but not limited to the minimum of the following features/functions/specifications:

- The system shall display any combination of live and recorded camera feeds on multiple workstations simultaneously using an IP network.
- The system shall provide low latency video with high quality images and support H.264, MPEG4, and Motion-JPEG compression schemes simultaneously.
- The system shall provide replication of individual video feeds at different frame rates for multiple users and other system processes.
- The system shall support simultaneous video feeds across multiple locations for centralized and decentralized storage, display, and distribution of video without limitation, but shall minimize load on video servers by streaming only the active video channels.

- The system shall be capable of streaming and recording video at different bit rates and variable frame rates up to full motion 25 fps (PAL) video on all camera feeds and shall support QCIF, CIF, VGA (640x480 pixels), D1 (720x576pixels) and 4CIF (704x576 pixels) camera resolution.
- The system shall provide the ability to remotely configure the cameras and shall allow configuration data to be imported from a spreadsheet.
- The system shall allow instant replay of video and will permit pausing of live video, forward and backward review of recorded video, and return to live viewing.
- The system shall manage storage of real-time video at any specified frame rate, duration, and physical location on the network.
- The system shall provide flexible archiving capability in terms of frame rate, duration, and location and shall utilize dynamic file allocation to ensure that the full duration of the selected video stream will be recorded, regardless of lighting condition, motion, or scene detail.
- System shall support access to the archived video, to seek to any point in the archive, to set the pre and post time, and to loop that segment of the archive.
- The system shall cater for redundant multi-site video storage. Meaning that the video feeds coming from the sites must be stored on primary and backup storage.
- The system shall provide a Management Console that shows the status of CPU, Memory, Disk Usage, and traffic analysis.
- The System shall support H.264 Compression Protocol and 128 bit encryption. The system shall provide diagnostic tools that support Simple Network Management Protocol (SNMP).
- The system shall provide for integration with other software applications through an open and published Application Programming Interface (API). Such applications shall include, but not be limited to, access control, video analytics, and other alarms and sensor inputs.
- The system shall be capable of running on a single physical server or distributed across the network, scaling to handle thousands of cameras and users.
- The system shall provide for or have the capability of interoperating with the functional modules providing the capability for multiple web-based display consoles to configure, manage, display, and control video throughout the IP network; multiple options to store video and audio; virtual matrix switching; client PC viewing; and, remote encoding and storage.
- The system shall be capable of simultaneously supporting 3rd party IP based cameras from a variety of different vendors.

The system shall provide the following administrator functionalities:

- Secure login
- Server, encoder, and camera administration

- Scheduled and event-based video recording
- User and role management
- · Fine-grained activity reports and system audit
- Ability to push pre-defined views to any number of digital monitors with Virtual Matrix Ability to schedule to operator shifts, event filters, temporary views.

The operator workstations running as part of the Video Management System shall provide the following operator functionalities:

- Secure login
- Flexible video displays
- PTZ controls including presets and advanced camera options (e.g. focus, white balance, iris)
- Digital zoom and instant replay
- Create instant recordings, "Record Now"
- Client-side video enhancements (adjusting brightness, color, transparency, etc.)
- Instantly swap between live and archive video of the same camera feed
- Archive review and clipping
- Event notifications
- Ability to search archived video based on motion within a predefined window within the video frame
- Synchronize playback of multiple archives

Supported file format types shall include or as per BOQ:

- WMV A standard file format for downloading and playing audio/video data or to stream data on a PC.
- AVI A standard file format for storing audio/video data on a PC.MP2
- Clip (BWM) A segment of video extracted from an existing stream-able archive.
- Digitally Signed Clip (BWX) A segment of video extracted from an existing stream-able archive and signed with a digital signature to verify content has not been tampered with.

Operator Workstation:

- The minimum configuration of the Operator workstation PCs and the Video Wall PCs shall be or as per BOQ:
 - workstation based on the new Intel® X38 Express performance chipset and the latest workstation-class dual core Intel processors:
 - Intel's Core [™] 2 Duo (2.83 GHz, 4 MB L2 Cache) or better
 - DDR-2 800 MHz ECC
- Should include the following Components or as per BOQ:
 - 160 GB SATA 3 GB/s NCQ 7200, 1st HDD
 - Intel Core 2 Duo E6850 3.0 4 MB/1333 CPU
 - 2 GB (2x1 GB) DDR2-800 ECC Memory
 - 768 MB PCIe Graphics
 - Microsoft Windows XP Pro 32-bit OS

- Graphic card: NVIDIA®, GeForce® FX 5700 Ultra, FX 5900 Ultra or FX 5950 Ultra, Matrox Parhelia™, ATI RADEON® 8500,9500,9800
- The Operator workstation PC and the Video Wall PC will be separate and the two applications will not be combined on the same PC.

The minimum configuration of the Management and Recording servers shall be:

- Rack mounted, high end server Multi processor based on a latest Intel processor.
- Minimum 2 GB of RAM
- Network adapter 1000 Mbps Ethernet
- Standard sound card is optional and recommended.
- Minimum 750GB storage capacity for installation.
- Redundant Power Supply.

1.1.4 STORAGE REQUIREMENTS

The video storage system shall have following features:

- Recording of all the camera streams must be stored for the period of 30days on DAS, NAS or SAN.
- The storage media must be SATA drives or Fiber Channel drivers or Flash Drives.
- Minimum storage requirement is 64TB raw (The supplier to confirm the storage requirement as per number of cameras, pixel resolutions, video compression and number of recording days)
 The storage servers must have redundant power supply and meet high availability standards
 The storage should be RAID 5 configured for disaster recovery.
- Each recording unit/server should allow for internal storage up to 32 TB per recording unit so as to allow expansion if later required

CCTV Color LCD Monitor

- The Video Color LCD Monitor shall be high performance with high resolution.
- Its image signal input / output port terminal allow bridge connection.
- The Video monitor shall have operating controls & shall be mounted below or on side-front of its screen.
- It should have 450v lines Resolution and variable control Knobs to control contrast, V hold HHold & brightness.
- Push buttons switch to control power On / Off and separate LED pilot light.
- The video monitor screen size shall be 21 inches flat & square tube shall produce clear distortion less viewing all the way out to the edge and corners of the screen.
- It shall consist of S- video input / output connectors separated output. Input signal shall be 1.0V p-p and impedance 75 ohms.

- The power source shall be AC 198-264 auto and power consumption shall be not more than 36 W.
- It shall consist of Automatic Voltage selector (AVS) to level voltage fluctuation instantly and automatically.

1.1.5 INTEGRATION (OPTIONAL)

CCTV system shall be integrated with Fire alarm system, Emergency Voice Evacuation system, Access control system and Building Management system for sequential operations and status monitoring.

25.7 CLEANING OF LINES

The lines shall be cleared of silt and other clogged material in the pipeline as directed by the Engineerin-Charge.

25.8 PAVEMENT RESTORATION

The paved surfaces which are cut shall be restored to the original condition according to drawings and as approved by the Engineer-in-Charge.

25.9 MEASUREMENT AND PAYMENT

25.9.1 COMPOSITE RATE

The measurement and payment for the items of the work of Sewerage hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in- Charge.

25.9.2 LABOUR RATE

The measurement and payment for the items of the work of Sewerage hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

23.1.6.3 LAYING OF SEWER PIPES

Sewer pipes shall be laid as per Clause 25.3 of Section 25 – Sewerage. The following conditions shall be taken care of particularly.

- i) Each length of pipe between manholes shall be in straight line and true to the alignment, position, gradient and levels.
- ii) Sewer laying shall proceed in all uphill direction, laying spigot end into already laid bell end. Reverse laying shall not be allowed and any such work so carried shall be rejected.
- iii) Each length of sewer pipe shall be checked for cracks and defects before placing in the line. Each pipe shall be placed carefully to the requisite line and grade and jointed perfectly with connecting pipes.
- iv) Pipes shall be cut only where directed by the Engineer-in-Charge in order to complete a length between manholes. All pipes shall be cut neatly and at right angles to the axis of the pipe and the cut of the pipe' shall be smooth and truly circular.
v) The top of bedding material shall be shaped to fit the pipe barrel, with pits left for the bells. When laying is not in progress, the open end shall be closed with a tapered wooden plug to keep out foreign matter.

23.1.13 LAYING OF PIPES IN TRENCHES

23.1.13.1 EXCAVATION OF TRENCHES AND REFILLING

The trenches shall be set out to suit alignment of the pipe lines. The trenches shall be carefully trimmed on sides and bottom so that pipe lines when laid shall rest on the firm bed throughout the length. Shallow joint holes shall be left for the joints, where necessary. Where pipe line is to be laid in plains the depth of cover, i.e. the normal distance from ground level to the top of the pipe be kept at about

800 mm and shall not be less than 750 mm except due to special reasons where the EngineerinCharge directs in writing to the contrary.

Backfilling of trenches shall be carried out in accordance with the provisions of Sub-Section 3.8.4(ii).

23.1.13.2 FLANGES

Flanged joints shall be provided at intervals of not more than 150 m or as directed by the EngineerinCharge. Each flanged joint shall be made by inserting an accurately cut disc of tough multiply rubber insertion about 3 mm thick of approved quality between the flanges. The bolt holes in the rubber insert as well as in the flanges shall be drilled to template. The bolts and nuts for all flanged joints shall conform to British Standard 10 and shall be of mild steel, hexagonal, round and diagonal. The bolts shall be pulled up gradually and evenly by the use of standard spanners of the approved make, so as to ensure a perfect joint.

23.1.13.3 BENDS, TEES AND OTHER SPECIALS

Bends, tees, reducers and other specials shall be provided and jointed at points as shown on the drawings or as directed by the Engineer-in-Charge. All changes in direction shall be effected by means of bends wherever practicable and the use of elbows shall be restricted only to cases where there is no room for bends. In such cases only round elbows will be allowed.

23.1.14 PIPES ANCHORED TO WALLS OR CEILINGS

Suitable and substantial hangers or fixings shall be provided for all horizontal and vertical lines of approved types and special vibration eliminating and flexible hangers shall be provided for all pipe work affected by moving machinery or expansion and contraction including building expansion joints. Hot and cold horizontal piping shall be supported in accordance with the schedule given as under:

	Maximum spacing of	Rod size for Hangers	
Pipe dia in mm	In Vertical run	In Vertical run In Horizontal run	
G.I and Flexible			
15 – 25	3.0	2.5	10
31 – 50	3.6	3.0	10
62 – 75	4.5	3.6	13
100 – 150	4.5	4.0	13
Cast Iron			

All sizes	3.0	1.5	13

One fixing shall be provided for each fitting. iii) Hanger shall be supported from approved concrete inserts in concrete slabs for all pipes 50 mm and above. Insert shall be as approved by the Engineer-in-Charge and shall have space for nuts of all size. All inserts shall have a reinforcing rod of specified diameter to be installed through slot provided for this purpose, and the Contractor shall be responsible for its being in place when concrete is poured.

If any pipe has to be hung where no inserts have been provided, the Contractor shall drill holes from below through concrete slabs and provide rods and hangers attached to not less than two approved type expansion shield each one capable of taking full maximum load. The rods and complete hangers shall be of adequate size to support the load, which they carry.

- iv) Approved roller supports, floor stands, wall brackets, masonry, etc. for all lines running above the floors, and which can be properly supported by the walls shall be provided. Pipe lines near walls may also be hung by hangers, carried from approved wall bracket at a higher level than the pipe.
- v) Pipes shall not be hung from the pipes of other trades or other pipes except for small water branches in toilet where no other practical means support can be found, in which case specific approval for the installation shall be obtained from the Engineer- in-Charge. Hangers shall not be fastened by means of vertical expansion bolts. Hanger shall be of heavy construction suitable for the size of pipe to be supported. All materials, except roller shall be a malleable iron or steel. Rollers shall be cast iron.

Hanger shall be swivel split ring, wrought pipe clamp, or adjustable type or as approved. vi) Special cares shall be taken in the placing of hangers at the top, bottom and in offsets of hot water risers so as to allow for expansion of the vertical piping. Vertical risers shall be securely supported from the building construction by means of pipe clamps at every floor.

vii) For cast iron hub and spigot pipe and fittings hangers shall be provided on not more than 1.5 meters centers or a minimum of one hanger for each length of pipe. Where excessive number of fittings are installed between hangers, the Contractor shall provide additional hangers or reinforcing as required to the satisfaction of the Engineer-in-Charge. Fittings shall be securely anchored to the building construction at changes of direction to eliminate all horizontal movement. The Contractor shall furnish and install steel channels and angles for piping support. These supports will be required where there is not roof slab or where the building structure is not directly usable for pipe support.

23.1.15 PIPE SLEEVES

Pipe line laid through any wall, floor, ceiling or roof may be arranged to pass through proper hot dipped galvanized sleeve pipes of ample diameter embedded therein to enable the pipe lines to pass easily and freely. The length of every such sleeve pipe shall be of the full width or thickness of the wall and in the case of roof, ceiling or floor, shall be at least 40 mm longer than the thickness thereof and shall project to that extent above the upper surface thereof unless the Engineer-in-Charge orders to the contrary. Inside diameter of sleeves shall be at least 25 mm greater than the outside diameter of pipe passing through it. Space between pipe and sleeve shall be lead caulked and made water tight wherever required.

23.1.16 HOT WATER SYSTEM

All Hot Water supply piping shall be insulated as specified herein. Prior to insulation the pipes shall be thoroughly cleaned of all rust, scales and other containments by wire brushing, sand blasting etc and by using aromatic solvents complying with ASTM D-3734 to remove oil, grease etc. Subsequent to the cleaning operation the pipe, shall be coated with two coats of approved, temperature resistant, anticorrosion paint. Insulation shall be applied to the painted pipe only after hydraulic testing as specified and shall be of a thickness shown as under:-

Nominal pipe dia mm	Insulation thickness (mm)

15 – 20	20
25 – 40	25
50 – 100	32

The insulation, covering and jacket canvas shall be suitably fixed and an approved temperature resistant adhesive shall be used. The circumferential and longitudinal joints for the kraft covering and canvas jacket shall be lapped at least 40 mm.

Further reinforcement shall be provided by the use of 20 mm wide soft aluminum bands, generally spaced at 450 mm and on either sides of elbows, tees, valves and other piping specialties. All butt joints shall be sealed with self -adhesive type of approved quality adhesive tape.

All valves, fittings and other specials shall be insulated with plain glass fibre wool blanket of thickness equal to the adjoining pipe insulation and shall be covered by kraft paper and canvas jacketing as specified earlier. Two coats moisture proof approved paint shall also be applied. The adjoining insulation near these fittings shall be trimmed into suitable sections to fit closely around the valves, flanges and fittings. All trimmed sections shall be secured by wrapping of approved type of selfadhesive tape to form a complete waterproof seal. All work shall be done in a neat and workman like manner and must reflect recommended practice.

23.1.17 EMBEDDED PIPELINES

Chassis shall be left in concrete or masonry walls where pipe lines are to be embedded. The cavity shall be deep enough so that after installation of pipes sufficient space is available for cover. Pipes shall be laid before plastering walls or laying of concrete floors so that no joint or cover is visible. Hot and cold lines shall be laid in separate chassis or cavities and wherever specified shall be painted with two coats of bitumen and wrapped in hessian cloth or polythene sheet.

23.1.18 INSTALLATION OF GAS PIPES

All pipes from gas regulator to the consumption point shall be laid as G.I pipes for water supply. Two coats of hot bitumen shall be given all around to the entire length of pipe and hessian cloth wrapped around it. There shall be no pressure on the joints to obviate the possibility of leakage later on.

23.1.19 PAINTING OF EXPOSED PIPES

All exposed pipes for cold, hot and mixed water and gas supply shall be painted if required in different colours as specified. One coat of red oxide primer and two coats of synthetic paint shall-be given to all M.S hangers, brackets and pipes.

23.1.20 DISMANTLING OF GI PIPES SYSTEM

Whenever dismantling of GI pipe system is required all the joints shall be carefully opened and the components such as pipes, sockets, specials, valves & fittings and holder bats etc. shall be carefully removed, cleaned, all the usable materials shall be sorted out and stacked properly for subsequent use.

23.1.21 INSTALLATION OF FIXTURES

23.1.21.1 TAPS, STOP COCKS AND VALVES

All taps, stop cocks and valves shall be eased and grease before fixing. The washers and gland packing shall be equally suitable for hot & cold water.

23.1.21.2 CHAMBERS FOR STOP COCKS AND VALVES

Chambers for stop cocks and valves shall be of brick mortar and plaster as specified and shown on drawings. The work shall be carried with applicable provisions of Section 11, Brickwork & Section 5, Plain and Reinforced Concrete.

23.1.21.3 GAS ROOM HEATERS & GAS LAMPS

The gas room heaters & gas lamps shall be of type and make as specified and shall be provided and installed as approved by the Engineer-in-Charge.

23.4 PAYMENT

23.4.1 COMPOSITE RATE

The measurement and payment for the items of the work of Road and Road Structures hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

23.4.2 LABOUR RATE

The measurement and payment for the items of the work of Road and Road Structures hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

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24. SURFACE DRAINAGE

24.2 SCOPE

The work covered by this Section consists in furnishing all plants, labours equipments, appliances and materials and performing all operations in connection with the construction of Surface Drainage in accordance with the Drawings and this Section of Specifications.

24.3 RELATED WORKS/SPECIFICATIONS

i) Earthwork - Section 3 - Earthwork ii) Concrete - Section 5 -

Plain & Reinforced Concrete iii) Block Masonry - Section 9 -

Cement Concrete Block Masonry iv) Rubble Masonry – Section 12

- Stone Masonry

v) RCC Pipes and Construction - Section 25 - Sewerage

All works shall be carried out according to the applicable provisions of the Sections referred above.

24.4 CONSTRUCTION REQUIREMENTS

24.4.1 PUNJAB STANDARD TYPE DRAINS

Punjab Standard Type Drains Types IV to VIII shall be constructed and shall be made of cement concrete 1:2:4 with 1:4:8 bedding or as specified concrete mix. The exposed surfaces of all inverts and drains including side slabs and bullnoze shall be applied a thin skin of about 6 mm thick 1:1 cement sand mortar immediately after the concrete has been placed and floating the same to clean smooth finish. The slabs for the side walls shall be moulded separately and shall be laid in 1:2 cement sand mortar on the concrete backing, previously prepared, not less than 14 days after being made. All joints being carefully struck perfectly clean and flush with the faces of the slabs. Where specified the walls shall be constructed of brick masonry, concrete block masonry or rubble masonry as shown on Drawings according to the applicable Sections referred in Sub-Section 24.2 above.

The preparation of the trench, aligning and grading shall be carried out in the same manner as required for sewers.

No extra shall be payable for curves, bends, falls, junctions, inlets, outlets and all other special work in connection with the drains and the cost of all such special work shall be included in the rates as given in the schedule.

24.4.2 CROSSING OVER DRAINS

RCC slab 15 cm as specified shall be provided over the drains where shown on drawings or directed by the Engineer-in-Charge.

24.4.3 APPROACHES TO THE CROSSINGS

The approaches in the street to the crossing shall be laid in herring bone pattern either flat or on edge as directed in first class bricks. The base shall be of cement concrete as specified and the bricks shall be laid on a 6 mm layer of plaster. Any special cutting or curved work, boundary corners, curves, slopes and changes of slopes, cambers, cutting shaping and wastage of bricks to fit irregular area and all other special work is also included. The joints shall be struck flush and smooth. All profiles and strips shall be provided by the contractor at his own costs. Unless cement pointing is required by the Engineer-in-Charge, the external surface of the joints shall be struck flush as the work proceeds and left perfectly flushed and smooth.

24.4.4 CONNECTION WITH SEWERS

The surface drains shall be connected with sewers through gully gratings or as shown on drawings.

The house outlet is connected through a khurra by means of connection drain to the main drain. The size of the khurra shall be according to the size of the outlet. The standard sizes of khurras are $30 \text{ cm} \times 30 \text{ cm} \times 23 \text{ cm}$ and $23 \text{ cm} \times 15 \text{ cm}$. Khurras shall be made in the space between the house wall and the reimbursement or side wall of main drain and if there shall be no space available then khurra shall be constructed on the reimbursement. The house connection drain shall join the main drain at 45 degree to provide smooth flow.

24.4.6 **TESTING OF DRAINS**

After completion the drain shall be tested for flow by filling upto the full section.

24.4.7 **REIMBURSEMENT**

The reimbursement is bricks laid in cement mortar 1:5 on both sides of the roads sloping towards the drain (3 mm in 229 mm slope) on a 6 mm layer or mortar over specified thickness of base concrete. The work shall include any strips, sides and edging of narrow width area to be paved with dry bricks on edge or flat. The work shall also include all extra works involved in laying narrow strips l6 mm, 114 mm or 229 mm in width along sides of the drains and for all curves, bends, slopes and changes of slopes and other work involving added labor and material for irregular areas, cutting, fixing and wastage of bricks required for such works.

All joints between the bricks and along outer end and inner side of the reimbursement shall be completely filled with specified mortar.

24.4.8 **TEGA**

The house walls shall be protected by 76 mm or 114 mm thick Tega (i.e. brick on end) laid in cement mortar projecting to a maximum height of not more than 150 mm above the drain and the work shall include all excavation, cutting and wastage of bricks. The external surface of the joints must be flushed as the work proceeds.

24.4.9 FOUNDATION FOR REIMBURSEMENT AND TEGA

76 mm or as specified cement concrete shall be provided under reimbursement and Tega.

24.4.10 **RCC PIPES**

RCC pipes shall be laid as specified and shown on Drawings. The work shall be performed complying with the provisions of Sub-Section 25.3 - RC Pipes under Sewerage.

24.5 MEASUREMENT AND PAYMENT

24.5.1 COMPOSITE RATE

The measurement and payment for the items of the work of Surface Drainage hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

24.5.2 LABOUR RATE

The measurement and payment for the items of the work of Surface Drainage hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and the designated location as defined in the Contract Agreement.

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25 SEWERAGE

25.1 SCOPE

The work covered by this section of the specifications consists in furnishing all reinforced concrete pipes, plant, labour, equipment, appliances and materials and in performing all operations required for installing and testing the sewer pipes in strict accordance with the specifications of this section and the applicable drawings and subject to the terms and conditions of the contract.

25.2 RELATED WORKS SPECIFICATIONS

- Section 3 Earthwork
- Section 5 Plain & Reinforced Concrete
- Section 11 Brickwork
- Section 27 Tube-well & Water Supply
- Section 28 Iron Steel & Aluminum Works

25.3 SEWER LINES

25.3.1 MATERIALS

All materials used in the manufacture of reinforced cement concrete pipes for use shall conform to ASTM Designation C-76-03 or latest revision and also with the following specifications.

a) Cement

The Portland cement to be used in the manufacture of reinforced concrete pipes shall conform to the requirement of BS-12/ASTM Designation C-150 (latest revision).

b) Aggregates

The coarse/fine aggregate to be used in the manufacture of concrete pipes to be furnished and installed shall be generally in accordance with the provisions of Section 5 - Plain & Reinforced Concrete.

c) Water

Water to be used in the manufacture of pipes shall be in accordance with the provisions of Section 5

- Plain & Reinforced Concrete approved by the Engineer-in-Charge.

d) Steel Reinforcement

The material shall conform to the specifications contained in Section 5 – Plain & Reinforced Concrete. e) Brick Ballast

Brick ballast shall have a maximum gauge of $1\frac{1}{2}$ inch and shall be graded down to $\frac{3}{4}$ inch and shall

not contain more than 10% which will pass through screen made of $\frac{1}{4}$ inch diameter bars spaced at

$\frac{3}{4}$ inch centre to centre.

25.3.2 NON-REINFORCED CEMENT CONCRETE PIPES

The non-reinforced cement concrete pipes shall conform to ASTM C-14, latest revision Class II equivalent. Pipe ends shall be thus tongue and groove or bell and spigot. The physical dimensions shall be as described in applicable provisions of ASTM C-14.

25.3.3 REINFORCED CONCRETE PIPES

25.3.3.1 CLASSES OF PIPE

The reinforced cement concrete pipes to be furnished and installed shall be of the strength Class II or specified otherwise on the Drawings.

Following technical criteria shall be adhered to:

Class of Pipe : Class-II

Concrete Strength : 4000 Psi (Cylinder Test)

The design requirements for these classes of reinforced cement concrete pipes shall be as described in ASTM Designation C-76, Table 1 to 5 for the respective strength classes. Unless otherwise called for in other parts of these Technical Specifications or as ordered, all reinforced cement concrete pipes shall comply with the Wall-B design requirements as set forth in said Table 1 to 5 of ASTM Designation C-76-82 or latest revision.

For pipes smaller than 12 inches dia BSS 556, Class-L shall be strictly followed:

25.3.3.2 BASIS OF ACCEPTANCE

Acceptance of reinforced cement concrete pipes will be on the basis of three edge bearing and material tests as per ASTM Designation C-76-79 or latest revision and inspection of manufactured pipes for defects and imperfections. The Contractor shall bear the cost of such tests and pay fees etc., and also pay for the carriage of such samples and all other expenses contingent to tests.

25.3.3.3 PIPE DIMENSIONS

The internal diameters and wall thicknesses of reinforced concrete pipes under this contract shall be as set forth in ASTM Designation C-76-82 or latest revision in Tables 1 to 5 for "Wall-B" pipes as required and shown on the Drawings.

For Class II Pipes, the Wall Thickness for various dia pipes is as under:

12 inch dia pipe	:	2.00 inch
15 inch dia pipe	:	2.25 inch
18 inch dia pipe	:	2.50 inch
21 inch dia pipe	:	2.75 inch
24 inch dia pipe	:	3.00 inch
27 inch dia pipe	:	3.25 inch
30 inch dia pipe	:	3.50 inch

The lengths of reinforced concrete pipes shall be as required to provide the designated laying length plus any overlap needed for the pipe joint. Pipe shall be of standard length of 8 ft. unless otherwise approved in writing by the Engineer-in-Charge. Only one laying length shall be permitted for each size of reinforced concrete pipe and pipes not of the approved uniform laying length shall not be used in the work.

For 9 inch dia RCC pipes following data in addition to ASTM-76 shall be applicable:

1.		Wall thickness	1 inch
	Reinforcement square inches		
2.		0.05	
	per linear foot of pipe wall		
3.		Concrete strengt Test)	h 4000 Psi (Cylinder

4.	Inside diameter at the mouth of socket		
	12½ inch		
	17		

Depth of socket 2¹/₄ inch
 Longitudinal Steel As stated below

"Each layer of circumferential reinforcement shall be assembled into a rigid case supported by 4 Nos. longitudinal bar of quarter inch diameter".

The strength test requirements in pounds per linear foot of pipe under the three-edge-bearing method shall be either the D-Load (test load expressed in pounds per linear foot per foot of diameter) to produce 0.01 in crack, or D-loads to produce the 0.01 in crack and the ultimate load as specified below, multiplied by the internal diameter of the pipe in ft.

D	- Loa	ad to pi	oduc	e a 0	.01 ir	n cra	ack		=	1000 po	unds
-											

D - Load to produce the ultimate load = 1500 pounds

Lift holes in the walls of reinforced cement concrete pipes will not be permitted for the purpose of handling and laying. Other approved lifting methods shall be employed.

25.3.3.4 CERTIFIED DRAWINGS AND DATA SHEETS

The Contractor shall submit in triplicate, for approval by the Engineer-in-Charge certified drawings and data sheets as required to provide complete information on all concrete sewer pipes, dimensions, type and dimensions of pipe ends, joint details proposed concrete design mix for each different strength class of reinforced pipe and any other information needed to demonstrate full compliance with these specifications.

No concrete sewer pipe shall be delivered to the work site until the Engineer-in-Charge has formally approved the certified drawings and data sheets and until all test requirements called for in the respective ASTM Standard Specifications C-76 or latest revision have been met.

25.3.3.5 JOINTS FOR CONCRETE PIPE SEWERS

The joints for concrete pipes shall be as specified and could be as follows:-

a) Rubber Gaskets Joints

Rubber gasket joints shall be used for either tongue and groove or bell and spigot pipes.

Rubber gasket joints shall be made using specially designed rubber gaskets, made to fit the applicable tongue and groove or bell and spigot pipes and adequately tested under operating conditions. Special care must be taken in the selection and handling of the concrete pipes for use with rubber gasket joints, to ensure that pipe ends shall be smooth and concentric with tolerances which closely conform to the requirements of the manufacturer of the rubber gaskets. The tongue or spigot end of each pipe shall be specially designed to perform groove or offsets to fit the manufacturer's rubber gaskets design.

The rubber gasket joints shall conform to all applicable requirements of the latest revision of ASTM Designation C443, entitled "Joints for Circular Concrete Sewer and Culvert pipe, using Flexible Watertight Rubber Type Gaskets" except that the test pressure need not exceed 10 feet of head at which the complete sewers shall meet the infiltration or exfilteration limits set forth hereinafter.

The groove end of tongue and groove pipes shall have at least one line of wire reinforcement of 8 gauge size placed in the centre of the groove.

The rubber gasket shall be installed on the pipe in accordance with the instructions of the gasket manufacturer. In general the gaskets shall be pre-assembled at the pipe manufacturing plant. The pipes shall be handled with special care at all times to prevent damage to the pipe ends. A lubricant shall be used for jointing the pipes as recommended by the rubber gasket manufacturer. Care shall be taken to avoid contamination of the gasket and lubricated surfaces with earth or other undesirable material during installation.

For either tongue and groove or bell and spigot pipes, mechanical means shall be used to pull the pipe home for all sizes of 12 inches or larger diameter in accordance with the recommendations of the rubber gasket manufacturer. Pipes of 9 inches diameter may be coupled manually using a cross member and bar. Under no circumstances will bars alone be used nor shall any motor driven equipment be used to force the pipe home.

b) Cement Mortar Joints

Cement mortar may be used where called for. This type of joint will normally be permitted only for sewers laid above the water table. Bell and spigot joints with cement mortar shall be made as follows:

The first pipe shall be in place to the established line and grade. The interior surface of the bell (socket) shall be thoroughly cleaned with a wet brush, and a sufficient layer of stiff mortar shall be applied to the lower portion of the bell. The spigot of the second pipe shall be thoroughly cleaned with a wet brush, and uniformly fitted into the bell so that the interiors of the two pipes are closely fitted and accurately aligned. The remaining annular space in the bell shall then be solidly filled with mortar in sufficient amount to form a head around the out side of the spigot. The interior surface of the pipe at the joint shall be cleaned of all surplus mortar and brushed to a smooth finish. The Contractor may at his own option, use jute firmly caulked into place for holding the bell and spigot joint in proper position.

Tongue & groove joints with cement mortar shall be made as follows:

The first pipe (downstream) shall be in place to the established line and grade with groove upstream. The groove of the first pipe shall be thoroughly cleaned with a wet brush and a layer of soft mortar shall be applied to the groove in the entire lower half of the pipe. The tongue end of the second pipe shall be thoroughly cleaned with a wet brush and, while it is in the horizontal position, a layer of soft mortar shall be applied to the entire upper half of the pipe. The tongue end of the second pipe shall then be inserted into the groove of first pipe until mortar is squeezed out on the exterior surface. The Contractor will use hamper jute gasket soaked in cement slurry, for holding the two pipes in proper position. The joints shall then be completely and solidly filled with stiff mortar on the outside of the pipe. The Interior surface of tile pipe at the Joint shall be rubbed smooth with a moist rag and not trowelled.

The Portland cement mortar used for making joints shall consist of one part cement and one part clean sand, thoroughly mixed dry with sufficient water slowly added to give proper consistency. The mortar shall be promptly used after it is made. The completed joints shall be immediately protected on the outside with an initial covering of moist earth canvas or burlap.

25.3.3.6 HOUSE CONNECTIONS

House Connections shall be made through manholes as indicated in the drawing or as directed by the Engineer-in-Charge.

House connection shall be provided individually for each plot by means of a 6 inch dia RCC sewer pipe and a dead end, laid at an average depth of 2.0 feet below NSL level and in such a manner that other services such as water supply, telephone and gas lines are not disturbed or interfered. The work of laying the sewer pipe shall conform to the specifications laid down in the relevant section of this contract.

Tile inlet of each house connection shall be plugged with brick masonry 4½ inches thick in 1:6 cement sand mortar both in the manhole and the pipe in the plot.

25.3.3.7 GULLY GRATING

Gully grating shall be made through manholes as indicated in the drawings or as directed by the Engineer-in-Charge.

Gully grating shall be provided on the road junctions on as mentioned in the drawings by means of a

9 inch dia RCC sewer pipe connecting the nearest manhole with the chamber of size I ft - 6 inches x 1 ft - 6 inches. The pipe is laid in such a manner that other services such as water supply and sewerage system are not disturbed or interfered. The work of laying RCC pipe shall conform to the specifications laid down in Sub-section 25.3.3.8. Mild steel grating shall be fixed at the top.

25.3.3.8 INSTALLATION

2 Handling of Pipes

Concrete sewer pipes shall be handled with special care at all times during the manufacture, while transporting to the site of work, and while installing. Each pipe shall be carefully inspected before being laid and no cracked, broken or defective pipe shall be used in the work. Chipping of the tongue and groove or bell and spigot pipe ends, which in the Engineer-in-Charge's opinion may cause defective joints, shall be sufficient cause for the rejection of any concrete pipe.

3 Excavation and Backfill

The excavation and backfill for sewer installations shall be as specified in applicable provisions of

Section 3 - Earthwork and will be paid for under separate contract items as classified. c) Placing of Bedding

i) Brick Ballast Bedding

The brick ballast shall be clean material of 1 to 1½ inch gauge broken from first class bricks or bats, or from dense over burnt bricks. No under-burnt bricks or bats nor those which have become spongy of porous in the process of burning shall be broken up for brick ballast.

The material shall be evenly spread over the full width of the formation in 4 inches loose layers and compacted with hand or mechanical rammers until the full thickness as shown on the drawings for

the particular pipe size has been built up and finished no more than $\frac{1}{4}$ inch below required level. The

Contractor shall note that it is essential that the material at the sides of the pipes is adequately compacted. Before the subsequent placing of pipe surrounding material, pipe joints shall be protected. Protection may take the form of a twist of yarn lightly pressed into the annular joints space or other equal protection approved by the Engineer-in-Charge.

ii) Crushed Stone Bedding

Crushed stone bedding shall be from an approved source. It shall be obtained from a dark colored igneous rock such as granite etc. It shall be strong durable, hard and impervious, having crystalline structure. The broken stone shall have sharp edges and clear fractured faces, shall be free from thin elongated or laminated pieces.

The crushed stone shall have a maximum gauge of $1\frac{1}{2}$ inch and shall be graded down to $\frac{3}{4}$ inch

when sifted through a screen made of $\frac{1}{4}$ inch diameter bars spaced $\frac{3}{4}$ inch center to center, it shall

yield not more than ten percent (10%) by volume of fine materials.

d) Laying of Sewers

Neither any sewer pipe nor the bedding shall be laid or placed till the alignment of the sewer and its levels and gradients have been carefully checked and tested with the trench excavation and found correct.

Each length of sewer pipe shall be checked for cracks and defects before placing in the line. Defects which in the opinion of the Engineer-in-Charge indicate imperfect placing, shall make, the pipe liable to rejection. Each pipe shall be placed carefully to line and grade and in close contact with adjoining pipe. These specifications require rejection of the work, if the sewer invert varies as much ½ inch from the proper elevation. As shown on Drawings, the bottom of the trench must be shaped to fit the pipe barrel, with holes left for the bells. If excavation has been carried below the correct grade, refilling must be done with satisfactory materials as approved by the Engineer-in-Charge at no extra cost. The concrete pipe joints shall be of the type specified above and shall be made in accordance with the aforesaid specifications.

When laying is not in progress, the open pipe shall be closed with a tapered wooden plug to keep out foreign matter.

25.3.3.9 TESTING OF SEWER LINES

a) General

All sewer built shall be tested for infiltration or ex-filtration as specified below. The tests shall be made at times selected or approved by the Engineer-in-Charge. Sections of the completed sewer shall be isolated and measurements of the infiltration or ex-filtration shall be made by approved method. The contractor shall furnish all labor, material and equipment required for making the tests with no extra compensation over and above the agreed contract prices for the laying of sewer lines. **b) Infiltration Test**

The sewers which are constructed with the ground water level above the invert level of the pipe shall be tested for infiltration after the sewers have been installed and backfilling has been substantially completed. The tests and measurement shall be performed by the Contractor in the presence of the Engineer-in-Charge as follows in accordance with ASTM C 969-02.

Conduct testing from manhole to manhole or between more than two manholes. The length of main tested shall not exceed 700 ft

- ix) Stop all dewatering operation and allow the groundwater to return to its normal level. Infiltration testing shall not be used unless the groundwater level is at least 2 ft above the crown of the pipe for the entire length of the test section.
- x) Plug all pipe outlets discharging into the upstream manhole. xi) Measure the groundwater elevation and determine the average head over the test section. xii) Measure infiltration leakage at the outlet of the test section. Because leakage allowances are small, measurements are best made by either timing the filling of a small container of known volume, or by directing flow into a container for a specified time and measuring the content, or by using small weirs.
- xiii) If the measured rate of leakage is less than or equal to the allowable leakage in accordance with (d) hereafter the section of sewer tested is acceptable.
- xiv) If the test section fails, it is not prohibited that it be repaired and retested in accordance with this practice.
- xv) The allowable leakage limit including manholes is 500 gallon/ inch of internal diameter (mile of sewer)

(24 h) when the average head on the test section is 6 ft or less. xvi) The average head on the test section is the head above the crown of the pipe at the upstream manhole plus the head above the crown of the pipe at the downstream manhole divided by two. ix) When the average groundwater head on the test section is greater than 6 ft. the allowable leakage shall be increased in proportion to the ratio of the square root of the average groundwater head to the square root of the base head of 6 ft.

- x) Manholes shall be tested separately and independently or with the pipeline with the allowance of 0.1 gallon (ft of diameter) (ft of head) (h). If building or house leads are connected to the main line being tested, allowance shall be made for permissible leakage in such leads.
- c) Ex-filtration Test xii) Conduct testing from manhole to manhole or between or between more than two manholes. The length of main tested shall not exceed 700 ft.

- xiii) Determine the groundwater elevation at both ends of the test section. If the groundwater level is less than 2 ft above the crown of the pipe measured from the highest elevation of the sewer, the exfiltration test shall be used.
- xiv) Plug all pipe outlets discharging into the upstream manhole and the test section outlet. Fill the sewer line with water.
- xv) At the upstream manhole the test head shall be established as minimum of 2 ft above the crown of the pipe, or at least 2 ft above existing groundwater, whichever is higher.
- xvi) Allow the pipe to remain saturated for a period long enough to allow water absorption in the pipe, a minimum of 4 h and up-to a maximum of 72 h. After the absorption period, refill the pipe to the required test head.
- xvii) Measure the leakage loss over a timed test period. The minimum test period shall be 15 min and the maximum shall not exceed 24 h.
- xviii) If the measured rate of leakage is less than or equal to the allowable leakage in accordance with (d) the section of sewer tested is acceptable.
- xix) If the test section fails, it is not prohibited that it be repaired and retested in accordance with this practice. The groundwater elevation shall be re-determined prior to a second test and the test head adjusted, if necessary in accordance with (iv).
- xx) For ex-filtration testing the allowable leakage limit including manholes is 500 gal. (in. of internal diameter) mile of sewer) (24 h) when the average head on the test section is 3 ft or less.
- xxi) When the average head on the test section is greater than 3 ft. the allowable leakage shall be multiplied by the ratio of the square root of the average test head and the square root of the base head of 3 ft.
- xxii) Manholes shall be tested separately and independently or with the pipeline with an allowance of 0.1 gal. (ft of diameter) (ft of head) (h).

f) Allowable Infiltration or Ex-filtration

The calculated amount of infiltration or ex-filtration over a 24 hour period shall not exceed 500 gallons per inch of pipe diameter per mile of sewer which rate shall be applied to the actual sewer size and length tested to determine the allowable infiltration or ex-filtration over the 24 hour period.

If the measured infiltration or ex-filtration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs so as to reduce the leakage to less than the permission maximum stated above.

g) Cleaning of Sewer Lines

The Contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer-in-Charge prior to handing it over to the Owner.

25.3.3.10 MEASUREMENT

The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately.

Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

25.4 UN PLACTICIZED POLYVINYL CHOLRIDE PIPES

The UPVC pipes to be furnished and installed shall be of the Class B to Class E, as specified on the Drawings. The design requirements for these classes of UPVC pipes shall be as described in Pakistan Standard Designation PS 3051 or British Standard BS 3505.

25.4.1.1 CERTIFIED DRAWINGS AND DATA SHEETS

The Contractor shall submit in triplicate, for approval by the Engineer-in-Charge certified drawings and data sheets as required to provide complete information on all concrete sewer pipes, dimensions, type and dimensions of pipe ends, joint details proposed concrete design mix for each different strength class of reinforced pipe and any other information needed to demonstrate full compliance with these specifications.

No concrete sewer pipe shall be delivered to the work site until the Engineer-in-Charge has formally approved the certified drawings and data sheets.

25.4.1.2 PRESSURE TESTING

It is recommended to test the pipeline in accordance with PS standards 3051 and BS 3505.

25.4.1.3 MEASUREMENT

The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed. The length shall be taken along the centre line of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately.

Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

25.5 MANHOLES

25.5.1 MATERIALS

Brick masonry, Portland cement concrete, and other materials shall meet the specified requirements of the relevant sections of the specifications, listed under clause 25.2 and elsewhere as necessary. Cast iron frame shall conform to the specifications as per B.S.S. 497, Manhole steps shall be of galvanized mild steel.

25.5.2 CONSTRUCTION REQUIREMENTS

Manholes shall be constructed with brick masonry laid in 1:3 cement sand mortar, built on 1:2:4 concrete base slab and as specified. The cover slab shall be 1:2:4 reinforced cement concrete, fitted with cast iron frame which shall have reinforced cement concrete cover as shown in the drawing. Reinforcement and concrete shall conform to the requirements or Section 5 – Plain & Reinforced Concrete. The outside and inside of the walls shall be plastered (½ inch thick) with 1:3 cement sand mortar and two coats of hot PB-4 bitumen shall be applied outside. At the bottom of manholes for sewers, a proper channel as per Drawings, shall be constructed in the whole length of the manhole along the centerline of the sewers, to lead the sewage from one sewer to the other. Galvanized mild steel steps shall be installed at 12 inches interval inside the manhole during the construction of the manhole walls. Cutting holes into the wall for the steps after construction will not be permitted. Top rung shall be 18 inches below the manhole cover and the lowest not more than 12 inches above the benching (floor).

Depth of manhole shall be from invert level of sewer to the top of manhole.

Where specified cast iron manhole covers conforming to the dimensions and weights as shown on drawings shall be used.

25.5.3 DROP MANHOLE

The Contractor shall construct drop manholes wherever shown in the drawings or ordered by Engineer-in-Charge. The Contractor shall make the drop connection as shown on the drawings or ordered by the Engineer-in- Charge.

25.5.4 MEASUREMENT

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The manhole covers shall be enumerated under relevant items.

Manholes shall be enumerated under relevant items. The depth of the manhole shall be reckoned from the top level of C.I. cover to the invert level of channel. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.

25.6 CAST IRON VENTILATING SHAFTS

Cast Iron Pipes & specials shall conform to BS-78 for spigot and sockets vertically cast pipes; BS-1211 for spigot and socket spun iron pipes and BS-2035 for flanged.

The work shall carried as specified shown on drawings and approved by the Engineer-in-Charge in accordance with applicable specifications.

25.6.1 MEASUREMENT

The Cast Iron ventilating shafts shall be measured in Kgs upto two decimal place.

25.7 CLEANING OF LINES

The lines shall be cleared of silt and other clogged material in the pipeline as directed by the Engineerin-Charge.

25.8 PAVEMENT RESTORATION

The paved surfaces which are cut shall be restored to the original condition according to drawings and as approved by the Engineer-in-Charge.

25.9 MEASUREMENT AND PAYMENT

25.9.1 COMPOSITE RATE

The measurement and payment for the items of the work of Sewerage hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in- Charge.

25.9.2 LABOUR RATE

The measurement and payment for the items of the work of Sewerage hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

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26. WELL SINKING

26.1 SCOPE

The works to be done under Well Sinking, consist of all such related works which extend below the ground specified in the Contract or as directed by the Engineer-in-Charge. Those works shall include constructing brick masonry reinforced brick masonry wells with reinforced concrete well curbs and steel angle cutting edges including bottom and top concrete plugs and sand filling as shown on the Drawings and specified herein. The works to be done shall include constructing reinforced concrete well curbs with steel cutting edges, brick masonry walls (Unless reinforced brick Masonry has been specifically specified or directed by the Engineer-in-Charge) dredging and sinking the wells, placing the bottom and. top concrete plugs and sand filling, and all incidental operations required to construct and sink the well foundations as shown on the Drawings or specified herein.

26.2 GENERAL

- a) All operations of the Contractor for well sinking and all materials used shall be subject to the approval of the Engineer-in-Charge.
- b) The Contractor shall sink the well at the designated locations in accordance with the lines and grades shown on the Drawings or established by the Engineer-in-Charge.

26.3 MATERIALS & WORKMANSHIP

The Contractor shall furnish all materials for the complete construction and sinking of the wells and all materials and workmanship shall meet the following requirements.

- a) Brick masonry shall conform to the applicable requirements of Section 11- Brick Work.
- b) Concrete shall conform to the applicable requirements of the Section 5, Plain & Reinforced Concrete.
- c) Reinforcement for Concrete shall be as shown on drawings and shall conform to Sub-Section 5.4, Plain & Reinforced Concrete.
- d) Sand filling shall be approved unprocessed river bed sand or, at the option of the Contractor approved river bed gravel, cobbles or brick bats mixed with sufficient river bed sand to completely fill the interstices in the coarser material.

26.4 CONSTRUCTION

The wells shall be constructed and sunk as open caissons as specified herein. Unless otherwise authorized by the Engineer-in-Charge, the Contractor will not be permitted to sink the well by any method which does not utilize the dredging and sinking principle substantially as follows:

a) The area at which the well is to be sunk shall be excavated to the approximate top elevation of the completed well foundation. In case spring level is higher than the top elevation of the completed well, the excavation shall be maintained in a dry condition by utilizing cofferdams and un-watering methods.

The excavation shall comply with provision of Section 3 - Earthwork.

- b) The well curb shall be constructed in place in the proper position, or if a pre-cast curb is used it shall be set in proper level position at the surface below which well sinking is to be carried. If a precast curbs is used it shall be set in proper level position. Precast curb shall not be handled until they have been cured for at least 14 days. The vertical bars for masonry reinforcement (wherever reinforced brick work has been specified or specially directed by the Engineer-in-Charge) shall be attached to the steel angle cutting edge by means of nuts and washers as shown on the Drawings.
- c) After placing of precast curbs; or not earlier than three days after placing of Concrete for castin-place curbs, brick Masonry walls with an approximate height of 1.5 meters shall be

constructed on the curbs as shown on the Drawings. Two straight edges as approved by the Engineer-in-Charge shall be rigidly attached to each of the outside faces of the well for the purpose of ensuring that the brick masonry courses are laid truly plumb and level and to provide a means by which the departure of the well from plumb and the drift of the well from its correct position during sinking may be determined, The well height in decimeters above the cutting edge as well as the level of each course of masonry shall be marked on the straight edges,

Wherever reinforced brick masonry walls have been specified or directed by the EngineerinCharge, vertical reinforcing and horizontal bond steel flats shall be embedded in the masonry as shown on the Drawings, Splices in the vertical reinforcing bars shall be made by welding or the screwing of sleeve nuts. Each strip shall be in place and drilled or punched to permit vertical reinforcing bars to pass through) horizontal bars,

d) The well shall be sunk by dredging (defined as removal of material from inside the well) until the top of the masonry is approximately 0.7 meters above the ground, whereupon straight edges for another lift of masonry shall be set and a second lift of masonry up to 3 meters in height constructed. Care shall be taken that the exterior faces of succeeding masonry lifts are constructed parallel to the axis of the well rather than plumb so as to indicate any uneven sinking of the well and permit remedial action to be taken. Each successive lift of masonry shall be allowed to set for three days before sinking of the well is resumed.

In caser spring level is high, then operation shall be maintained in a dry condition using coffer dams and dewatering methods.

- e) Dredging shall be accomplished in such a manner that the hole within the well shall not be extended below the cutting edge by more than 1.25 meter and that, when the well is sunk to its final position, the material outside of the well will not have been disturbed. Except when specifically authorized by the Engineer-in-Charge, explosives shall be used in conjunction with dredging. Dredged material shall be used for backfill or placed in spoil banks adjacent to the locations of work as approved by the Engineer-in-Charge.
- f) Each well shall be frequently checked for plumb by means of plumb lines and mason's level or other approved means. Corrective action, consisting of dredging from the high side until the well rights itself, shall be taken immediately if the well is found to be sinking unevenly. If required, weights shall be added at the top of the well masonry on the high side or the Contractor may be required to employ shoring or tension rigging on the upper body of the well foundation to assist in plumbing the well foundation. The corrective force shall be applied concurrently with sinking of the well. Completed well foundations shall not depart from plumb by more than 2.5 cm in 1.27 m which shall be the only deviation allowed from the true position of the well as shown on the Drawings.
- g) Each well shall also be frequently checked for longitudinal and lateral drift during sinking by the use of a suitable sighting device, or other means approved by the Engineer-in-Charge, and by establishing satisfactory control points a safe distance from the construction so as to remain undisturbed, from which the straight edges outlined in sub-clause (b) above may be clearly sighted. The longitudinal and lateral centerlines of the top of any well foundation shall not deviate from the centerlines established on the Drawings by an amount greater than an equivalent tilt of 2.5 cm in 1.27 m. The vertical distance used to establish the equivalent tilt shall be the vertical distance from the level shown on the Drawings to the top of the well. The deviation may consist of tilt. drift, or combination thereof; however, the completed well shall not depart from plumb by more than 2.5 cm in 1.27 m.
- h) If the well does not sink as the dredging is advanced, a greater height of masonry, weighting or running shall be employed. Running, defined as the practice of removing water from within the well to reduce buoyancy and thereby increase the effective weight of the well, shall not be employed without. the approval of the Engineer-in-Charge.
- i) If for any reason a well is cracked either vertically or horizontally, the masonry shall be removed insofar as practicable to eliminate the crack and rebuilt. A crack or portion thereof,

which cannot be eliminated practicably by' rebuilding in the opinion of the Engineer-in-Charge, shall be grouted to the satisfaction of the Engineer-in-Charge.

- j) When a well has been sunk to its indicated elevation, the bottom interior of the well shall be carefully sounded to detect the presence of any material within the space to be occupied by the bottom plug, and any material so detected shall be removed. The false masonry if constructed to increase the weight for sinking shall also be removed.
- 2. Where specified:
 - a) Without un-watering, the bottom plug concrete shall be placed by means of a tremie, bottom dump buckets, or other approved means which will preclude any free fall of the concrete in the water. The concrete shall be worked under the masonry corbelling and carried at least to the height indicated on the Drawings.
 - b) After the bottom plug concrete has set at least one day, and without unwatering the well, the sand filling shall be placed in lifts not exceeding one meter in depth and with a 24-hour elapse of time between placement of the lifts to permit settlement of the fill.
 - c) After the sand filling is placed to the demarcated elevation within the well, the top plug concrete shall be placed and screeding level at the elevation of the top of the brick masonry, If the well is titled within the permissible limits, the masonry at the top of the well shall be constructed, so that the top surface of the masonry around the perimeter of the well meets the specified elevation.

26.5 LOG RECORD OF EXCAVATION

The Contractor shall furnish to the Engineer-in-Charge log of the Sinking of each well. The log record the day and hour at which sinking commenced, suspended, resumed and completed, a description of materials dredged; time during which each lift of brick masonry is built; the height of the lift; the daily record of sinkage obtained, deviation of the well from plumb position and description of action .to plumb the well, and any unusual occurrences or data as is required to document the progress of well sinking. The form of the log shall be approved by the Engineers-in-Charge.

26.6 ALTERNATIVE PROCEDURE FOR SINKING

Sinking of the well by any other of the so called traditional methods employed in Pakistan may be utilized when approved by the Engineer-in-Charge provided the essential requirements of these Specifications are met.

26.7 MEASUREMENT AND PAYMENT

26.7.1 COMPOSITE RATE

The measurement and payment for the items of the work of Well Sinking hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

26.7.2 LABOUR RATE

The measurement and payment for the items of the work of Well Sinking hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

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IRON STEEL AND ALUMINUM WORKS

28.1 IRON AND STEEL WORKS

28.1.1 SCOPE

This Section covers general requirements of Iron steel, steel work fabrication, methods including precautions for erection of steel structures, painting and other general requirements incidental to steel work, for complete job as shown on the design drawings or as directed by the Engineer-in-Charge.

The applicable requirements of this section as determined by the Engineer- in-Charge shall apply to all Iron and structural steel works. 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-in- Charge.

28.1.2 CODES AND STANDARDS

The work shall conform to the requirements of the following Codes and Standards, unless otherwise specified.

ASTM A-36-81	Structural steel specifications
ASTM A-307-80	Specifications for carbon steel bolts.

BS 729-71 Hot dip galvanized coating on iron and steel articles. AWS D-12

Recommended Practice for welding steel

28.1.3 SUBMITTALS

Prior to execution of work and sufficiently in advance, the Contractor shall submit the following to the Engineer-in-Charge for approval:

a) Shop Drawings

Shop Drawings, which shall show full construction details, quantities and locations, with metal gauges, reinforcing, cut-outs, holdfasts & attachment to adjacent construction and materials. b) Samples

Representative samples of a typical metal window and ventilator, hardware, accessories and any other product required.

For metal doors and shutters, cross-sections of typical welded jointed or assembled frame, in specified thickness showing reinforcing, welding and prime paint coat.

c) Methodology

Methodology for fabrication, installation, erection and fixing.

28.1.4 QUALITY ASSURANCE

a) Type and Form of Product

All metal doors, windows, ventilators and shutters shall be the product of reputable manufacturer and.

shall be of the type indicated on the Drawings and shall conform to the requirements specified herein. b)

Metal Doors and Shutters

All metal door and shutter frames shall be made of good quality cold rolled steel; exterior frames and doors shall be galvanized steel.

Frames shall be fabricated form locally available hot flush hollow pressed sections, 'Z' section angle, tee and channel or pipe sections as specified in the drawings. Materials shall conform to ASTM-A-36.

All frames shall be secured to the structure with strong wrought iron holdfasts. Holdfast shall be 50 mm wide and 6 mm thick and shall be secured to frames. Attachment shall be concealed.

Shutters shall be double skin made of frames of any of the sections noted above with faceplate of at least 18 S.W.G. or as shown in the drawings.

The internal surfaces of frames and shutter including frame shall be painted with one coat of epoxy primer or as specified.

External surfaces in contact with or embedded in concrete shall not be painted, greased or oiled. However, such surfaces shall be given a cement wash after sandblast cleaning. All other external surfaces shall be given two coats of primer and two coats of epoxy enamel paint or as specified.

Accessories such as hinges, steel standard track, roller and guides, standard bracket, anchors, bolts, locks handles, latches, L--drops, stoppers, hydraulic door closure shall be heavy duty and shall conform to the requirements shown on the drawings or as directed by the Engineer -in-Charge. c) Metal Window and Ventilators

- Window frame and ventilator sections shall be of mild steel.
- Hinges shall be subject to the approval of the Engineer-in-Charge.
- All operating hardware shall be of bronze lacquered iron as specified.
- d) Structural Steel

All structural steel shall conform to the requirements of ASTM A-36 or equivalent.

e) Welding

All welding shall be executed and inspected in accordance with the provisions of the applicable code of the American Welding Society.

f) Bolts

All bolts, including anchor bolts shall conform to the requirements of ASTM A-307 or equivalent.

28.1.5 DOORS AND WINDOWS

28.1.5.1 DELIVERY AND STORAGE

- a) Doors shall be packed individually in a manner which will ensure complete protection of all door surfaces and shall be stored in upright position, under cover, in a manner so as to prevent rust and damage.
- b) Frames shall be supplied with removable angle spreaders securely fastened to the bottom of each joint. The spreaders shall not be removed until frames are secured in place.
- c) Windows shall be delivered in a manner that prevents damages to the units and shall be stored off the ground, under cover, in a manner so as to prevent rust or damage.

28.1.5.2 PRODUCTS – GENERAL REQUIREMENTS

- a) All contours and arises in metal door shall be true and sharp as can be produced in the thickness of metal required.
- b) Construction joint of steelwork welded to full depth and width, or equivalent splice plates shall be welded on unexposed faces of frames. Exposed surfaces of welded joints shall be dressed and ground smooth to produce invisible connections.
- c) Reinforcement and stiffeners shall be welded to the inside of the frame surfaces.
- d) Window frames and ventilators shall conform to the sections shown on the detailed Drawings and all corners shall be electrically flash welded and finished smooth.
- e) Weather baffles shall be integrally rolled and shall provide contact on all the four sides of the operating ventilators.
- Weep holes and drips shall be provided for drainage in accordance with Drawings or instructions of Engineer-in-Charge.
- g) All windows shall be designed for exterior glazing to accommodate glass thickness specified.
- h) Ventilators shall show in or out, as indicated on the Drawings and shall be mounted over heavy steel pivots with brass pins.
- i) Push bars for out swinging windows shall be a notched device for fixed settings and designed to lock shutters in open/closed position.
- j) In-swinging windows shall be provided with a casement for fastener, designed and arranged to close with wedging erection to draw each leaf firmly into contact with window fixed rail.
- k) Windows shall be provided with all necessary clips and anchors required for securing the windows to the structure.

28.1.5.3 FABRICATION OF DOORS AND WINDOWS

a) Shape

The steel sections shall be thoroughly straightened in the shape by methods that will not injure it before being laid off or worked in any way.

b) Cutting and Forming

All members shall be so cut and formed that they can be accurately assembled without being unduly cracked strained or forced into position.

c) Jointing

The jointing of different parts of the members of mild steel shall be carried out by welding process in conformity with the requirements of American Welding Society for such joints. Welding points shall be made quite smooth by filing them and making smooth.

d) Galvanizing

If required all exterior doors frames, anchors reinforcing and related items shall be fabricated from hot dipped galvanized steel, conforming to BS-729, Part-1. After fabrication all welds shall be touched up with liquid zinc.

Window frames and ventilators shall be hot dipped galvanized after fabrication conforming to BS-729 Part-1 as specified.

28.1.5.4 FABRICATION OF ROLLING SHUTTERS

a) Shutters

The shutter shall be fabricated using standard galvanized corrugated segments of the required length according to size of the shutter and of 22 gauge thickness. These segments shall be inter-linked properly to allow rotation for smooth rolling up and down. In order to reduce noise during operation, 2 inch (50 mm) wide wire reinforced canvas belt shall be riveted (using aluminum rivets) to both shutter ends. The aluminum rollers shall be installed at top.

b) Guide

The guides for the shutter shall be fabricated from mild steel plates and shall be embedded to wall or columns by providing necessary anchors.

c) Main Rollers

The main rollers, mounted on the supporting pipe, on which the shutter has to roll up, shall be of mild steel with deep groove ball bearings and provision for greasing.

d) Supporting Shaft

The supporting shaft shall be of standard mild steel pipe, strong enough to support the load of the shutter with minimum deflection. This shaft shall have adequate supports at the ends fabricated from mild steel plates. Each shutter shall have separate bracket supports. However, due to space limitation for mounting, the same may be made common for adjacent shutter. e) Coil Spring

On each end, between the bracket support and the roller coil, a spring shall be provided. The spring shall be of spring steel one end of which shall be fixed to the pipe and the other to the roller. These springs shall be suitable to balance the weight of the shutter to allow smooth operation. f) Cover

The cover shall be fabricated from 22 gauge galvanized steel sheet of uniform shape and size without deformations.

28.1.5.5 INSTALLATION

a) Doors, Windows and Ventilators The Contractor shall be responsible for proper protection and installation of all items furnished.

Should the prime coat be damaged, or rust scale appears, he shall at his own expense and at the Engineer-in-Charge's direction, have all exposed surfaces cleaned to bare bright and re-primed with an approved priming coat before finish painting.

All items shall be installed plumb and square and shall be solidly anchored in a good workman-like manner in accordance with the approved Shop Drawings. The Contractor shall be responsible for the protection of installed items from damages 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 final acceptance.

b) Wire Gauze

Unless otherwise specified or directed by the Engineer-in-Charge, the wire gauze to be fixed with doors, windows and ventilators shall be 22 gauges having 12x12 mesh and shall be from an approved manufacturer.

c) Shutters

The installation of all components of the shutter shall be done true to line and level and in perfect plumb. It should be ensured that the shutter should roll up automatically after initial manual lifting upto a desired height. The shutter closing should also be easy smooth and unobstructed. The operation shall be performable by a single person.

28.1.5.6 PRIMARY COAT AND FINISHING

- a) The non-galvanized doors, windows and ventilators shall be painted with primary coat of red oxide and good quality double boiled linseed oil or any approved anti-corrosion paint after proper grinding. Afterwards two coats of synthetic enamel paint of approved make and shade shall be given.
- b) Two coats of red primer and one coat of synthetic enamel paint shall be applied on all components of shutters except galvanized shutter, after fabrication and before installation. One coat of synthetic enamel paint shall be applied to all exposed surfaces after installation. Before applying paint all surfaces shall be cleaned from rust, burrs, scale, dust or grease.
- c) The finished work shall be strong and rigid; neat in appearance and free from defects. Plain surfaces shall be smooth and free from warp or buckle. Molded members shall be clean, straight and true. Fastenings shall be concealed where practicable.
- d) The painting as specified shall be carried out in accordance with the applicable provisions of Section 17, Painting and Varnishing.

28.1.5.7 MEASUREMENT

a) Shutters

The width and height of shutters shall be measured to the nearest cm. The area shall be calculated in square metre correct to two places of decimal. The rate shall include the cost of materials and labour involved in all the operation described above. Nothing extra shall be paid for cement concrete block or wooden blocks nor anything deducted for these from the measurement of the masonry wall.

b) Rolling Shutter

Clear width and clear height of the opening for rolling shutter shall be measured correct to a mm. The clear distance between the two jambs of the opening shall be clear width and the clear distance between the sill and the soffit (bottom of lintel) of the opening shall be the clear height. The area shall be calculated in square metres correct to two places of decimal. The rate shall include the cost of materials and labour involved in all the operations described above including cost of top cover and spring except ball bearing and mechanical device of chain and crank operation, which shall be paid for separately.

c) T-Iron Doors, Windows and Ventilators Frame

T- iron door windows and ventilator frames shall be measured in running metre, along the centre line of the frame correct to a 1mm and weight calculated on the basis of standard tables. No deduction or extra payment shall be made for making holes and making arrangement for fixing fittings including packing wherever necessary. No deduction will be made for not providing tie bars in case of windows and ventilators.

d) Pressed Steel Door Frames

The length shall be measured in running metre correct to a cm along the centre line of the frames.

e) Items of work for which unit of measurement is Kg in CSR Doors

The weight of finished section shutters of different sizes, inclusive of all fixed /welded fittings i.e. hinges pivots lugs, brackets striking plates etc, shall be worked out before fixing of shutters (exclusive of weight of glass panes, glazing clips, putty etc.). Sectional weight of steel members only shall be measured without weight of glass panes etc. Any loose fittings such as casement stays/fasteners etc. shall be enumerated and paid for separately.

Unit of measurement shall be Kg and Weight of cleats, brackets, packing pieces bolts nuts, washers distance pieces separators diapharam gussests (taking overall square dimensions) fish plates, etc. shall be added to the weight of respective items unless otherwise specified. No deduction shall be made for skew cuts.

28.1.6 GLAZING

28.1.6.1 APPLICABLE STANDARDS

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

BSI	British Standards Institution
952	Glass for glazing
5051	Security glazing Part I & II
CP.152	Glazing

28.1.6.2 GENERAL

- a) Each type of glass shall have the manufacturer's label on each pane, and the labels shall remain on the glass until final cleaning.
- b) Glazing sealant shall be as recommended by the manufacturer for the particular application.
- c) Spacer shims (distance pieces) shall be plasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on drawings between glass and rebates, bead or cleat. Depth shall give not less than
 - 6mm cover of glazing sealant.
- d) Contractor shall submit samples for each type of glass, minimum 100mm x 100mm in size with protective edges. Samples of glazing sealant minimum 0.1 liter of specified types shall be submitted. Samples of minimum of three glass blocks shall also be submitted.
- e) Contractor shall submit 300 mm long sample of each type of glazing gasket.
- f) Contractor shall also submit printed materials manufacturer's installation instructions for specified glazing glass block gaskets, compounds sealants and accessories including description of required equipment and procedures and precautions to be observed.

28.1.6.3 DELIVERY STORAGE AND HANDLING

- a) Contractor shall deliver materials in manufacturer's original, unopened containers clearly labeled with manufacturer's name and address, material, brand, type, class and rating as applicable.
- b) Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements which may damage glass.
- c) Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces.

28.1.6.4 MATERIALS

a) General

Glass shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to fit the rebates so as to have a uniform clearance of 1.6 mm round the panes between the edges of glass and the rebates. All glass shall be best quality from reputable manufacturer as approved by the Engineer-in-Charge.

Unless otherwise indicated glass shall be of the following weight per square metre for various sizes mentioned below:

- i) Not exceeding 300 x 350 mm 4.3 Kg/M.
- ii) Exceeding 300 x 350 mm but not exceeding 600x600 mm 8.0 kg/M. iii)

Exceeding 600 x 600 mm but not exceeding 750x750 mm - 9.0 kg/M. iv) Exceeding

750 x 750 mm but not exceeding 900x900 mm - 9.8 kg/M.

v) Plate glass 6 mm thick shall be used where size of glass exceeds 900mm either in breadth or in length or in both.

b) Sheet Glass

Sheet glass shall be of thickness and size shown on the Drawings. Each glass shall be bedded with a thin layer of good quality putty as approved by the Engineer-in-Charge and should be fixed with glazing bead securely screwed and finished off neatly.

c) Obscure Glass

Obscure glass shall not be less than 5 mm thick with one side smooth and polished whereas the other side with pattern to be selected by the Engineer-in-Charge, if specified, sheet glass shall be made obscure by grinding off the polish from one side.

d) Plate Glass

Plate glass shall be first quality polished transparent glass, conforming to the applicable requirements of BS 952. Unless otherwise indicated, plate glass shall be 6 mm thick with two surfaces ground smooth and polished so as to give clear undistorted vision and reflection.

f) Wire Reinforced Glass

Wire reinforced glass shall be 6.35 mm thick polished plate reinforced with Georgian wire conforming to the applicable requirements of BS 952.

g) Tinted Glass

The imported tinted glass for doors, windows and ventilators shall be of specified thickness and tint and shall be from a manufacturer as approved by the Engineer-in-Charge. The tinted glass shall comply with the applicable specifications of B.S. 952.

h) Solar Control Film/Glass

The approved Solar Control film shall be applied on all sun-facing glasses of doors and windows as indicated on the Drawings. It shall consist of aluminum vapour coated polyester film with water activated adhesive thereon. Color shall be soft grey. The film shall be optically clear from the inside. Total thickness shall be 0.025 mm to 0.033 mm.

h) Glass Blocks

The glass block shall be of specified size and shall be from a Manufacturer approved by the Engineerin-Charge.

i) Putty

Putty for wood frames shall be of the best linseed oil conforming to the requirements of BS-544 and for metal frames best metallic putty. Wherever required the putty shall be colored to match with woodwork. The rebates, if not painted, shall be well primed with boiled linseed oil to prevent the wood drawing the oil from the putty.

j) Unbreakable Glazing (Poly Carbonate Sheet)

Unbreakable glazing material shall be LEXAN MR-4000 sheet as manufactured by GE Structural Product or approved equivalent and shall be provided as glazing where shown on the Drawings. It shall have the property of high impact resistance, weather resistance, clarity, 'and durability. It should be attractive and light weight.

28.1.6.5 BEADS AND SHIMS

Glazing beads shall be of deodar wood.

Spacer shims (distance pieces) shall be of plasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on the Drawings between glass and rebate, bead or cleat. Depth shall give not less than 6 mm cover of putty.

28.1.6.6 GLAZING SEALANTS AND COMPOUNDS

Contractor shall provide material colored to match frame in which glass is installed and only compounds known to be fully compatible with surfaces which they will contact as follows.

- 1) Two component polysulfide glazing for sealant.
- 2) One component acrylic glazing for sealant.
- 3) Acrylic-latex glazing sealant consisting of modified latex rubber and acrylic emulsion, nonhardening, non-staining and non-bleeding.
- 4) Cleaners, Primers & sealer as recommended by the sealant manufacturer.

28.1.6.7 ACCESSORIES

a) Glazing Sealant

It shall be tape or ribbon of polymerized butyl or mixture of butyl and polyisol butylene compounded with inert fillers and pigments, solvent based, 95 percent solids thread or fabric reinforced, paintable, non-staining.

b) Setting Blocks

It shall be chloroprene (Neoprene) 70 to 90 durometer hardness, compatible with sealant used, channel shaped and of the necessary height for proper perimeter clearance.

 c) Channels, Gaskets, and spacer's It shall be chloroprene (Neoprene), 40 to 50 durometer hardness compatible with sealant used.

28.1.6.8 INSTALLATION OF GLAZING

a) Preparation

All rebates and grooves shall be clean, dry and unobstructed at the time of glazing. The beads shall match the surrounds. Manufacturer's recommendations for the putty, metal surrounds and primer shall be followed.

b) General

All glazing shall be wind and watertight on completion. Edge clearance shall be equal all around each pane, and not less than 3 mm. No void or space shall be left at the back of bedding compound. Surplus bedding compound to top and side edges shall be stripped at an angle to avoid collection of water. Sand blasted glass shall be protected from oil attack by treating edges before fixing, and cleaning surfaces after fixing, as recommended by glass manufacturer. c) Glass

Glass shall be secured with spring clips or cleats as provided or recommended by the manufacturer. Back-putty shall be of regular thickness, not less than 1.5 mm short of sight line. Surface shall be brushed lightly to seal putty to glass.

d) Fixing

For bead fixing, setting blocks shall be located as required in BS 6262. Spacer shims (distance pieces) shall be used in all external bead fixing and located opposite each other on each side of glass not more than 600mm apart around the perimeter.

e) Control Film

All run-facing glasses shall be washed properly with potable water to render them free from any greasy matter. Solar control film shall be applied on cleaned glass by authorized servicemen for this work as approved by the Engineer-in-Charge. The film shall be applied on the glass before it is fixed at its appropriate place. The film shall be applied with approved adhesive in such a way that no air bubble is left between the glass and film and optical clarity is not affected.

f) Depth of Rebate

The minimum rebate depths will depend upon the area of the pane and block and exposure conditions as under:

For small panes upto 0.372 square metre in area inside buildings or for external panes not exceeding 0.093 square metre, the depth should not be less than 6.3 mm. For linseed oil or metal putty the depth should not be less than 7.9 mm for wood or metal and 9.5 mm for stone brick or similar material. For non-setting compounds, the depths should not be less than 9.5 mm.

The depth of rebate shall be increased for larger panes or for panel which butt together, and for exposed conditions. The increase in rebate shall be as shown on the Drawings or as directed by the Engineer-in-Charge.

28.1.6.9 INSTALLATION OF GLASS BLOCKS

The method and equipment used for transporting the glass blocks and neat white cement paste shall be such as that will not damage the glass block nor delay the mixed paste of white cement. Glass blocks shall be laid as shown in the drawings or as directed by the Engineer-in-Charge. Both Horizontal and vertical joints shall be approximately not more than 1/16" in thickness and. completely filled with white cement paste. Each glass block shall be bedded firmly by tapping with the rubber hammer. All Horizontal and vertical joints shall be parallel to each other. All glass block shall be erected true to line plumb and level. Excess mortar at the outer edges shall be removed with cloth.

After completion of days' work, the glass block wall shall be thoroughly cleaned with water and/or damp cloth as directed by the Engineer-in-Charge.

28.1.6.10 CARE AGAINST DAMAGE

While glazing operation is in progress great care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be re-fixed at Contractor's expense.

No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass ad checked by the Engineer for water tightness.

28.1.6.11 PROTECTION AND CLEANING OF GLAZING

- a) Remove all smears labels and excess glazing sealent. Leave clean inside and outside free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with new glass at no additional expense to the Employer.
- b) All glass surfaces shall be washed clean both inside and outside within two weeks prior to final acceptance by the Employer

28.1.6.12 MEASUREMENT

The width and height of glass shall be measured to the nearest cm. The area shall be calculated in square metre correct to two places of decimal

28.1.7 MISCELLANEOUS STEEL WORK

28.1.7.1 GENERAL

The work covered shall include furnishing; fabricating, installing and painting Miscellaneous

Steel Work including the following:

- Steel stairs
- Steel Joists, Protection angles and channels
- Steel Grating
- Steel Hand Rail
- Steel Gates
- Embedded plate, anchor bolts and other miscellaneous items

Drawings, material, fabrication, surface preparation shall conform to the applicable requirements of relevant clauses of these specifications. Any proposed deviation due to field conditions and availability of local material shall be submitted to the Engineer-in-Charge for approval a week prior to the start of the work.

a) Steel Stairs

i) General

Structural steel stairs complete with grating treads or checkered plate treads, landings, supporting structures, handrail supports etc. shall be furnished and installed in accordance with working drawings.

ii) Material

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

iii) Installation

The stairs shall be installed in a first class workman like manner. Connections to adjacent concrete structures shall be made with anchor bolts or shall be welded to embedded part at site as shown on the drawings.

b) Steel Joists, Protection Angles and Channels

Steel protection angles joists and channels as shown on drawings and specified shall be erected true to line and level. Steel angles and channels shall be grouted and fixed in position by using anchors as shown on the drawings or as directed by the Engineer-in-Charge.

c) Steel Grating

Steel grating shall conform to the requirement as shown on drawings. All panels shall be banded on the all edges as specified.

d) Steel Hand Rail

Steel Hand Rail shall be fabricated in accordance with the drawing or as directed by the Engineerin-

Charge and shall conform to the applicable requirement of ASTM A53 for the type and class of pipe indicated.

28.1.8 FENCING

28.1.8.1 GENERAL

This work shall consist of constructing post and barbed wire fence or chain link fence in accordance with the details and at the locations shown on the Drawings or as directed by the Engineer-in-Charge.

28.1.8.2 MATERIALS

a) Barbed Wire

Barbed wire shall conform to the requirements of ASTM A-121 Class-1. The barbed wire shall consist of two (2) strands of twelve and a half ($12\frac{1}{2}$) gauge wire, twisted with two (2) points, fourteen (14) gauge barbs spaced ten (10) cm apart.

b) Chain Link Fabric

Chain link fabric shall be fabricated from ten (10) gauge galvanized wire conforming to AASHTO M181 and shall be of the type shown in the Drawings. Before ordering the chain link fabric the Contractor shall submit a sample of the material to the Engineer-in-Charge for his approval. c) Concrete Posts

Concrete posts shall be made from 1:2:4 (4000 psi - 6"x12" cylinder strength) concrete in accordance with Section 5 – Plain & Reinforced Concrete. The posts shall be cast to the length shown on the detailed drawings and shall have a smooth surface finish.

d) Steel Posts

Steel posts shall be of the section length as specified or as shown on the Drawings. The posts shall be of copper bearing steel and shall confom to the requirements of AASHTO M-183 for the grade specified.

e) Wooden Ballies

The wooden ballies shall be of shisham or kail wood as specified and approved by the Engineer-in-Charge.

f) Steel Reinforcement

Steel reinforcement for the concrete posts shall be deformed steel bars Grade-60 or Grade-40 as specified conforming to the provisions of Section 5 – Plain & Reinforced Concrete.

The Concrete shall comply with provisions of Section 5 – Plain & Reinforced Concrete. g) Hardware Nuts, bolts, washers and other associated hardware shall be galvanized after fabrication as specified

in ASTM 153.

28.1.8.3 CONSTRUCTION REQUIREMENTS

a) Erection of Posts

The posts shall be erected vertically in position, inside the formwork of the foundation block prior to the placing of the concrete and shall be adequately supported by bracing to prevent movement of

the post during the setting process of the concrete. The posts shall be erected to the height and location shown on the Drawings or as directed by the Engineer-in-Charge.

b) Installation of Chain Link Fabric

The chain link fabric shall be set to line and elevation and pulled tight between each post before spot welding or other method of fixing is carried out.

Where splicing of the fabric is necessary or at joints the lapping of the chain link fabric shall be a minimum of ten (10) cm and shall occur only at the concrete post. No horizontal splicing will be permitted. The, fabric shall be fixed to the concrete post as shown on the Drawings.

28.2 ALUMINIUM WORKS

28.2.1 APPLICABLE STANDARDS

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

ISO (International Organization for Standardization)

6612Windows & Doors-Wind resistance tests6613Windows & Door-Air permeability testBSI (British Standard Institution)1227Hinges4873Aluminum alloy windows

28.2.2 SUBMITTALS

a) General

The Contractor shall in general comply with the provisions of Clause 28.1.3 and 28.1.4. b) Manufacturer's Certificate

The Contractor shall on request get certificate signed by the manufacturer stating that each lot has been sampled tested and inspected and has met the requirements in accordance with these specifications and the same shall be furnished to the Engineer-in-Charge.

c) Guarantee

The manufacturer shall furnish his standard written guarantee against leakage of rain water excessive infiltration of dust air and all defects in materials, workmanship covering all the work under this section.

Such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturers and the Contractor may have by law or other provision of the Contract Agreement.

28.2.3 INSPECTION & TESTING

a) Contractor shall arrange tests and analysis if directed by the Engineer- in-Charge of scaled models of each Door, window ventilator type at the maker's works or any laboratory specified by the Engineerin-Charge for the material supplied by him to be tested in the presence of the EngineerinCharge/Inspector to whom test certificates, proof sheets etc. shall be furnished. The models shall be submitted to the Engineer-in-Charge 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-in-Charge may

have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer-in-Charge to reject after delivery of materials found not in accordance with these specifications.

b) After approval of shop drawings and tests etc. the Contractor shall submit at his own cost one mockup 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.

28.2.4 PRODUCT DELIVERY AND STORAGE

- a) The Contractor shall deliver doors windows ventilator and louvers in a manner preventing damage to units. The contractor shall store materials off the ground under cover in a manner preventing deterioration or damage.
- b) 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.

28.2.5 MATERIAL

- a) All the sections used for Doors, windows, ventilators & fly screens shall be of best quality aluminum products such as equal and unequal angles, channels, tubes, corrugated strips mouldings etc; in accordance with international standards conforming to ASTM B-308 & B-221.
- b) Frames

The frames of aluminum doors, windows, ventilator, louvers and fly proof shutters shall be formed from rolled, strip or extruded aluminum and be at least 2mm thick deluxe section. Fastenings bolts and screws shall be made from hardened aluminum.

- c) Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.
- d) Gaskets shall be vinyl glazing channel gasket according to commercial standard CS-230-60.
- e) Hardware as required shall be manufacturer's standard hardware of aluminum, stainless steel or other corrosion resistant materials and shall blend in design with the frame finishes.
- f) Joint sealant shall be approved elastomeric.
- g) Fittings and fixtures shall be as per approved samples.

28.2.6 FINISHED COATING

a) General

The finished coating shall be as stated on the Drawings and applied strictly in accordance with the manufacturer's instructions.

The color of the coating shall be selected from available ranges if not stated in the drawing and or bill of quantities. The Contractor shall offer samples for approval prior to the final selection and the manufacture of these elements.

b) Anodized coating

The aluminum anodizing shall comply with BS 3987 and be integral color hard coat anodizing 550 kp/mm² hardness, minimum 25 microns thick.

The color of anodizing shall be as described on the drawings. Samples of color including limits of color variation shall be submitted to the Engineer-in-Charge for his approval before work commences. The Engineer-in-Charge reserves the right to reject the products of any supplier who cannot guarantee a reasonable limit of color variation, the acceptable limit of variation being at the Engineerin-Charge's discretion.

c) Polyester Powder coating

All aluminum sections that are to receive a polyester powder coating shall be given a caustic etch followed by an anodic oxide treatment to obtain an architectural class 1 anodic coating. Anodization should be not less than 25 micron thickness.

All aluminum works shall be finished in colored electrostatic polyester powder coating as per DIN standard 53151, 53153, 53156 or equal and approved to Ral color subject to the Engineer-in-Charge's approval.

d) Coating Thickness

As and when instructed by the Engineer-in-Charge, the Contractor shall provide certificates from independent laboratories that the minimum thickness as specified has been applied to the aluminum sections. Failure to provide such information shall result in the complete installation being rejected and replaced at the Contractor's expense.

e) Dissimilar Materials

All aluminum surfaces that are to be in contact with cured concrete, mortar, steel and other metals shall have the contact surfaces protected wherever they may entrap moisture or corrosive elements. Metals that are to be in contact with mortar or concrete shall be protected with a two coat bituminous

coating. Prime paint shall be applied to steel parts of anchors, anchor inserts, reinforcement, supports, and all parts after field welding or blotting with zinc chromate. Minimum dry film thickness shall be of 1 mil for zinc chromate.

28.2.7 FABRICATION

a) General

All nuts, bolts, washers and screws used for assembly and fixing shall be of adequate strength for their purpose within the design and shall be stainless steel grade 18/8.

All sealants used in the assembly of, and in the fixing of cladding and window framing, shall be nonsetting to allow thermal movement without detriment to those joint sealants used for peripheral caulking and shall be one part silicone sealant and shall conform to BS 4245. All spliced joints between mullions will be sealed with an approved silicone product, compatible with other sealants and packing used. All ironmongery which is to have the same finish as the frames and shall be approved by the Engineer-in-Charge.

At all opening of windows and doors and where there are louvered screens and doors, a fly screen shall be provided to the approval of the Engineer-in-Charge, constructed following the principles & specifications as described elsewhere in this specification.

Glazing sections shall be set in special heat resisting PVC and of channel type. Separate glazing sections on each side of the glass will not be permitted. The following table indicates the basic requirements for window construction. The weights of framing make no allowance for beads, glazing bars, opening light framing, coupling mullions or transoms.

Classification	Min. weight of basic frame kg/m run	Max. superficial area of window in Sq. M.	Max. Dimension either way mm	Remarks
Light	0.60	1	1500	
Light	1.00	3	2000	
Medium	1.50	5	2500	
Medium	2.00	9	3000	
Heavy	2.50	12	3500	
Heavy	3.00	12	3500	With door

b) Sliding Windows and doors

Weather-stripping - high density acrilan wool weather pile shall be used. There should be double brushes at every contact between shutter and frame sections for complete insulation. These should be present consistently throughout the unit between the inside and the outside and no portions without it are permitted.

The rollers for sliding shutters for both windows as well as doors shall be of the adjustable type. The adjusting screws must be accessible in the assembled state of the shutters and a vertical adjustment of 7 mm should be possible.

All sections for sliding windows and doors should be hollow section and the cross section dimensions of the sections should not be less than 60x40mm.

The outer frame must be suitable for accommodating sliding fly screens as required.

The handle-latch set should have all visible surfaces finished as the aluminum sections. The handle must have a proper grip. A small projecting flange or recess in the shutter sections cannot be accepted to serve as handles. The latching mechanism should not be surface mounted but should be concealed within tile sections. Sash rails of vertical sliding windows are to be of tubular box
sections with corner joints of outer frames and sashes interlocked, and the balance mechanism is to be an approved proprietary product.

c) Side hung windows, doors and ventilators

All windows and doors should be weather-stripped with heat resistant PVC sections. The weather protection should be achieved by a positive compressive action against the PVC section and should not depend on external contact with the PVC section. At every contact between two profiles two weather-stripping section should be provided to complete weather protection.

The bottom sections for hinged doors must be capable of being adjusted vertically if necessary. The gap between the bottom section and the floor should be covered with a pair of special splay-type PVC sections.

The shutter sections for both windows as well as doors shall be hollow section type and shall be overall size 57×45 mm and door sections shall be overall size 81×45 mm (including flanges).

The shutters of the windows and doors should be assembled with concealed corners of high rigidity. Hinges should be concealed within the sections.

Hinges shall be anodized aluminum with stainless steel pins and nylon washers. Handles shall be anodized aluminum finished to match the aluminum sections and mounted with self-lubricating nylon washers.

A mortice cylinder rim automatic deadlock of high quality with double pin tumbler Is to be used.

Windows shall have anodized aluminum handles, color as framing and a latching mechanism securing the shutter to the frame both at the top and bottom.

Fitting where required:

- d) Single action door closer concealed in the head bar of the outer frame and mounted on an adjacent pivot at the threshold and deadlock fitted.
- e) The left hand leaf of double doors with flush bolts at head and sill with deadlock fitted to the right hand leaf.
- f) Escape doors to have panic bolt assembly with vertical elements concealed in the stile and door closer as in (a).
- g) Fly screens

Fly screens shall be fitted to all opening leaves of windows or sliding doors, consisting of a separate metal sub-frame in with aluminum mesh fly wire. The fly screens shall be adequately secured with suitable dips, set screws or turn buckles and shall be removable for maintenance purposes. Fly screen doors shall consist of similar section to metal casement doors and shall be fitted with removable panels of fly wire.

The aluminum frame .to the fly screen shall be finished to match the framing of the window or sliding door with color and type of mesh to Engineer-in-Charge 's approval.

h) Glazing

The glass shall conform to specification laid down under Section 28.1.6; '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. All the glass shall be best quality of approved manufacture or equivalent standard as approved by the Engineer-in-Charge.

28.2.8 ERECTION AND WORKMANSHIP

28.2.8.1 ERECTION

- a) Raw plugs and anchoring bolts shall be embedded into the concrete or masonry for holding the doors, windows, ventilators and louvers in their correct position.
- b) Care shall be taken to install the doors and windows, ventilators and louvers in line and plumb, solidly anchored in a good workman-like manner in accordance with the Drawings. Should any scale or scratch appear on the surface of doors, windows, ventilators and louvers the Contractor shall at .his

own expense and at the Engineer-in-Charge's direction have all exposed surface cleaned to bare bright metal and made good as required.

All joints between structure and the metal shall be fully caulked and painted. All works shall be installed in strict accordance with the manufacturer's instructions.

28.2.8.2 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 workmanship like manner in accordance with the manufacturer's instructions and as specified herein. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, cement mortar stains 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. Beads and grooves shall be ensured to be clean, dry and unconstructive at the time of glazing. The complete unit shall be airtight and watertight on completion.

No door and window shall be considered complete until the finger prints and other stains and marks have been removed from the surface of glass and aluminum.

Temporary protection shall be achieved by applying water soluble protective coating capable of withstanding the action of mortar.

Protective coating shall be applied in the manufacturer's plant to the exposed surface of all components after removing all fabrication compounds, mixture and dirt accumulations.

28.2.8.3 FINISHING

All exposed surfaces shall be carefully polished and all alloy defects, die marks scratches, strokes or other surface blemishes shall be buffed to a clear surface and given an anodic oxides treatment. The structural shape of aluminium members shall be of uniform quality, color and temper; clean, round, commercially straight and free from injurious defects

28.2.9 PROTECTION AND CLEANING

- Temporary protection shall be achieved by applying water soluble protective coating capable of withstanding the action of mortar.
- Apply coating in the manufacture(s plant to the exposed surfaces of all components.
- Before application of coating, remove all fabrication compounds, moisture and dirt accumulations.

28.2.10 DEFECTIVE WORK

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

28.2.11 MEASUREMENT

The height and breadth shall be measured correct to a cm. The height of the Window and Doors shall be measured as the length and breadth from outside to outside of the end. The area shall be calculated in square metres, correct to two places of decimal.

28.3 MEASUREMENT AND PAYMENT

28.3.1 COMPOSITE RATE

The measurement and payment for the items of the work of Iron, Steel and Aluminum Works hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and

shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

28.3.2 LABOUR RATE

The measurement and payment for the items of the work of Iron, Steel and Aluminum Works hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

General Technical Specifications

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29. HORTICULTURE

29.1 GENERAL REQUIREMENTS

29.1.1 SCOPE

Work covered under this section consists of furnishing all labour, equipment and material necessary to perform all operations required for landscaping inclusive but not limited to finished grading, supplying and spreading of soil and manures, turfing, planting/seeding/grass for lawns including supply and installation of tree guards, decorative stones, maintenance period, landscape, warranty, appliances and services necessary for and incidental to completing all the turfing operations and the associated works in a workmanship like manner, according to the provisions of the Contract.

29.1.2 QUALITY ASSURANCE

The work must be undertaken by an experienced contractor specialising in turfing work and other specified activities. Work shall be performed and supervised at all times by qualified personnel.

All materials shall be shipped with certificates of inspection as required by the Engineer-in-Charge. Manufacturer's certified analysis for standard packaged products shall be provided.

29.1.3 SUBMITTALS

The Contractor shall submit catalogue data and literature of manufacturers and suppliers.

The Contractor shall submit manufacturer's certified analysis of all standard products, including soil, fertilisers, peat, seed, inorganic and organic mulches.

The Contractor shall submit a Performance Schedule for plantation of grass and carrying out other works within fourteen (14) days of the start of the Contract. This schedule shall identify the source of procurement of grass for plantation.

The Contractor shall submit a weekly work schedule for approval before work is started. The schedule shall identify tasks to be completed on a weekly basis and the anticipated schedule for completing the tasks. The Contractor will then modify and submit the schedule on a weekly basis identifying tasks completed, tasks to be completed, problems encountered and recommendations.

If ordered a soils report is to be submitted by the Contractor for all soils to be used for preparation of ground. The Contractor shall arrange for an approved independent analyst to prepare a physical and chemical analysis of the soil and irrigation water to be used. The analyst shall also provide recommendations on soil amendment, fertiliser application and the like. The report shall be submitted to the Engineer-in-Charge for approval before soil is placed. In the case of imported soil, the report shall be submitted at least 10 days prior to delivery. The report shall identify the source(s) from which imported soils are to be furnished. At a minimum, the soil shall be analysed for:

- a) Total salts (electro-conductivity of soil solution)
- b) Soil pH

- c) Exchangeable sodium, calcium, magnesium and potassium
- d) Available phosphates
- e) Organic matter as a percentage
- f) Available zinc, manganese, iron and boron
- g) Total sulphates

The soil analysis shall also include fertilisers and other amendment requirements and quantities which when incorporated with the soil will provide the required nutrient levels for vigorous plant growth.

Additional soil samples shall be taken at the rate of one in every 20 loads or as directed by the Engineer-in-Charge and analysed. The results will be compared with the original sample to ensure consistency and compatibility of supply.

If specified, an operation and maintenance manual is to be provided by the Contractor. Instructions shall be furnished for year round care of plantation to be followed by the Owner. As a minimum, the manual will include the following:

- 1 Irrigation details: including water application rates and maintenance procedures
- 2 Fertilisation: including fertiliser descriptions, application rates and application schedule 3 Salinity control: including leaching methods and leaching program monitoring.
- 4 Pesticide/fungicide/herbicide applications: including safety application rates, procedures, and schedules.
- 5 Turf grass management: including mowing procedures, a verification, topdressing, vertical mowing for thatch removal, rolling, over-seeding and springing.
- 6 General maintenance: including pruning, stakes and ties, replacement and clean-up, protective fencing and grading.
- 7 Equipment inventory: including maintenance procedures and manufacturer's maintenance manual.
- 8 Landscape maintenance personnel requirements and job descriptions.

29.1.4 JOB CONDITIONS

The Contractor shall proceed with and complete grass planting operations as rapidly as possible as portions of the Site become available.

No planting shall be carried out during periods of heavy rain, sandstorms, heavy winds, or during intense daytime heat.

When special conditions warrant a variance to the planting time and conditions, a proposed planting schedule shall be submitted to the Engineer-in-Charge for review and approval. In such cases, the planting will be installed at no additional cost and all conditions and obligations such as maintenance and warranty remain the same.

29.2 SOIL

Soil shall be sweet sand or washed marine sand free of admixtures of subsoil, foreign matter, toxic substances, weeds and any material or substance that may be harmful to plant growth. The Contractor shall furnish agricultural soil from approved sites.

Material shall be stored in piles less than 1 metre high. Piles shall be protected from undue compaction and maintained free of contamination and construction debris. The soil shall comply with the following chemical criteria:

- a) pH value: not less than 6.5 nor more than 8.5
- b) Electro-conductivity: less than 4 mm mhos/cm saturated extract at 25 oC
- c) Free carbonates: less than 0.5 % air dried.
- d) Chlorides: less than 200 ppm in saturated extract.
- e) Sulphates: less than 200 ppm in saturated extract.

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Exchangeable sodium: less than 15 % in neutral normal ammonium acetate. f)

Table 00 4/a)

g) Boron: less than 1.5 ppm, hot water soluble.

The soil shall comply with the grading criteria in Table 29.4(a).

l able 29.4(a)					
Sieve Size (mm)	% by Pass				
5.000	100				
2.380	65 to 100				
1.180	45 to 100				
0.600	35 to 80				
0.300	5 to 48				
Sieve Size (mm)	% by Pass				
0.150	0 to 15				
0.075	0 to 3				

29.2.1 SOIL CONDITIONERS & FERTILIZER

Peat shall be used where specified. Peat shall be a natural product of sphagnum moss peat/peat humus derived from a fresh water site. Peat shall be shredded and granulated to pass through a 12 mm mesh screen and conditioned in storage piles for at least 6 months after excavation. The peat shall be free from sticks, stones, roots, and other objectionable matter. It shall have a pH value of not less than 4 and nor more than 7.5. The minimum organic content shall be 85% on a dry weight basis. Peat shall be delivered in undamaged commercial bales in air dry condition.

Manure shall be the decomposed animal manure of fully fermented pre-dried cow or chicken manure with minimum nitrogen, phosphoric acid and potassium percentage of 2-2-2 and a pH value of 6.0 to 7.5. Sludge waste product may be used as a substitute subject to approval of the Engineer-in-Charge. Manure and sludge shall be free of stones, sticks and non-bio-degradable material. Fertilizer shall consist of an approved compound containing not less than

10% Nitrogen

15% Phosphoric Acid 10% Potash or similar approved compound

29.2.2 PLANTING SOIL INGREDIENTS

The planting soil in gradients shall consist of approved soil, peat, manure and other soil conditioners as specified. The ingredients shall be placed in sequence as specified to meet the requirements of grass to be planted.

GRASS PLANTATION (LAWNS) 29.3

29.3.1 SITE PREPARATION FOR PLANTING AREAS

i. . **General Requirements** The Contractor shall examine areas to receive grass plantation with requirements and conditions affecting performance of work in this Section. The Contractor shall not proceed with plant operations until unsatisfactory conditions are discussed with the Engineer-in-Charge and corrected.

The Contractor shall determine the location of above grade and underground utilities and perform work in a manner which will avoid damage to them. Damage to underground utilities shall be repaired at the Contractor's expense.

When conditions detrimental to the growth of grass are encountered, such as rubble, adverse drainage or obstructions, the Contractor shall notify the Engineer-in-Charge prior to planting. The area shall be cleared of stones, pebbles, stubbles, grass roots and other injurious matters and clods shall be broken.

The following pre-planting steps shall be required for building a lawn.

- a) Careful grading makes good drainage so that lawn won't puddle and develop spots that are water logged and soft, or hard and dry.
- b) Incorporating organic matter and other soil amendments which are needed for proper growth and easy maintenance.
- c) Blending of top soil with native soil is done to make a transitional layer between top soil and native soil as it avoids trapping roots in a shallow top soil basin in which they would be dependent on frequent feeding and very frequent watering.

The Engineer-in-Charge shall verify that sub-grades are as specified. ii.

Sub-Surface Grading

All perennial weeds shall be treated with an approved herbicide and the period of time recommended by the manufacturer shall be allowed to elapse prior to commencing grading operations.

Grading operations shall occur when the sub-soil is reasonably dry and workable.

Areas to be graded shall be graded to smooth flowing contours with all minor hollows and ridges removed. Rock projections and boulders shall be removed and disposed of at a location agreed with the Engineer-in-Charge.

Non-cohesive, light subsoil shall be loosened with a 3-tine ripper to a depth of 300 mm at 600 mm centres. Stiff clay and other cohesive subsoil shall be loosened with a single tine ripper to a depth of 450 mm at 1 m centres.

A minimum of 150 mm of approved soil in accordance with 29.2 shall be spread uniformly over the loosened area and incorporated into the sub-grade soil to obtain a uniform and well pulverised soil mix.

The area shall be compacted to a minimum of 90 % of maximum dry density as determined in accordance with Test 13 of BS 1377.

iii. Finished Grading

Grades shall be brought to the finished ground levels agreed with the Engineer-in-Charge to a tolerance of ± 25 mm. Finished ground levels shall be 30 mm below adjoining paving or kerbs after compaction and settlement. Grading shall be carried out in such a manner that even gradients are formed between the spot levels with a pleasant contour. No depressions shall remain which could collect standing water.

Soil shall be placed in lifts not greater than 150 mm in thickness.

The filled area shall be compacted to a minimum of 90% of maximum density as determined in accordance with Test 13 of BS 1377. The manure shall be spread uniformly for the specified thickness.

iv. Scalping Old Lawns

The old lawn contains noxious weed grasses as Bermuda grass and old sod shall be stripped off with flat back spade before building a new lawn. The existing sod shall not be dug into soil as clumps of buried sod.

v. Making the lawn bed smooth

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A lawn bed shall be as smooth and flat as possible. However it should have slight pitch, even in flattened garden. Figure on fall of 6 to 12 inches in 100 feet so that water can run off once the root has reached its saturation point.

29.3.2 SEEDING A PREPARED LAWN BED

Divide the amount of seed necessary for the area into four equal portions, so that there are four approaches over the seed bed. Divide the seed bed half by running a string down the middle. Broadcast one quarter portion down each half, spreading it evenly and uniformly within each marked area. Then run the string across the middle of the lawn in the opposite directions and scatter the remaining two quarter portions on the two halves.

Broadcast the seed on the prepared lawn bed while the air is quite. It shall be done with hand or mechanical seeder.

After the seed is broadcast, rake it in lightly to ensure a thorough contact of seed with seed-bed soil. Very lightly brush up the seeded surface with a wire rake using light circular motion so that the seed is dispersed evenly. In case there are concentrated patches, swirl them out lightly into the surrounding area to make an even covering. At this stage, do the cross raking and mulching in flat soled shoes, tennis shoes, or barefooted.

In case of hot dry weather or drying winds, in the 30 days after sowing, apply a thin, moisture holding mulch, over the seed. After seeding and cross raking, put on a 1/8 to 1/16 inch layer of peat moss of screened sawdust that has been aged at last one year. Don't toss it upward so that it falls in piles.

Whatever the covering, roll it smooth with a light roller (empty) after you have applied it. If a peat moss covering is lumpy, chop up the lumps with the back side of a wire rake before rolling.

For initial watering, use adequate length of hose to get all the way around the lawn without dragging across it and a hand sprinkler that throws out a through but gentle spray. An hour a day for 20 to 30 days of watering shall be needed when days are warm and windy, waters 2 to 3 times a day to keep the surface continuously wet and keep the top dark with moisture until all the grasses are up.

If seeds and mulch happens to wash off on to an adjoining paved area, don't attempt to blast them back into place with the spray as it may washout more seeds along the sides of the seedbed.

After the first week, the little seeding will have gained enough stature to take a bending. It is possible at that time, to pull the weeds that come up with the seeds, lay a plank out across the seedbed and walk along it to pull the weeds.

Mow the lawn first time, when the grass is about 2 inches high or when the blades of grass take on a noticeable curvature. Bent grasses that are to be cut at 1 inch height should never be allowed to grow much higher than 1 inch. It is important that the mower be sharp at all times.

29.3.3 SEEDING ON A SLOPE

Lawns can be planted successfully on the ground that slopes upto 15%. If the slope is steeper, a ground cover or a system of terraces would be more satisfactory.

Prepare the seedbed as described in specifications 29.2.2.with following special care;

When racking the seed bed, rake across the slope, when rolling the seed bed, roll it up and down. Burlap or specially manufactured anti-erosion net spread over a newly seeded slope will keep moisture in the ground and prevent seed from washing away. If burlap is of a tight weave, remove it as soon as the grass begun to come up. Anti-erosion net or loose weave burlap can be left in place to vet. Sprinkler system can be used if the slope can be covered with burlap and holes are cut for the sprinklers head. Otherwise water the seedbed by hand, standing at the bottom of the top. Don't use sprinklers for at least two weeks and then run them slowly to avoid puddling or washout.

If erosion is likely to be a problem, install a drain scraper across the top of the slope to carry water off to one side.

Sodding with desired permanent grasses is a good solution where an immediate erosion hazard exists.

29.3.4 SODDING A PREPARED LAWN BED

i. Shipping and Delivery

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Prior to shipping the grass to be planted shall be inspected, dug, and made ready for shipping in accordance with standard practices and procedures. The Engineer-in-Charge shall be notified of the delivery schedule in advance so the grass may be inspected upon arrival at the Site.

All unacceptable grass shall be removed from the Site immediately. The Engineer-in-Charge may request inspection at the source prior to delivery of grass to the Site. The Engineer-in-Charge reserves the right to reject any delivery that does not meet the quality requirements.

ii. Storage

Grass shall be installed as soon as possible after delivery to the Site. Grass shall be protected from exposure to wind and direct sunlight prior to installation. Grass not installed on the day of arrival shall be stored in shaded areas, protected from the wind and maintained and watered to good horticultural standards until planted. Care shall be taken to ensure that the grass does not dry out.

Seed and fertilisers shall be kept in dry storage away from contaminants in areas as designated or approved by the Engineer-in-Charge.

Soil, compost, fertilisers and other amendments shall be delivered to the Site and stored separately in approved locations and in a manner to avoid contamination and wetting until soil mixing operations commence.

iii. Procedure

Unroll the sod on prepared soil, lay the strips parallel with the strips staggered as in the brick layer running bond patterns. Press each successively laid strip snugly up against the one next to it.

After the sod strips are all laid in this fashion, roll the sod with roller half filled with water to smooth out rough spots and bond the sod with soil.

Now water a little more carefully than usual for a few days till the grass is set.

29.3.5 SPRINGING OR PLANTING GRASS ROOTS

i. Grass Materials

Grass sprigs shall be provided as healthy living stems stolons or rhizomes with attached roots including two to three nodes. They shall be 5 to 15 mm long without adhering soil. The limitation of time between harvesting and planting of sprigs shall be 24 hours. Sprigs shall be obtained from heavy and dense turf, free from weeds. Sprigs that have been exposed to heat and excessive drying will be rejected. Sprigs shall be planted at 150 mm apart in both directions.

Grass seed shall be the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentage of mixtures, purity, weed seed content, and inert material. Seed that has become wet, mouldy, or otherwise damaged will not be acceptable.

On-site seeding shall be done in the presence of the Engineer. The seed mixture shall be sown at the rate of 35 g/m2. Grass seed mixtures shall be listed by schedule with information as follows: a) botanical name

- b) common name
- c) proportion by weight
- d) minimum percentage of pure seed
- e) minimum percentage of germination
- f) maximum percentage of weed seed

Turf shall be strongly rooted, not less than 2 years old, free of weeds and undesirable native grass. Only turf that is capable of vigorous growth and development when laid shall be used.

Turf shall be of a uniform size in width and length. Broken pads or pads with uneven ends will not be acceptable.

ii. Grass Sowing

(i) The soil shall be suitably moistened and then the operation of planting grass shall be commenced. The grass shall be dibbled at 10 cm, 7.5 cm, 5 cm apart in any direction or other spacing as specified to a depth of 15 cm. Dead grass and weeded shall not be planted. The Contractor shall be responsible for watering and maintenance of levels and the lawn for 30 days or till the grass forms a thick lawn free from weeded and fit for mowing whichever is later.

Generally planting in other direction at 15 cm, 10 cm, spacing is done in the case of large open spaces, at 7.5 cm spacing in residential lawn and at 5cm spacing for Tennis Court and sports ground lawn.

(ii) During the maintenance period, any irregularities arising in ground levels due to watering or due to trampling by labour, or due to cattle straying thereon, shall be constantly made up to the proper levels with earth as available or brought from outside as necessary Constant watch shall be maintained to ensure that dead patches are replanted and weeds are removed.

29.4 IRRIGATION WATER

29.4.1 SALT CONTENTS

Irrigation water shall be provided by the Contractor from a source approved by the EngineerinCharge as being suitable for irrigation. Water shall be free from substances harmful to plant life. Water sources shall not exceed the following parameters:

- a) pH : 6 to 7
- b) total dissolved solids : less than 1000 ppm

29.4.2 CAPACITY

Each soil type has its own water holding capacity. The larger the sol particles, the less will be its water holding capacity.

Here is the capacity of 100 square feet of soil, 1 feet deep

i)	In Sand -	6	0 Gal. = 1" deep irrigation
ii)	In Loam -	6	60 Gal. = 1-1/2" deep
irrigation	iii) I	n	Clay - 160 Gal. = 2-1/2"
deep irrig	ation		

Obviously the lighter soil must be watered more frequently than the heavy soil in order to keep moisture in it. In good deep soil grass roots will go down to from 24 to 30 inches, depending upon the type of grass, its age (a lawn root system goes deepest during the first year or two), and how the soil is watered. The root depth is however limited if the top soil is under laid with a layer of soil that is impervious to water.

29.4.3 RATES OF WATER LOSS

The average water loss in mild summer areas is about 1 inch of water each week. In the hot localities, especially when a dry wind is blowing, the weekly loss increases to 2 inches and more in a week.

29.4.4 HOW DEEP DOES THE WATER GO

In dry soil one inch of water will penetrate as follows:

i) In Sand - 12"

ii) In Loam - 6" iii) In

Clay - 4" to - 5"

Water does not move down through soil until each soil particle has its film of water. After each particle has its quota, the additional water is free to move on the external particle. How deep one inch of water will penetrate depends on the moisture in the soil when water is applied.

For example an open field with a clay soil that was completely dried out by the time of a rain, had to receive 10 inches of rain before it becomes wet to a depth of 3 feet. But an added inch of water would penetrate 3 feet and more if the first were saturated.

29.4.5 INTERVALS FOR WATERING OF LAWN

Alternate wetting and partial drying out of soil, encourage healthier plant growth and deeper rooting in hot summer areas.

Normally the soils would need more than 1" deep irrigation every week depending upon the penetration, aeration and the wilting coefficient of soil. Deep watering once a week shall be preferable which is however practicable only in canal irrigated area. In other areas light irrigation is resorted every 2nd or 3rd day or daily sprinkling.

29.5 LAWN MAINTENANCE DURING PLANT ESTABLISHMENT PERIOD

The Contractor shall be responsible for maintenance of lawn as specified. Maintenance shall consist of watering, fertilising, weeding, mowing, trimming and other operations as required to establish a smooth acceptable lawn free of eroded or bare areas. If required, the Contractor shall apply maintenance fertiliser after the second mowing. Any additional fertiliser shall be added when grass is dry. After application of the fertiliser, the area shall be watered well

The Contractor shall maintain lawns for not less than the period stated below and longer as required to establish an acceptable lawn.

Seeded lawn areas shall be maintained through three (3) maintenance cuttings but not less than sixty (60) days after substantial completion.

Sprigged and turfed lawn areas shall be maintained through two (2) maintenance cuttings but not less than thirty (30) days after substantial completion.

29.6 FINAL ACCEPTANCE

Prior to the completion of the plant establishment period, a preliminary inspection shall be undertaken by the Engineer-in-Charge. The time for this inspection shall be established in writing.

The plant establishment and warranty period will end with this inspection provided the grass is growing in healthy condition. The Contractor shall repair any damages and defective turf shall be replaced. Replaced plants will be of the same size and species as originally specified.

A final inspection, if required, shall be undertaken by the Engineer-in-Charge to determine that the deficiencies noted in the preliminary inspection have been corrected. The time for this inspection shall be established in writing.

29.7 DECORATIVE BOULDERS

The stone boulders for placement in lawns shall be of size and shape as specified. The stones shall be of quartzite from river gravel limestone, sandstone from quarry as approved by the EngineerinCharge. Stones shall be hard sound durable and free from weathering and defects and patches of loose or soft materials that may adversely affect strength and appearance.

The stones shall be placed in lawn as specified. The procurement shall be on the basis of sample stones presented by Contractor and approved by the Engineer-in-Charge.

29.8 TREE GUARDS

29.8.1 GENERAL

Tree guard shall be as specified and approved by the Engineer-in-Charge.

29.8.2 BITUMEN DRUMS GUARDS

Bitumen Drum shall be free of damage or any weathering. The drums shall be perforated as specified and painted with alternate lines of black/white enamel paint of an approved brand.

29.8.3 RCC GUARDS

RCC guards shall be of specified sizes and shape and produced complying with the requirements of Section 5 – Plain and Reinforced Concrete. The guards shall be given three inside and outside white washing coats complying with the provisions of Clause 15.3 – White Washing of Section Finishing. The guards shall be cast to the length shown on drawings and shall have a smooth surface.

29.8.4 SOLID BLOCK MASONRY GUARDS

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Solid Block Masonry Blocky Guards for trees shall be of Block Masonry for the size and shape as specified with perforations as shown. The Block masonry shall comply with the provisions of Section – 9 Block Masonry. In general the perforations shall be 33% of the surface area of guards. The foundation shall be of 1:2:4 Plain Concrete as shown in Drawings complying with the requirements of Section 5 – Plain & Reinforced Concrete.

29.8.5 BRICK MASONRY GUARDS

The Brick Masonry Guards for trees shall be of size and shape as shown on Drawings complying with provisions of Section 11 – Brickwork. The white washing shall comply with applicable provisions of Section 15 – Finishes.

29.8.6 STEEL FRAME TREE GUARD

Steel frame Tree Guard shall be of size and shape as specified made of ASTMA-36 steel sections. The members shall be framed by welding according to AWS Code as specified using AWS 7016/7018 electrodes. The tree guards shall be given two coats of enamel paint over a primer as specified in accordance with applicable provisions of Section 15 – Finishes.

29.8.7 G.I. BARBED WIRE

GI barbed wire where specified shall be fixed as shown on Drawings. The work shall comply with applicable provisions of Sub-Section 28.1.7 under - Iron Steel & Aluminium Works.

29.9 MEASUREMENT AND PAYMENT

29.9.1 COMPOSITE RATE

The measurement and payment for the items of the work of horticulture hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

29.9.2 LABOUR RATE

The measurement and payment for the items of the work of horticulture hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

ANNEXURE-B

LAWNS

Contrary to expectations, lawn installation and maintenance are among the more expensive and timeconsuming horticultural activities, The individual grass plants are not only subject to many pests and diseases, but also are deliberately crowded 'and in intense competition for space, light, water, and nutrients. Nevertheless there is great personal desire and community pressure for a beautiful lawn to reduce dust and mud, to soften and enhance the landscape, and to sit and play on.

Glass Seeu Mixtures						
Situation	Hardiness zone	Composition				
Sunny area	3-7	75% improved bluegrasses+25% improved red fescues				
Shady area	3-7	75% improved red fescues+25% improved bluegrasses				
Play area	4-8	80% improved tall fescues+20% perennial rye				
Quick cover	3-9	75% annual rye+25% redtop				
Rough lawn	3-8	33 1/3%ladino clover + 33 1/3% bluegrasses + 33 1/3 % tall fescues				
Heavy traffic	4-8	60%fescues+ 20% bluegrasses +20% perennial rye				
Overseeding	7-9	100% redtop				

Table B-1 Grass Seed Mixtures

Establishing a good lawn demands quality seed, appropriate to the particular soil and climatic conditions. Many grass species have been selected and bred for particular characteristics (Table181). Within these, named cultivars have been developed that are generally superior to the unimproved species. The amed cultivars have the disadvantage of being almost isogenic (genetically uniform) To increase the lawn's survival under adverse conditions, most lawn grasses are sold as mixtures of two or more species. These mixtures are usually' keyed to hardiness zones, to environmental conditions in various lawn climatic regions, arid to the expected use of the lawn. In southern climates (Hardiness Zones 8 to 10) many lawns are established with a single species of grass, frequently as blends of several cultivars. Lawn grass seed should be labeled with the species and cultivars included, the germination percentage, the percentage weed seed (less than 1 percent is best), the percent of inert materials (less than 5 percent) and the percent of crop seed (less than 0.3 percent). Certified seed labels indicate that the plants were inspected in the field and were found to be true to type

SOWING

Sowing seed into a well prepared seed bed can be done by hand or with mechanical grass seeding machine. Since the seed is small, hand seeding, is made easier if the seed is thoroughly mixed with a carrier such as sand or topsoil. To ensure uniform distribution of seed, half the seed is sown in one direction and the other half at right angles to the first lot. After planting, the seed may be raked with a tooth rake to make sure that the seed is in direct contact with the ground. Rolling or treading the seeded area also ensures good contact. The seed should not be covered by more than 0.2 to 0.3 cm (1/8 in.) of soil for most cool-season grasses. Some varieties, such as the bluegrasses, germinate slowly, requiring over three weeks for full germination. Mulching the sown area conserves moisture, prevents the seed from being washed away by heavy rains, and prevents wide swings in temperature. A weed-free straw or hay cover is excellent when used at the rate of 100 kg/100 m2 (100lb/100 ft2). On steep slopes or banks, cheesecloth, sacking, or one of the commercially available mulching cloths can be used. The grass blades will grow through the mulch which usually rots away within a few months.

If the seedbed was properly prepared and adequately fertilized, additional fertilizer may not be needed for the first months of lawn growth. If fall planting was done, a light fertilization in spring when the grass begins to grow may be helpful, particularly if the plants are pale green or yellowish. A phosphorus deficiency is recognized as dark green plants with red stems and reduced growth.

To avoid compaction of the soil, new lawns should not be walked on for the first month following appearance of the seedlings. Mowing can begin at this time with mower height set at 2 in. Chemical weed control is best deferred for another month or can be done the following spring.

SODDING

Sod is pre grown turf consisting of a weed-free mixture of grasses appropriate to the area. It should be purchased locally. Rectangles or strips of a mature turf 1 to 3 years old. are cut with special equipment-to a thickness of 2 to 3 cm (I in.), with little soil below the mat of roots. Laying sod is expensive, but it is an effective method on slopes subject to erosion or where a line, mature lawn is to be established in a short time. In many areas sodding provides an excellent turf, usually weed free, that is permanent with proper maintenance.

In Hardiness Zones 4 to 8 sodding is most successful when done in the fall, although spring sodding may be done if adequate moisture and care are provided. In Hardiness Zones 8 to 10, where warmseason grasses are used, summer sodding is best. It is important that the sad is laid as soon as possible after delivery; a delay of even a few days will injure the turf since the root systems are exposed.

Soil preparation is identical to that used for seedbeds except that the soil is graded 2 to 3 cm (1 in.) lower near walkways to adjust for the thickness of sad. The bed must be well prepared and leveled to allow firm and close contact between the sod; and the soil. Rectangles or strips are planted as tightly together as possible, much as flooring tiles are laid: To minimize trampling or compaction of the soil, a board is laid over the soil surface to be sodded. After the sod is installed, the area is topdressed with a thin layer of good topsoil and topsoil worked into the cracks between the pieces of sodding. The new lawn is light tamped or rolled to ensure good soil-sod contact and is watered immediately. Should be watered frequently for the first growing season to prevent root damage and to encourage good root penetration. A light application of superphosphate will accelerate root penetration.

Some grasses, particularly the warm-season species and the bent grasses, also be established from plugs or plantings (Table B-2). Plug sodding utilize small rectangles or discs of sodded grasses with adhering soil. These are plant 15 to 30 cm (6 to 12 in.) apart in well-prepared bed.

MAINTENANCE

If a fine, thrifty, weed-free lawn is desired, its maintenance becomes a significant part of management and cultivation. Unfortunately, lawns are neither work-free nor trouble-free. Fertilization. Liming, watering or irrigation, mowing. and control of animal and plant pests are the basic constituents of lawn management.

FERTILIZING

If soil nutrients are brought to an adequate level during site preparation, additional fertilization will be unnecessary for the hulk of the first growing season. Indeed, over-fertilization is inadvisable since a young root system is less tolerant of high levels of inorganic salts than is the root system of an established lawn. Excessive nitrogen results in succulent, soft growth that is less disease and insect resistant.

Lawns should not be fertilized when the grass or the soil is wet. But it is good practice to water thoroughly after spreading fertilizer to wash any chemicals off the leaves, This prevents burning and ensures that the fertilizer reaches and enters the soil.

There is some confusion about the amount or rate of fertilizer application. While the phosphorus and potassium components in standard fertilizer formulations are necessary for grass development, lawn grass growth is primarily dependent upon the amount of nitrogen supplied, and it is the nitrogen component that is given primary consideration in determining fertilizer applications. For lawn applications, the amounts needed are usually given as pounds of nitrogen per thousand square feet or kilograms per hundred square meters, To provide 1 lb N/ 1000 ft² (1kg N/100 m2) using a 10-1010 fertilizer, 10 lb (4 kg) of fertilizer would be used.

Fertilizers may contain inorganic nitrogen as ammonium or nitrate ions, organically bound nitrogen, or a mixture of both, Inorganic nitrogen is immediately available to the plants, while organically bound forms release nitrogen slowly. When spring applications of fertilizer to coolseason lawns or summer applications to warm-season lawns are made, the combination formulations work well in spite of their high cost. For fall applications, where immediate uptake in cool weather is desired, only inorganic formulations are cost efficient.

'Fertilization schedules depend on the region and the grass type (figure18-3). Warm-season grasses put on most of their growth during the hot summer months and should be fertilized at the time of maximum growth. Bermuda grass, St.Augustine grass, zoysia, or Bahia grass benefit. from high fertilizer applications. Bermuda grass should receive 5 kg N/100 m2 (5 lb N/1000 ft2), St.Augustine grass and the zoysias 2 kg N/100 m2, and Bahia grass 3 kg N/100 m2.

LIMING

It should be obvious that correction of soil pH should be done only when it needs correcting as determined by a soil test. In general, established lawns on sandy soils require liming every two to three years, while those on clay soils need adjustment only every five to six years. The lime is usually supplied in a finely ground or granular form and can be spread at any time of the year, although late fall or very early spring are best. Amounts vary according to need, but are in the range of 10 to 30 kg/100 m2 (10 to 30 lb/1000 ft2).

WATERING

Watering or irrigation of lawns is, for most areas of North America, a necessity. An acre (0.4 ha)of lawn can transpire 2400 gallons (9600 liters) of water per day in midsummer. Considerable damage will occur if soils dry to their permanent wilting point (-15 bars) for any length of time. Many lawn grass roots grow to 30 cm (1 ft) or more into the subsoil and moisture levels at this depth should not fall below -8 bars during the period when the grasses arc actively growing. It requires 2 to 5 cm (I to 2 in.) of water to bring the upper 30 cm (12 in.) of a sandy or silty loam soil from near wilting point to field capacity. This amount of water will be transpired or lost by evaporation in a week under summer conditions. To replace this water, regular watering is required. In midsummer, when cool-season grasses stop growth and become

summer- dormant, less, water is needed. if it is desirable to maintain growth during this time watering must be continued at somewhat higher rates than the 2 to 5 cm per week.

A light sprinkling of water several times a week is poor management practice. A good deal of this wafer is merely evaporated from leaf and soil surfaces and does-not enter the soil at all. The water that does enter the soil remains in the upper few centimeters and the grass roots become concentrated in this superficial horizon. The danger of massive root kill by even light droughts or a short period of hot weather is great. Watering should provide the amount needed to bring the upper 30 cm (12 in.) to field capacity and should be repeated when this layer is still above the permanent wilting point-usually once a week or more frequently in very hot, dry weather with moderate to high winds.

MOWING

The fundamental rule on lawn mowing is to use only well-designed, well- maintained, and wellsharpened equipment. A dull blade, whether on it reel or a rotary mower, will shatter rather than cut grass blades cleanly and will increase the number of plants that die or become susceptible to infection. Although reel mowers involve more human effort, they preferable to rotary mowers because they cut cleaner and are less dangerous to use.

Cool-season grasses should not, except under special circumstances, be mowed closer than 5 cm (2 in.). Close mowing removes too much of the photosynthetic leaf blade tissue and depresses the growth of-root systems. It also exposes previously shaded stems to direct sunlight which may result in sun scald. Cool-season grasses should be mowed at frequent intervals during the growing period. It is a good general rule that lawns should be mowed when the grass length has exceeded the recommended height by no more than 1.0 to 1.5 cm (1/2 in.) where mowing shock is minimal. The warm-season grasses are generally cut shorter than the cool-season grasses, Bermuda grass is maintained at heights of 1.5 to 2.0 cm (5/8 in.) and the others at 2.0 to 2.5cm (3/4 to 1 in).

WEEDS

A bright green, well-trimmed, and weed-free lawn is not only an esthetic pleasure, but adds financial value to a property. Weed control is a necessary' cultural practice for most areas. Close to 50 species of weed plants invade lawns and require control if clean turf is to be maintained (Figure 18-4). Weed control starts with the turf itself. A healthy lawn, provided with adequate fertilizer, water, and lime and properly mowed, resists the invasion of the seeds of many lawn particularly if the turf is mowed to at least 3.5 to 5.0 cm (1.5 to 2.0 in.), a cutting height that is also best for lawn development.

Weedy species in lawns are separated into persistent (perennial) non persistent (annual) types and each type includes monocots and dicots. Two of the more troublesome weedy plants are the crabgrass and the nimble-wills. Both are monocots related to the lawn grasses. The crab-grasses are annuals, and nimble-will is a persistent perennial. The crab-grasses are vigorous C4. Photosynthetic plants and are particularly difficult to eliminate once they have become established. Other grass species that are problems for lawns are the creeping bent-grasses foxtails, Dallies-grass and quack grass.

Since the desired lawn grasses are usually as sensitive to herbicides as are the weedy species, special control measures are required in an established lawn. When lawns contain few weeds, hand removal is the least damaging method of control. Removal is best done after a rain or thorough irrigation since many weeds have relatively superficial root systems and it is easier to pluck out the entire plant when the soil is damp. Many weeds reproduce easily from rootstocks and failure to remove the entire plant results in spread of the weed. This is particularly true for dandelion (Taraxacum), cinquefoil (Potentilla canadensis) and the plantains (Plantago spp.).

Both pre-emergence and post emergence herbicides are used in any thorough weed control program. The pre-emergence herbicides inhibit weed seed germination and early seedling growth, but have virtually no effect beyond that stage. They are effective in treating established lawns to eliminate crabgrasses, goose- grass (Eleusine indica), and creeping bentgrass all of which are resistant to most other herbicides. They may also be effective against seedlings of broad-leaved weeds, although post emergence herbicides

are usually used for these plants. Pre-emergence herbicides are available as granules that at spread in early spring. They should not be used on new lawns since they can kill lawn grass seedlings.

The post emergence herbicides include 2, 4-dichlorophenoxyacetic acid (2, 4-D) and its derivatives plus a variety of other chemicals that interfere with a number of physiological activities including photosynthesis, respiration, and synthesis of various compounds. Many are available as spreadable granules or as liquid formulations used as sprays. With few exceptions, spray formulations are most effective against young plants: as many weeds age, their tolerance to herbicides increases.

Herbicides are human and animal toxins. and as with all chemicals, package directions should be followed exactly. They can injure or kill desirable plantings and should not be used in very hot weather where they volatilize or in wind conditions where they may be carried to other plantings. Spot applications can be made by tipping a stick with a paint brush or a piece of plastic foam and touching individual weeds with the herbicide. Although formulations of fertilizer plus herbicides are available for dual treatment of lawns, they are more expensive than purchasing and applying each separately, and the timing for optimum effectiveness of each may be different.

PESTS AND DISEASES

Three insect types are responsible for most lawn problems. Those that suck sap include the chinchbugs, some aphids, and scale insects. Plants of Augustine grass in the south are particularly plagued by chinch bugs. The webworms, occasionally called tobacco crambids, are larvae of moths that damage by feeding on grass leaves and stems. Armyworms, the larval stage .S. another moth, are leaf feeders. By far the most serious pests are grubs, the larval hatchlings of the Japanese beetle, Mayor June beetles, and the billbugs. Beetle grub damage is evidenced by death of patches of grass in June through early August and by observations of white grubs directly beneath the sod. These insect feed on the roots of grass plants just below the sod level and can destroy a large lawn area within a week.

The sap sucking insects and leaf feeders are controlled with appropriate insecticide sprays, usually applied in midsummer in the south and a few earlier in more northerly climates. Grubs can be controlled by preventing through sound cultivation practices, trapping or killing adults, use of biological, control and soil treatments with appropriate pesticides.

Other animal pests rarely present major problems. Termites damage the roots of some grass species in the Ohio River basin, wireworms occasionally attack grass rhizomes near potato fields, ants are more of a nuisance. Land crabs dig holes in southern lawns and arc controlled with a rotenone solution poured into each burrow. Mole burrows are unsightly and can result in uprooted plants. Moles feed on grubs, so that grub control almost invariably. Resolves the mole problem. No one has successfully dealt with neighborhood dogs, cats, and squirrels.

A well-managed lawn is the best disease control. Among the worst management practices in terms of disease development is over-fertilization with high nitrogen formulations. Hot, wet summers are unavoidable, but they should alter the gardener that special care must be exercised if serious fungal diseases are to be avoided. Among the most common diseases of lawn grasses are the mildews, rusts, and smuts. Mildew infections look as if the grass had been dusted with a white powder and are controlled with fungicides. Rusts and smuts rarely kill thrifty, deep-rooted grass plants and can usually be controlled by fungicides; Smuts attack tender leaves forming black, powdery spore masses on curled leaves. In northern regions snow molds are a recurrent problem. The snow mold fungi attack overwintering leaves, and the results of their activity, dead circles or patches of grass, are seen when the snow melts. Unless the disease is far advanced, fungicidal treatments are effective.

REPAIR, RESTORATION AND RENOVATION

Even with reasonable maintenance. lawn repair, restoration or renovation becomes necessary. Soil compaction in traveled areas, the growth of shade trees, diseases, and neglect can individually or collectively create problems that must be corrected. These operations should be distinguished from routine maintenance.

Older lawns that show minor wear and tear can be repaired by relatively simple procedures. Chemical and hand removal of weeds is best done prior to mowing the lawn to 2.5 cm (1.0 in.). Clippings should not be added to a compose the heap, but collected and discarded. Fertilization to correct nutrient deficiencies, liming as indicated by soil tests, and accelerated maintenance techniques should be included. Repair work can be done at any time of year, but spring and fall are best.

Much has been written about the horrors of thatch buildup as a factor in lawn decline and waste of it is probably overstated. The stolon's of lawn grasses such as the bents and Bermuda grass are horizontal stems that extend along the ground and become intertwined. As stolon's die, they can form a thick layer of organic material that decomposes slowly, sheds water, causes soils to dry out, and harbors earwigs and other pests. True thatch is a fluffy, matted blanket of these stolon's above the soil.

GROUND COVERS

In many situations grass lawns are neither practical nor desirable. Heavily shaded areas including those on the north sides of structures, under mature trees, and behind hedges and tall fences rarely receive enough light to allow a good lawn to develop; Areas immediately adjacent to woodlots also rarely form good lawn. Steep banks are difficult to mow, are frequently dry and infertile, and rarely can be successfully seeded because of runoff and erosion, All of these situations are being handled by planting ground cover plants. These should not be considered as second choices or compromise plantings, many ground covers are handsome and colorful additions to the landscape (Table B-3). Contrasting textures, foliage colors, and splashes of flower color add greatly to the total view of a garden.

Most effective ground covers are herbaceous perennials or small woody shrubs. They may trail along the ground or spread by rhizomes so that bare areas are quickly covered. Some ground covers are essentially care-free, requiring only minimal fertilizing and watering, while others need as much or more attention as lawn grasses. Because of the large number of possible ground covers, selection is based not only on prevailing environmental conditions, but also on considerations of hardiness, foliage and flower interest, and the landscaping plan.

Many low-growing perennial flowering plants can be used as ground covers, Baby's breath (Gypsophila repens) turfing daisy (Matricaria tchihatchewe), some saxifrages, lily of the valley (Convaltaria majolis), and others can fill in shaded areas .For southern areas (Hardiness Zones 9 to 10), gopher apple (Geobalanus spp.), peperomia, creeping charley (Pilea hummulariaefolia) inch plant (Zebrina pendula), and several species of veronica are excellent shade-tolerant ground covers. Although not usually considered as ground covers, there are herbs to suit most conditions and locations. Included among those that are often used as ground covers are catnip, tarragon, mint, pennyroyal, burnet, germander, lovage.

Latin Name	Common Name	SEEDS		Plugs or Plant		Mowing	Remarks
		Time Rate (lb/1000ft ²)		Time	Rate (lb/1000ft²)	Height (in)	
			Cool Season Grasses				
Agropyron crictatium	Crested Wheetgrass	F	1-2			2	Dry, cool areas

Table B-2

Seeding of Planting of Lawn Areas

Stamp & Signature

Agrostis canina	Velvet bentgrass	F	1-2 1 Hu		Humid, cool areas			
A.gigantea	Redtop	F	1-2			1.5	Quick cover, short- lived.	
A.stolonfera	Creeping bentgrass	F	1-2	F	1000	1	Humid, cool areas	
A.tenuis	Colonial bentgrass	F/S	1-2			1	Humid, cool areas, finest lawns	
Bouteloua grevilis	Blue gramagrass	S	1-2			1.5	Dry, cool areas drought resistant	
Festuca rubre	Red fescue	F	3-5			2	Dry, cool areas shade resistant	
F.ruba	Fescue improved	F	2-4			2	Water resistant, shade tolerant	
F.ruba hetrophylla	Chewing Fescue	F	3-5			1.5	Cool areas, shade resistant	
Lolium mulslorum	Annual ryegrass	F/S	4-6			2	Quick cover, short lived.	
L.perenne	Perennial ryegrass	F/S	3-5			1.5	Used in mixtures with other grasses.	
Poa pratense	Common blue grass	F	2-3			2	Drought resistant, rough use	
P. pratense	Bluegrass improved	F	1-2	F	1000	2	Most common component in mixtures.	
Trifolium repens	White Clover	F/S	2-4	-4 1.5 Cool area legume.		Cool areas, nitrogen fixing legume.		
T.r. forma lodigense	Ladino clover	F/S	2-4				Dry areas, rough lawns	
			Warm season	grasses				
Buchloe dactylsides	Buffalo grass	S	1-2	S	50	1.5	Drought resistant, rough use	
Cynodon Dactylon	Bermuda grass	S	2-3	S/S	10	0.75	Southern areas, in acidic area	
Emerochola optiroides	Centipede grass	S	2-3	S/S	10	1	Low maintenance invasive	
Paspalum notaum	Bahia grass	S	2-3			1	Humid Warm areas, coarse textures	
Stenotaphrum condatum	St. Augustine grass			S/S	30	1	Shade tolerant heat resistant	
Zoysia Matrella	Japanese zoysia	S/S	1-2	S/S	30	1	Wear resistant, yellows in summer	
Z.tenuifolia	Velvet Zoysia	S/S	1-2	S/S	30	1	1 Fine texture, yellows in summers	

Table B-3

Some Ground Cover Plants

Latin name	Common name	Mature height(cm)	Light	Soil	Flowers	Hardiness zone
Acaena microphella	Sheepbur	0.5	FS	N	_	7
Achillea spp.	Yarrow	30	FS	N	_	3
Aegropodium spp.	Goutweed	35	FS	N		4
Ajuga repens	Bugleweed	20	FS	N	+	4
Akebia quinata	Akebia	Vine	Sh	N	_	5
Aloe spp.	Aloe	10	FS	N	+	9
Andromeda polifolia	Bog roesmary	30	FS	Wet	+	3
Arabis alpine	Rock ress	20	FS	N	+	4
Arctostaphylos spp,	Bearberry	30	FS	VVet		3
	Thrift	0 30	FS ES	N/ot	+	3
Cerastium spp.	Snow in summer	20	Sh	N	+	3
Chamaemelum nobile	Chamomile	15	FS	N	+	4
Convallaria majalis	Lily – ofthevalley	20	Sh	N	+	3
Cornus Canadensis	Bunchberry	18	FS	Wet	+	3
Coronilla varia	Crown vetch	60	FS	N	+	4
Dichondra micrantha	Dichondra	8	Sh	N	_	9
Duchesnea indica	Indian	5	Sh	Wet	_	6
	strawberry					
Erica carnae	Heath	25	FS	Acid	+	6
EUONYMUS FORTUNEI	Wintercreeper	15	FS	Wet	_	5
Fragaria chiloensis	Wild strawberry	12	FS		+	5
Galax urcreolate	Wandflower	15	Sh		+	4
Gaultheria procumbens	Wintergreen	1	Sh		+	4
Glechoma hederacea	Ground ivy	2	FS		_	4
Hadera helix	English ivy	Vine	Sh		_	6
Juniperis cvs	Creeping juniper	35	FS		_	4
Liriope spicata	Lilyturf	20	FS		+	7
Mitchella repens	Partrideberry	3	Sh		+	4
Mazus reptans	Mazus	3	Sh		+	4
Ophiopogon japonicas	Dwarf lilyturf	15	Sh		+	6
Pachysandra spp.	Pachysandra	30	Sh		_	5
Phlox subulata	Moss pink	15	FS		+	4
Phylanodiflora	Lippie	10	FS		_	6
Potentilla spp.	Cinquefoil	10	FS		+	5
Prunella vulgaris	Self-heal	5	FS		+	3
Sagina subulata	Pearlwort	10	FS		+	5
Sedum spp.	Stonecrop	10	FS		+	4
Teucrium chamaedrys	Germander	30	Sh		+	6
Thymus spp.	Thyme	4	FS		+	4
Veronica spp.	Speedwell	10	FS		+	4
Vinca minor	Periwinkle	15	Sh		+	5

Vtola spp.	violet	10	Sh	+	3

FS = full sun; Sh = partial shade; N = normal soil ; wet=can withstand wet soil; acid= requires pH

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

M/s	
Contact Person:	
Address	
Tel #	_Fax #
Mobile #	e-mail:
NTN #	SRB Registration #