SIALKOT TANNERIES ASSOCIATION (GUARANTEE) LIMITED (STAGL)

ROAD AND FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE SIALKOT

TENDER DOCUMENTS

Volume-I

Instructions to Bidders, Conditions of Contract, BOQ, Forms of Bid and Appendices to Bid

(SINGLE STAGE ONE ENVELOPE)
BASED ON PPRA STANDARD BIDDING DOCUMENT

April, 2026

SECTION I: INVITATION FOR BIDS

Invitation For Bids

Date: ……..

1. This Invitation for Bids follows the Procurement Notice (PN) / Procurement Advertisement (PA) for " Road and Finishing Works at CETP at Sialkot Tannery Zone, Sialkot" on EPADS.

2. The Sialkot Tannery Association Guarantee Limited (STAGL) has received funds from own and different sources towards the cost of these works, and it intends to apply part of the proceeds of these funds to cover eligible payments under the contract for " Road and Finishing Works at CETP at Sialkot Tannery Zone, Sialkot".

3. The *Procuring Agency* now invites electronic bids from eligible bidders for these works:
   - Registered with SECP
   - Registered with PEC in C-4 or higher category.
   - Holding valid registration and active status with FBR and PRA
   - And meeting the qualification and evaluation criteria set in the documents

4. The bidding shall be conducted in line with the procedure prescribed under Public Procurement Rules 2004, e-Pak Procurement Regulations, 2023 and any Regulations, Regulatory Guides, Procurement Guidelines or Instructions issued by the Authority (from time to time), and is open to all potential bidders registered in the EPADS.

5. All bids must be accompanied by a Bid Security in an acceptable form as specified in Bid Data Sheet (BDS), amounting to **PKR 1,600,000/-**

6. The electronic bids prepared in accordance with the instructions prescribed in the electronic bidding documents must be submitted through EPADS on or before date and time specified in the advertisement. Electronic bids will be opened by using EPADS on the same day at 30 minutes after bid closing time.

   Chief Executive Officer
   Sialkot Tannery Zone,
   05 Km from Sialkot International Airport, Kuluwal Road, Chowk Khambranwala, Sialkot,
   Phone: 052 4365140 / 0336 5386442
   Email: info@stagl-skt.com

Table of Contents

SECTION II: INSTRUCTION TO BIDDERS (ITBs)

A. INTRODUCTION

1. Scope of Bid	1.1	The Procuring agency/Employer (PA), as indicated in the **Bid Data Sheet** (BDS) invites Bids for the execution of Works as specified in the BDS and **Section V- Works Requirements**. The name, identification, and number of lots (contracts) of this National/ International Competitive Bidding process are specified in the BDS.
2. Source of Funds	2.1	Source of funds as referred in Bid Data Sheet.
3. Eligible Bidders	3.1	A bidder may be natural person, company or firm or public or semi-public agency of Pakistan or any foreign country**,** or any combination of them with a formal existing agreement (on Judicial Papers) in the form of a joint venture or consortium. In the case of a joint venture or consortium, all members shall be jointly and severally liable for the execution of the Contract in accordance with the terms and conditions of the Contract. The joint venture or consortium shall nominate a Lead Member as nominated in the BDS, who shall have the authority to conduct all business for and on behalf of any and all the members of the joint venture or consortium during the Bidding process, and in case of award of contract, during the execution of contract. *(The limit on the number of members of JV or Consortium may be prescribed in BDS, in accordance with the guidelines issued by the PPRA)*.
	3.2	The appointment of Lead Member in the joint venture or consortium shall be confirmed by submission of a valid Power of Attorney to the Procuring agency/Employer
	3.3	Verifiable copy of the agreement that forms a joint venture or consortium shall be required to be submitted as part of the Bid.
	3.4	Any bid submitted by the joint venture or consortium shall indicate the part of proposed contract to be performed by each party and each party shall be evaluated (or post qualified if required) with respect to its contribution only, and the responsibilities of each party shall not be substantially altered without prior written approval of the Procuring agency/Employer and in line with any instructions issued by the Authority.

	3.5	The invitation for bids is open to all prospective bidders subject to any provisions of incorporation or licensing by the respective national/ international incorporating agency or statutory body established for that particular trade or business.
	3.6 .	Foreign Bidders must be locally registered with the appropriate national incorporating body or the statutory body, before participating in the national/international competitive bidding with the exception of such procurements made by the foreign missions of Pakistan. For such purpose the bidder must have to initiate the registration process before the bid submission and the necessary evidence shall be submitted to the Procuring agency/Employer along with their bid, however, the final award will be subject to the complete registration process.
	3.7	A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidders may be considered to have a conflict of interest with one or more parties in this Bidding process, if they: a) are associated or have been associated in the past, directly or indirectly with a firm or any of its affiliates which have been engaged by the Procuring agency/Employer to provide consulting services for the preparation of design or technical specifications of the works that are the subject of the bid; or b) any of its affiliates has been hired (or is proposed to be hired) by the Procuring agency/Employer as Engineer for the Contract implementation; or c) The works to be executed are resulting from or directly related to consulting services for the preparation or implementation of the project that the bidder provided or were provided by any affiliate that directly or indirectly controls, is controlled by, or is under common control with that firm; d) have controlling shareholders in common; or e) receive or have received any direct or indirect subsidy from any of them; or f) have the same legal representative for purposes of this Bid; or g) have a relationship with each other, directly or through common third parties, that puts them in a position to

		have access to information about or influence on the bid of another bidder, or influence the decisions of the Procuring agency/Employer regarding this Bidding process; or h) Submit more than one bid in this bidding process.
	3.8	A Bidder may be ineligible if – (a) he is declared bankrupt or, in the case of company or firm, insolvent; (b) payments in favor of the bidder is suspended in accordance with the judgment of a court of law other than a judgment declaring bankruptcy and resulting (in accordance with the national laws) in the total or partial loss of the right to administer and dispose of its property; (c) legal proceedings are instituted against such bidder involving an order suspending payments and which may result, in accordance with the national laws, in a declaration of bankruptcy or in any other situation entailing the total or partial loss of the right to administer and dispose of the property; (d) the bidder is convicted, by a final judgment of a Court of Law or relevant Professional Statuary Body, of any offence involving professional conduct; (e) The bidder is debarred/ blacklisted by a national level Procuring agency/Employer and hence debarred due to involvement in corrupt and fraudulent practices, or performance failure or due to breach of bid securing declaration. (f) The bidder is blacklisted or debarred by a foreign country, international organization, or other foreign institutions for the period defined by them.
	3.9	Bidders shall provide to the Procuring agency/Employer evidence of their eligibility, proof of compliance with the necessary legal requirements to carry out the contract effectively.
	3.10	Bidders shall provide such evidence of their continued eligibility to the satisfaction of the Procuring agency/Employer, as the Procuring agency/Employer shall reasonably request.
	3.11	Bidders shall submit proposal relating to the nature, conditions

		and modalities of sub-contracting wherever the sub-contracting of any elements of the contract is envisaged.
4. Eligible Material and Equipment	4.1	All the material and equipment to be mobilized under the contract shall have their origin in eligible source countries, and all expenditures made under the contract will be limited to such materials and equipment. For this purpose, ineligible countries are stated in the section-IV titled as "Eligible Countries".
	4.2	For purposes of this Clause, "origin" means the place where the material, equipment is produced, manufactured, or processed, or through manufacture, procession, or assembly, another commercially recognized article results that differs substantially in its basic characteristics from its imported components or the place from where the services are/to be supplied.
	4.3	The nationality of the bidder shall not determine the origin of the material and equipment.
	4.4	To establish the eligibility of the material and equipment, Bidders shall fill the country-of-origin declarations included in the Form of Bid.
5. One Bid per Bidder	5.1	A bidder shall submit only one bid, in the same bidding process, either individually as a bidder or as a member in a joint venture or any similar arrangement.
	5.2	No bidder can be a sub-contractor while submitting a bid individually or as a member of a joint venture in the same bidding process.

6. Cost of Bidding	6.1	The Bidder shall bear all costs associated with the preparation and submission of its bid, and the Procuring agency/Employer shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.
B. BIDDING DOCUMENTS		
7. Contents of Bidding Documents	7.1	The scope of Works, bidding procedures, and terms and conditions of the contract are prescribed in the bidding documents. In addition to the Invitation for Bids, the bidding documents which should be read in conjunction with any addenda issued in accordance with **ITB 9.2** include: **Section I -**Invitation for Bids **Section II** Instructions to Bidders (ITBs) **Section III** Bid Data Sheet (BDS) **Section IV** Eligible Countries **Section V** Works Requirements Technical Specifications & Schedule of Requirements **Section VI** Standard Bidding Forms **Section VII** General Conditions of Contract (GCC) **Section VIII** Special Conditions of Contract (SCC) **Section IX** Contract Forms
	7.2	The number of copies to be completed and submitted with the Bid is specified in the **BDS.**
	7.3	The Procuring agency/Employer is not responsible for the completeness of the bidding documents and their addenda, if they were not obtained directly from the Procuring agency/Employer or the signed pdf version downloaded from the website of the Procuring agency/Employer or the Authority's website or e-Procurement System as the case may be. However, Procuring agency/Employer shall place both the pdf and editable version of the same on its website and Authority's website or e-Procurement System to facilitate the bidder for filling the standard bidding forms.
	7.4	The bidder is expected to examine all instructions, forms, specifications, terms and conditions prescribed in the bidding documents. Failure to furnish all the information required in the bidding documents will be at the bidder's risk and may result in the rejection of his bid.

8. Clarification of Bidding Document, Pre-bid Meeting	8.1	A prospective bidder requiring any clarification of the bidding document may notify the Procuring agency/Employer in writing or in electronic form that provides record of the contents of communication at the Procuring agency/Employer's address indicated in the **BDS.**
	8.2	The Procuring agency/Employer will within three (3) working days after receiving the request for clarification, respond in writing or in electronic form to any request for clarification provided that such request is received not later than three (03) days prior to the deadline for the submission of Bids as prescribed in **ITB 24.1.** However, this clause shall not apply in case of alternate methods of procurement.
	8.3	Copies of the Procuring agency/Employer's response will be forwarded to all identified prospective bidders through an identified source of communication, including a description of the inquiry, but without specifying its source. In case of downloading of the bidding documents from the website of Procuring agency/Employer or e-Procurement System, the response of all such queries will also be available on the same platform available at the website.
	8.4	Should the Procuring agency/Employer deem it necessary to amend the bidding documents as a result of a clarification, it shall do so following the procedure as prescribed under **ITB 09.**
	8.5	If indicated **in the BDS**, the bidder's designated representative is invited at the bidder's cost to attend a pre-bid meeting at the place, date and time mentioned in the **BDS**. During this pre-bid meeting, prospective bidders may request clarification of the schedule of requirement, the evaluation criteria or any other aspects of the bidding documents.
	8.6	Minutes of the pre-bid meeting, if applicable, including the text of the questions asked by bidders, including those during the meeting (without identifying the source) and the responses given, together with any responses prepared after the meeting will be transmitted promptly to all prospective bidders who have obtained the bidding documents. Any modification to the bidding documents that may become necessary as a result of the pre-bid meeting shall be made by the Procuring agency/Employer exclusively through the use of an Addendum pursuant to **ITB 9.** Non-attendance at the pre-bid

		meeting will not be a cause for disqualification of a bidder.
	8.7	The bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the bidder's own expense.
	8.8	The bidder and any of its authorized personnel will be granted permission by the Procuring agency/Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder and its personnel will release and indemnify the Procuring agency/Employer from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.
9. Amendment of Bidding Documents	9.1	Before the deadline for submission of bids, the Procuring agency/Employer for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder or pre-bid meeting may modify the bidding documents by issuing addenda.
	9.2	Any addendum issued including the notice of any extension of the deadline shall be part of the bidding documents pursuant to **ITB 7.1** and shall be communicated in a timely manner and on equal opportunity basis. Where notification of such change, addition, modification or deletion becomes essential, such notification shall be made in a manner similar to the original advertisement. *Provided that the bidder who had either already submitted their bid or handed over the bid to the courier prior to the issuance of any such addendum shall have the right to withdraw his already filed bid and submit the revised bid prior to the original or extended bid submission deadline.*
	9.3	To give prospective bidders reasonable time in which to take an addendum/corrigendum into account in preparing their bids, the Procuring agency/Employer may, at its discretion, extend the deadline for the submission of bids: *Provided that the Procuring agency/Employer shall extend the deadline for submission of bid, if such an addendum is issued within last three (03) days of the bid submission deadline.*

C. PREPARATION OF BIDS

10. Language of Bid	10.1	The bid prepared by the bidder, as well as all correspondence and documents relating to the bid exchanged by the bidder and the Procuring agency/Employer shall be written in the English language unless specified in the B**DS.** Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant pages in the English language unless specified in the **BDS**, in which case, for purposes of interpretation of the bidder, the translation shall govern.
11. Documents Establishing Eligibility of Material, Equipment and Works, their Conformity to Bidding Documents	11.1	The bid prepared by the bidder shall constitute the following components: - a) Documentary evidence established in accordance with **ITB 11** that the material, equipment and services to be provided by the Bidder are eligible material, equipment and services, and conform to the Bidding Documents; b) Documentary evidence established in accordance with **ITB 12** that the bidder has been authorized to carry out the Construction works; c) Documentary evidence established in accordance with **ITB 12** that the bidder is eligible and/or qualified for the subject bidding process; d) Form of Bid and Bid Prices completed in accordance with **ITB 14 and 15;** **e)** Completed schedules as required, including priced Bill of Quantities in accordance with **ITB 13 & 15.** **f)** Technical Proposal completed in all aspects in accordance with **ITB-17**. g) Bid security or Bid Securing Declaration furnished in accordance with **ITB 19;** h) Alternative bids, if permissible, in accordance with **ITB 20;** i) Duly Notarized Power of Attorney authorizing the signatory of the Bidder to submit the bid**;** and j) Any other document required in the **BDS**.

	11.2	In addition to the requirements, bids submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all members. Alternatively, a letter of intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all members and submitted with the bid, together with a copy of the proposed Agreement.
	11.3	The bidder shall furnish, as part of its bid, all those documents establishing the eligibility in conformity to the terms and conditions specified in the bidding documents for all material, equipment and works which the bidder proposes to execute.
	11.4	The documentary evidence of conformity of the material, equipment and works to the Bidding Documents may be in the form of literature, drawings, and data, and shall consist of: a) a detailed description of the work methodology, approach, schedule and resources to be mobilized at site; b) an item-by-item commentary on the Procuring agency/Employer's Technical Specifications demonstrating substantial responsiveness of the material, equipment and works to those specifications, or a statement of deviations and exceptions to the provisions of the Technical Specifications; c) any other procurement specific documentation requirement as stated in the **BDS**.
	11.5	The required documents and other accompanying documents must be in English. In case any other language than English is used the pertinent translation into English shall be attached to the original version.
12. Documents Establishing Eligibility and Qualification of the Bidder	12.1	The bidder shall furnish, as part of its bid, all those documents establishing the bidder's eligibility to participate in the bidding process and/or its qualification to perform the contract if its bid is accepted.
	12.2	The documentary evidence of the bidder's eligibility to bid shall establish to the satisfaction of the Procuring agency/Employer that the bidder, at the time of submission of its bid, is from an eligible country as defined in Section-IV titled as "Eligible Countries".
	12.3	The documentary evidence of the bidder's qualification to perform the contract if its bid is accepted shall establish to the satisfaction of Procuring agency/Employer that:

		a) The bidder has the financial and technical capability necessary to perform the Contract, meets the qualification criteria specified in Section-V, Evaluation and Qualification Criteria and **BDS**. b) In the case of a bidder not doing business within Pakistan, the bidder is or will be (if awarded the contract) represented by a local bidder (Joint Venture) in accordance with the PEC works bylaws, and in case of award of works such foreign firm is required to participate in the execution of works to carry out its obligations as prescribed in the Conditions of Contract and /or Technical Specifications. c) That the bidder meets the qualification criteria listed in Section-V, Evaluation and Qualification Criteria and **BDS.**
13. Letter of Bid and Schedules	13.1	The Letter of Bid (Technical or Financial as the case may be) and Schedules, including the Bill of Quantities, shall be prepared using the relevant forms furnished in Standard Bid Forms. The forms must be completed without any alterations to the text, and no substitutes shall be accepted except as provided under **ITB 22.** All blank spaces shall be filled in with the information requested.
14. Letter of Bid	14.1	The bidder shall fill the Letter of Bid (Technical or Financial as the case may be) furnished in the bidding documents. The Standard Bid Forms must be completed without any alterations to its format and no substitute shall be accepted.
15. Bid Prices	15.1	The bid prices quoted by the bidder in the Standard bid Forms, Bill of Quantities and in the Price Schedules shall conform to the requirements specified below or exclusively mentioned hereafter in the bidding documents.
	15.2	The bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. If a Price Schedule shows items listed but not priced, their prices shall be construed to be included in the prices of other items in the Bill of Quantities and will not be paid for separately by the Procuring agency/Employer.
	15.3	Items not listed in the Price Schedule shall be assumed not to be included in the bid, and provided that the bid is still substantially responsive in their absence or due to their nominal nature, the corresponding average price of the respective item(s) of the remaining substantially responsive bidder(s) shall be construed to be the price of those missing item(s):

		Provided that: a) where there is only one (substantially) responsive bidder, or b) where there is provision for alternate proposals and the respective items are not listed in the other bids, The Procuring agency/Employer may fix the price of missing items in accordance with market survey, and the same shall be considered as final price.
	15.4	The Bid price to be quoted in the Form of Bid in accordance with **ITB 15.1** shall be the total price of the bid.
	15.5	Unless otherwise specified in the **BDS** and the Contract, the rates and prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract.
	15.6	If so specified in **ITB 1.1**, bids may be invited for individual lots (contracts) or for any combination of lots (packages).
	15.7	Prices quoted by the Bidder shall be fixed during the bidder's performance of the contract and not subject to variation on any account. A bid submitted with an adjustable price will be treated as non-responsive and shall be rejected, pursuant to **ITB 30,** unless otherwise price adjustment is permissible under Conditions of the Contract.
	15.8	All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date twenty-eight (28) days prior to the deadline for submission of bids, shall be included in the rates and prices and the total bid price submitted by the bidder.
16. Currencies of Bid and Payment	16.1	The currency(ies) of the bid and the currency(ies) of payments shall be as specified in the **BDS.**
	16.2	For the purposes of comparison of bids quoted in different currencies, the price shall be converted into a single currency specified in the bidding documents. The rate of exchange shall be the selling rate, prevailing on the date of opening of (financial part of) bids specified in the bidding documents, as notified by the State Bank of Pakistan on that day.
	16.3	Bidders shall indicate details of their expected foreign currency requirements in the Bid, if prescribed in the BDS.
	16.4	Bidders may be required by the Procuring agency/Employer to clarify their foreign currency requirements, if prescribed in the

		BDS and to substantiate that the amounts included in Lump Sum and in the **SCC** are reasonable and responsive to **ITB 16.1**.
17. Documents Comprising the Technical Proposal	17.1	The bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in **Section IV – Standard Bid Forms**, in sufficient detail to demonstrate the adequacy of the bidder's proposal to meet the work requirements and the completion time.
18. Bid Validity Period	18.1	Bids shall remain valid for the period specified in the **BDS** after the bid submission deadline prescribed by the Procuring agency/Employer. A bid valid for a shorter period shall be rejected by the Procuring agency/Employer as non-responsive**.** The period of bid validity will be determined from the complementary bid securing instrument i.e. the expiry period of bid security or bid securing declaration as the case may be.
	18.2	Under exceptional circumstances, prior to the expiration of the initial bid validity period, the Procuring agency/Employer may request the bidders' consent to an extension of the period of validity of their bids only once, for the period not more than the period of initial bid validity. The request and the bidders' responses shall be made in writing or in electronic forms that provide record of the content of communication. The Bid Security provided under **ITB 19** shall also be extended 28 days beyond the deadline of extended bid validity period. A bidder may refuse the request for the extension of his bid without forfeiting his bid security or causing to be executed his Bid Securing Declaration. A bidder agreeing to the request will not be required nor permitted to modify its bid, but will be required to extend the validity of its Bid Security or Bid Securing Declaration for the period of the extension, and in compliance with **ITB 19** in all respects.
19. Bid Security or Bid Securing Declaration	19.1	Pursuant to **ITB 11.1** unless otherwise specified in the **BDS**, the bidder shall furnish as part of its bid, a Bid Security in form of fixed amount not exceeding five percent of the estimated value of procurement determined by the Procuring agency/Employer and in the amount and currency specified in the **BDS** or Bid Securing Declaration as specified in the **BDS** in the format provided in **Section VI (Standard Bidding Forms)**.

		In case Procuring agency/Employer is inviting bids in lots / packages, the bidder shall be required to submit his bid security against the respective lot/ package for which he is submitting his bid, which shall not exceed five percent of the estimated value of that particular lot/ package.
	19.2	The Bid Security or Bid Securing Declaration is required to protect the Procuring agency/Employer against the risk of Bidder's conduct before award of the contract to the most advantageous bidder which would warrant the security's forfeiture, pursuant to **ITB 19.9.**
	19.3	The Bid Security shall be denominated in the local currency or in another freely convertible currency, and it shall be in the form specified in the **BDS** which shall be in any of the following: a) A bank guarantee, an irrevocable letter of credit issued by a Scheduled bank in the form provided in the Bidding Documents or another form acceptable to the Procuring agency/Employer and valid for twenty-eight (28) days beyond the end of the validity of the Bid. This shall also apply if the period for Bid Validity is extended. In either case, the form must include the complete name of the bidder; b) A cashier's or certified cheque; or c) Another security as indicated in the **BDS.**
	19.4	The Bid Security or Bid Securing Declaration shall be in accordance with the Form of the Bid Security or Bid Securing Declaration included in **Section VI (Standard Bidding Forms)** or another form approved by the Procuring agency/Employer prior to the bid submission.
	19.5	The Bid Security shall be payable promptly upon written demand by the Procuring agency/Employer in case any of the conditions listed in **ITB 19.9** are invoked.
	19.6	Any bid not accompanied by a Bid Security or Bid Securing Declaration in accordance with **ITB 19.1 or 19.3** shall be rejected by the Procuring agency/Employer and shall be declared as non-responsive bid, pursuant to **ITB 30**.
	19.7	Unsuccessful bidders' Bid Security will be discharged or returned as promptly as possible, however in no case later than thirty (30) days after the expiration of the period of Bid Validity prescribed by the Procuring agency/Employer pursuant to **ITB**

		18. The Procuring agency/Employer shall make no claim to the amount of the Bid Security, and shall promptly return the Bid Security document, after whichever of the following that occurs earliest: (a) The expiry of the Bid Security; (b) The entry into force of a procurement contract and the provision of a performance security (or guarantee), for the performance of the contract if such a security (or guarantee), is required by the Biding documents; (c) The rejection by the Procuring agency/Employer of all Bids; (d) The withdrawal of the bid prior to the deadline for the submission of bids, unless the biding documents stipulate that no such withdrawal is permitted.
	19.8	The successful bidder's Bid Security will be discharged upon the bidder signing the contract pursuant to **ITB 47,** or furnishing the performance security (or guarantee), pursuant to **ITB 48**.
	19.9	The Bid Security may be forfeited or the Bid Securing Declaration executed: a) if a Bidder: i) Withdraws its Bid during the period of Bid Validity as specified by the Procuring agency/Employer, and referred by the bidder on the Form of Bid except as provided for in **ITB 18.2**; or ii) Does not accept the correction of errors pursuant to **ITB 32;** or b) In the case of a successful bidder, if the bidder fails: i) to sign the contract in accordance with **ITB 47**; or ii) to furnish performance security (or guarantee) in accordance with **ITB 48.**
	19.10	In case of Bid Security issued by the foreign bank is allowed by the Procuring agency/Employer, the same should be counter guaranteed by a corresponding bank in Pakistan. Furthermore, in case of joint venture, it should be in the name of Joint venture to ensure joint responsibility.
20. Alternative Bids by Bidders	20.1	Bidders shall submit offers that comply with the requirements of the bidding documents, including the basic bidder's technical design as indicated in the specifications and Bill of Quantities. Alternatives will not be considered, unless

		specifically allowed for in the **BDS**. If so allowed, **ITB 20** shall prevail.
	20.2	When alternative schedule for execution of works is explicitly invited, a statement of that effect will be included in the **BDS** as will the method for evaluating different schedule for execution of works.
	20.3	If so allowed in the **BDS**, bidders wishing to offer technical alternatives to the requirements of the bidding documents must also submit a bid that complies with the requirements of the bidding documents, including the basic technical design as indicated in the specifications. In addition to submitting the basic bid, the bidder shall provide all information necessary for a complete evaluation of the alternative by the Procuring agency/Employer, including technical specifications, breakdown of prices, and other relevant details. Only the technical alternatives, if any, of the Most Advantageous Bidder conforming to the basic technical requirements (without altering the bid price) shall be considered by the Procuring agency/Employer.
21. Withdrawal of Bids	21.1	Before bid submission deadline, any bidder may withdraw, substitute, or modify its bid after it has been submitted by sending a written notice, duly signed by an authorized representative, and the corresponding must accompany the respective written notice.
	21.2	Bids requested to be withdrawn in accordance with **ITB 21.1** shall be returned unopened to the bidders.
22. Format and Signing of Bid	22.1	The Bidder shall prepare an original and the number of copies of the bid as indicated in the **BDS**, clearly marking each **"ORIGINAL"** and **"COPY"** as appropriate. In the event of any discrepancy between them, the original shall prevail: *Provided that except in Single Stage One Envelope Procedure, the bid shall include only the copies of technical proposal.*
	22.2	The original and the copy (ies) of the bid shall be typed or written in indelible ink and shall be signed by the bidder or a person or persons duly authorized to sign on behalf of the bidder. This authorization shall consist of a written confirmation as specified in the **BDS** and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid, except for un-amended printed literature, shall

		be initialed by the person or persons signing the bid.
	22.3	Any interlineations, erasures, or overwriting shall be valid only if they are signed by the person(s) authorized for signing the Bid.

D. SUBMISSION OF BIDS

23. Sealing and Marking of Bids	23.1	In case of Single Stage One Envelope Procedure, the bidder shall seal the original and each copy of the bid in separate envelopes, duly marking the envelopes as **"ORIGINAL"** and **"COPY".** The envelopes shall then be sealed in an outer envelope securely sealed in such a manner that opening and resealing cannot be achieved undetected. **Note:** *The envelopes shall be sealed and marked in accordance with the bidding procedure adopted as referred in Rule-36 of Public Procurement Rules,2004.*
	23.2	The inner and outer envelopes shall: a) be addressed to the Procuring agency/Employer at the address given in the **BDS**; and b) bear the title of the subject procurement or project name, as the case may be as indicated in the **BDS**, the Invitation for Bids (ITB) title and number indicated in the **BDS**, and a statement: **"DO NOT OPEN BEFORE",** to be completed with the time and the date specified in the **BDS**, pursuant to **ITB 24.1.**
	23.3	In case of Single Stage Two Envelope Procedure, The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Proposal and the other Financial Proposal. Both envelopes to be enclosed together in an outer single envelope called the Bid. Each Bidder shall submit his bid as under: a) Bidder shall submit his **TECHNICAL PROPOSAL** and **FINANCIAL PROPOSAL** in separate inner envelopes and enclosed in a single outer envelope. b) **ORIGINAL** and each copy of the Bid shall be separately sealed and put in separate envelopes and marked as such. c) The envelopes containing the **ORIGINAL** and copies will be put in one sealed envelope and addressed / identified as given in **ITB 23.2.**
	23.4	The inner and outer envelopes shall: a) be addressed to the Procuring agency/Employer at the

		address provided in the **BDS**; b) bear the name and identification number of the contract as defined in the **BDS**; and provide a warning not to open before the time and date for bid opening, as specified in the **BDS** pursuant to **ITB 24.1.** c) In addition to the identification required in **ITB 23** hereof, the inner envelope shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to **ITB 25.**
	23.5	If all envelopes are not sealed and marked as required by **ITB 23.2**, **ITB 23.3** and **ITB 23.4** or incorrectly marked, the Procuring agency/Employer will assume no responsibility for the misplacement or premature opening of bid.
24. Deadline for Submission of Bids	24.1	Bids shall be received to the Procuring agency/Employer no later than the date and time specified in the **BDS.**
	24.2	The Procuring agency/Employer may, under exceptional circumstances and at its discretion, extend the deadline for the submission of bids by amending the Bidding Documents in accordance with **ITB 9**, in which case all rights and obligations of the Procuring agency/Employer and bidders previously subject to the deadline will thereafter be subject to the new deadline.
25. Late Bids	25.1	The Procuring agency/Employer shall not consider for evaluation of any bid that arrives after the deadline for submission of bids, in accordance with **ITB 24**.
	25.2	Any bid received by the Procuring agency/Employer after the deadline for submission of bids shall be declared late, recorded, rejected and returned unopened to the bidder.
26. Substitution and Modification of bids	26.1	A bidder may substitute or modify his bid after it has been submitted, provided that written notice of the substitution or modification of the bid, is received by the Procuring agency/Employer prior to the deadline for submission of bids.
	26.2	Revised bid may be submitted after the substitution or modification made in the original bid in accordance with the provisions referred in **ITB 22.**

E. OPENING AND EVALUATION OF BIDS

27. Opening of Bids	27.1	The Procuring agency/Employer will open all bids, in public, in the presence of bidders' or their representatives who choose to attend, and other parties with a legitimate interest in the bid proceedings at the place, on the date and at the time, specified in the **BDS**. The bidders' representatives present shall sign a attendance sheet as a proof of their attendance.
	27.2	First, envelopes marked **"WITHDRAWAL"** shall be opened and read out and the envelope with the corresponding bid shall not be opened, but returned to the bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening.
	27.3	Second, outer envelopes marked **"SUBSTITUTION**" shall be opened. The inner envelopes containing the Substitution Bid shall be exchanged for the corresponding Original Bid being substituted, which is to be returned to the bidder unopened. No envelope shall be substituted unless the corresponding Substitution Notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.
	27.4	Next, outer envelopes marked **"MODIFICATION"** shall be opened. No Technical Proposal and/or Financial Proposal shall be modified unless the corresponding Modification Notice contains a valid authorization to request the modification and is read out and recorded at the opening of the bids. Any modification shall be read out along with the Original Bid except in case of Single Stage Two Envelope Procedure where only the Technical Proposal, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Financial Proposal, both Original and Modification, will remain unopened till the prescribed financial bid opening date.
	27.5	Other envelopes holding the bids shall be opened one at a time, in case of Single Stage One Envelope Procedure, the bidders' names, the bid prices, the total amount of each bid and of any alternative bid (if alternatives have been requested or permitted), the presence or absence of Bid Security, Bid Securing Declaration and such other details as the Procuring agency/Employer may consider appropriate, will be announced by the Procurement Evaluation Committee.

	27.6	In case of Single Stage Two Envelope Procedure, the Procuring agency/Employer will open the Technical Proposals in public at the address, date and time specified in the **BDS** in the presence of bidders' designated representatives who choose to attend and other parties with a legitimate interest in the bid proceedings. The Financial Proposals will remain unopened and will be held in custody of the Procuring agency/Employer until the specified time of their opening.
	27.7	The envelopes holding the Technical Proposals shall be opened one at a time, and the following read out and recorded: (a) the name of the bidder; (b) whether there is a modification or substitution; (c) the presence of a Bid Security or Bid Securing Declaration, if required; and (d) Any other details as the Procuring agency/Employer may consider appropriate.
	27.8	Bids not opened and not read out at the bid opening shall not be considered further for evaluation, irrespective of the circumstances.
	27.9	Bidders are advised to send in a representative with the knowledge of the content of the bid who shall verify the information read out from the submitted documents. Failure to send a representative or to point out any un-read information by the sent bidder's representative shall indemnify the Procuring agency/Employer against any claim or failure to read out the correct information contained in the bidder's bid.
	27.10	No bid will be rejected at the time of bid opening except for late bids which will be returned unopened to the bidder, pursuant to **ITB 25.**
	27.11	The Procuring agency/Employer shall prepare minutes of the bid opening. The record of the bid opening shall include, as a minimum: the name of the bidder and whether or not there is a withdrawal, substitution or modification, the bid price if applicable and the presence or absence of a Bid Security or Bid Securing Declaration.
	27.12	The bidders' representatives who are present shall be requested to sign on the attendance sheet. The omission of a bidder's signature on the record shall not invalidate the contents and affect the record. A copy of the record shall be distributed to all the bidders.
	27.13	A copy of the minutes of the bid opening shall be furnished to individual bidders upon request.

	27.14	In case of Single Stage -Two Envelop Bidding Procedure, after the announcement of technical evaluation report, the Procuring agency/Employer, shall at a time within the bid validity period, publicly open the financial proposals of the technically responsive bidder only. The financial proposal of bidders found technically non-responsive shall be returned un-opened to the respective bidders after seven days of the announcement of technical evaluation report, except those aggrieved bidder(s) whose complaints are pending before the Grievance Redressal Committee.
28. Confidentiality	28.1	Information relating to the examination, clarification, evaluation and comparison of bids and recommendation of contract award shall not be disclosed to bidders or any other persons not officially concerned with such process until the time of the announcement of the respective evaluation report.
	28.2	Any effort by a bidder to influence the Procuring agency/Employer processing of bids or award decisions may result in the rejection of its bid.
	28.3	Notwithstanding **ITB 28.2** from the time of bid opening to the time of contract award, if any bidder wishes to contact the Procuring agency/Employer on any matter related to the bidding process, it should do so in writing or in electronic forms that provides record of the content of communication.
29. Clarification of Bids	29.1	To assist in the examination, evaluation and comparison of bids, the Procuring agency/Employer may, ask any bidder for a clarification of its bid including breakdown of prices invariably in writing. Any clarification submitted by a bidder that is not in response to a request by the Procuring agency/Employer shall not be considered.
	29.2	The request for clarification and the response shall be in writing or in electronic forms that provide record of the content of communication. No change in the prices or substance of the bid shall be sought, offered, or permitted, except clarification for the correction of arithmetic errors discovered by the Procuring agency/Employer during the evaluation of bids which shall be sought in accordance with **ITB 32**.
	29.3	The alteration or modification in the bid which in any case affect the following parameters will be considered as a change in the substance of a bid: a) evaluation & qualification criteria;

		b) required scope of work; c) contract price; d) all securities requirements; e) tax requirements; f) terms and conditions of bidding documents. g) change in the ranking of the bidder
	29.4	From the time of bid opening to the time of Contract award if any bidder wishes to contact the Procuring agency/Employer on any matter related to the bid it should do so in writing or in electronic forms that provide record of the content of communication.
30. Preliminary Examination of Bids	30.1	Prior to the detailed evaluation of bids, the Procuring agency/Employer will determine whether each bid: a) meets the eligibility criteria defined in **ITB 3** and **ITB 4**; b) has been prepared as per the format and contents defined by the Procuring agency/Employer in the bidding documents; c) has been properly signed; d) is accompanied by the required securities; and e) is substantially responsive to the requirements of the bidding documents. The Procuring agency/Employer's determination of a bid's substantial responsiveness will be based on the contents of the bid itself.
	30.2	A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the Bidding Documents, without material deviation or reservation. A material deviation or reservation is one that: - a) affects in any substantial way the scope, quality, or performance of the Works; b) limits in any substantial way, inconsistent with the bidding documents, the Procuring agency/Employer's rights or the bidders' obligations under the Contract; or c) if rectified, would affect unfairly the competitive

		position of other bidders presenting substantially responsive bids.
	30.3	The Procuring agency/Employer will confirm that the documents and information specified under **ITB 11, 12** and **13** have been provided in the bid. If any of these documents or information is missing, or is not provided in accordance with the Instructions to Bidders, the bid shall be rejected.
	30.4	The Procuring agency/Employer may waive-off any minor informality, nonconformity, or irregularity in a bid which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Bidder. ***Explanation:*** *A minor informality, non-conformity or irregularity is one that is merely a matter of form and not of substance. It also pertains to some immaterial defect in a Bid or variation of a bid from the exact requirements of the invitation that can be corrected or waived without being prejudicial to other bidders. The defect or variation is immaterial when the effect on quantity, quality, or delivery is negligible when contrasted with the total cost or scope of the works. The Procuring agency/Employer either shall give the bidder an opportunity to cure any deficiency resulting from a minor informality or irregularity in a bid or waive the deficiency, whichever is advantageous to the Procuring agency/Employer. Examples of minor informalities or irregularities include failure of a bidder to –* (a) *Submit the number of copies of signed bids required by the invitation;* (b) *Furnish required information concerning the number of its employees;* (c) *the firm submitting a bid has formally adopted or authorized, before the date set for opening of bids, the execution of documents by typewritten, printed, or stamped signature and submits evidence of such authorization and the bid carries such a signature.*
	30.5	Provided that a Technical Bid is substantially responsive, the Procuring agency/Employer may request the bidder to submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial

		nonconformities or omissions in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any such aspect of the technical Proposal linked with the ranking of the bidders. Failure of the bidder to comply with the request may result in the rejection of its bid.
	30.6	Provided that a Technical Bid is substantially responsive, the Procuring agency/Employer shall rectify quantifiable nonmaterial nonconformities or omissions related to the Financial Proposal. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of the missing or nonconforming item or component.
	30.7	If a bid is not substantially responsive, it will be rejected by the Procuring agency/Employer and may not subsequently be evaluated for complete technical responsiveness.
31. Examination of Terms and Conditions; Technical Evaluation	31.1	The Procuring agency/Employer shall examine the bid to confirm that all terms and conditions specified in the **GCC** and the **SCC** have been accepted by the bidder without any material deviation or reservation. For this purpose: "Deviation" means departure from the requirements specified in the Bidding Document. "Reservation" means setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document.
	31.2	The Procuring agency/Employer shall evaluate the technical aspects of the bid submitted in accordance with **ITB 31,** to confirm that all requirements specified in **Section V – Works Requirement**, **Technical Specifications of** the Bidding Documents have been met without material deviation or reservation.
	31.3	If after the examination of the terms and conditions and the technical evaluation, the Procuring agency/Employer determines that the bid is not substantially responsive in accordance with **ITB 30,** it shall reject the bid.

32. Correction of Arithmetic Errors	32.1	Bids determined to be substantially responsive will be checked for any arithmetic errors. Errors will be corrected as follows: - a) if there is a discrepancy between unit prices and the sub-total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail, and the sub-total price shall be corrected, unless in the opinion of the Procuring agency/Employer there is an obvious misplacement of the decimal point in the unit price, in which the total price as quoted shall govern and the unit price shall be corrected; b) if there is an error in a total corresponding to the addition or subtraction of sub-totals, the sub-totals shall prevail, and the total shall be corrected; and c) where there is a discrepancy between the amounts in figures and in words, the amount in words will govern. d) Where there is discrepancy between grand total of price schedule and amount mentioned on the Form of Bid, the amount referred in Price Schedule shall be treated as correct subject to elimination of other errors.
	32.2	The amount stated in the Bid will, be rectified by the Procuring agency/Employer in accordance with the above procedure for the correction of errors and, with, the concurrence of the bidder, shall be considered as binding upon the bidder. If the bidder does not accept the corrected amount, its bid shall be rejected after forfeiture of Bid Security or execution of the Bid Securing Declaration, as the case may be, in accordance with **ITB 19.9.**

33. Conversion to Single Currency	33.1	The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the Works from outside the Procuring agency/Employer's country (referred to as the "Foreign Currency Requirements") shall indicate the same in the letter of bid-financial proposal. The proportion of the Bid Price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the Bidder's home country or, (ii) at the bidder's option, entirely in Pak rupees provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in his bid.
	33.2	To facilitate evaluation and comparison, the Procuring agency/Employer will convert all bid prices expressed in the amounts in various currencies in which the bid prices are payable. For the purposes of comparison of bids quoted in different currencies, the price shall be converted into a single currency specified in the bidding documents. The rate of exchange shall be the selling rate, prevailing on the date of opening of (financial part of) bids specified in the bidding documents, as notified by the State Bank of Pakistan on that day.
	33.3	The currency selected for converting bid prices to a common base for the purpose of evaluation, along with the source and date of the exchange rate, are specified in the **BDS**.
34. Evaluation of Bids	34.1	The Procuring agency/Employer shall evaluate and compare only the bids determined to be substantially responsive, pursuant to **ITB 30**.
	34.2	In evaluating the Technical Proposal of each Bid, the Procuring agency/Employer shall use the criteria and methodologies listed in the **BDS** and in terms of works requirement. No other evaluation criteria or methodologies shall be permitted.
	34.3	The Procuring agency/Employer's evaluation of a bid will take into account: a) the bid price, excluding provisional sums and the provision, if any, for contingencies in the summary bill

		of quantities, but including day work items, where priced competitively; b) price adjustment for correction of arithmetic errors in accordance with **ITB 32.1;** c) converting the amount resulting from applying (a) and (b) above, if relevant, to a single currency in accordance with **ITB 33**;
	34.4	The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.
	34.5	If these bidding documents allow bidders to quote separate prices for different lots, and the award to a single bidder of multiple lots, the methodology of evaluation to determine the lowest evaluated lot combinations in the Form of Bid, is specified in the **BDS.**
	34.6	If the bid, which results in the Evaluated Bid Price (Most Advantageous Bid), is seriously unbalanced or front loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract. **Explanation:** *"Unbalanced" or "front-loaded" bids consist of deliberately submitting bids with artificially high prices or unit rates for the early stages of a construction project, offset by artificially low prices or unit rates for the later stages of the project, to improve the contractor's cash flow.*

35. Domestic Preference	35.1	If the **BDS** so specifies, the Procuring agency/Employer will grant a margin of preference to the domestic contractor in line with the rules, regulations, regulatory guides or instructions issued by the Authority from time to time.
36. Determination of Most Advantageous Bid	36.1	The Procuring agency/Employer shall compare the evaluated bids in accordance with the predefined bidding procedure, of all substantially responsive bids to determine the Most Advantageous bidder.
37. Qualification of Bidder	37.1	The Procuring agency/Employer shall determine to its satisfaction whether the bidder is substantially responsive and whose bid is declared as most advantageous bid either continues to meet (if prequalification applies) or meets (if post-qualification applies) the qualifying criteria specified in Evaluation and Qualification Criteria. *Note: In case of International bidding, the parameters for incorporation or licensing within Pakistan may be fulfilled as part of post qualification.*
	37.2	The determination shall be based upon an examination of the documentary evidence of the bidder's qualifications submitted by the bidder, pursuant to **ITB 12**.
	37.3	Prior to contract award, the Procuring agency/Employer will verify that the successful bidder (including each member of a JV) is not blacklisted/debarred. The Procuring agency/Employer will conduct the same verification for each sub-contractor proposed by the successful bidder.
38. Sub-Contractors	38.1	The bidder shall provide details regarding any specialized sub-contractor to the Procuring agency/Employer. In case change of sub-contractors, the bidder shall promptly notify the Procuring agency/Employer and obtain approval for replacement of sub-contractors.
	38.2	Bidders may propose sub-contracting up to the percentage of total value of contracts or the volume of works as specified in the **BDS.**

39. Abnormally Low Financial Bid	39.1	Where the bid price is considered to be abnormally low, the Procuring agency/Employer shall perform price analysis either during determination of Most Advantageous Bid or as a part of the post-qualification process. The following process shall apply: a) The Procuring agency/Employer may reject a bid if the Procuring agency/Employer has determined that the price in combination with other constituent elements of the bid is abnormally low in relation to the subject matter of the procurement (i.e. scope of the procurement or ancillary services) and raises concerns as to the capability and capacity of the respective Bidder to perform that contract; b) Before rejecting an abnormally low bid the Procuring agency/Employer shall request the bidder an explanation of the bid or of those sections which it considers contribute to the bid being abnormally low; take account of the evidence provided in response to a request in writing; and subsequently verify the bid or parts of the bid being abnormally low; c) The decision of the Procuring agency/Employer to reject a bid and reasons for the decision shall be recorded in the procurement proceedings and promptly communicated to the bidder concerned; d) The Procuring agency/Employer shall not incur any liability solely by rejecting abnormally bid; and e) An abnormally low bid means, in the light of the Procuring agency/Employer's estimate and of all the bids submitted, the bid appears to be abnormally low by not providing a margin for normal levels of profit. **Guidance for Procuring agency/Employer:** In order to identify the Abnormally Low Bid (ALB) following approaches can be considered to minimize the scope of subjectivity: (i) Comparing the bid price with the cost estimate; (ii) Comparing the bid price with the bids offered by other bidders submitting substantially responsive bids; and (iii) Comparing the bid price with prices paid in similar contracts in the recent past either government- or development

		partner-funded.
	39.2	The Procuring agency/Employer will determine to its satisfaction whether the bidder that is selected as having submitted the most advantageous bid is qualified to perform the contract satisfactorily, in accordance with the criteria listed in **ITB 12**
	39.3	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 bidder's qualifications submitted by the bidder, pursuant to **ITB 12,** as well as such other information as the Procuring agency/Employer deems necessary and appropriate. Factors not included in these bidding documents shall not be used in the evaluation of the bidders' qualifications.
	39.4	Procuring agency/Employer may seek "Certificate for Independent Price Determination" from the bidder and the results of reference checks may be used in determining award of contract. ***Explanation:*** *The Certificate shall be furnished by the bidder. The bidder shall certify that the price is determined keeping in view of all the essential aspects such as raw material, its processing, value addition, optimization of resources due to economy of scale, transportation, insurance and margin of profit etc.*
	39.5	An affirmative determination will be a prerequisite for award of the contract to the bidder. A negative determination will result in rejection of the bidder's bid, in which event the Procuring agency/Employer will proceed to the next ranked bidder to make a similar determination of that bidder's capabilities to perform satisfactorily.

F. AWARD OF CONTRACT

40. Criteria of Award	40.1	Subject to **ITB 36** and **37**, the Procuring agency/Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has been declared as Most Advantageous Bidder, provided that such bidder has been determined to be: a) eligible in accordance with the provisions of **ITB 3;** b) is determined to be qualified to perform the Contract satisfactorily; and c) Successful negotiations have been concluded, if any.
41. Negotiations	41.1	The Committee of the Procuring agency/Employer may negotiate with the Most Advantageous Bidder relating to the following areas: (a) a minor alteration to the technical (drawings, design technical specifications) details of the statement of works; (b) Methodology, work plan, staffing in view to streamline the work; (c) a minor amendment to the special conditions of Contract; (d) finalizing payment arrangements; (e) clarifying details that were not apparent or could not be finalized at the time of Bidding;
	41.2	Where negotiation fails to result into an agreement, the Procuring agency/Employer may invite the next ranked bidder for negotiations. Where negotiations are commenced with the next ranked bidder, the Procuring agency/Employer shall not reopen earlier negotiations.
42. Procuring agency/Employer's Right to reject All Bids	42.1	Notwithstanding **ITB 37**, the Procuring agency/Employer reserves the right to reject all the bids, and to annul the bidding process at any time prior to acceptance of bid, without thereby incurring any liability to the affected bidder(s). However, the Authority (i.e. PPRA) may call from the Procuring agency/Employer the justification of those grounds.
	42.2	Notice of the rejection of all bids shall be given promptly to all bidders that have submitted bids.
	42.3	The Procuring agency/Employer shall upon request communicate to any bidder the grounds for its rejection of its bids, but is not required to justify those grounds.

43. Variations	43.1	The Engineer shall make any variation in the quantity of the Works or any part thereof that may, in his opinion, be necessary and for that purpose, or if for any other reason it shall, in his opinion, be appropriate, he shall have the authority to instruct the Contractor to do and the Contractor shall do any of the following: a) increase or decrease the quantity of any work included in the Contract, b) omit any such work (but not if the omitted work is to be carried out by the Employer or by another contractor), c) change the character or quality or kind of any such work, d) change the levels, lines, position and dimensions of any part of the Works, e) execute additional work of any kind necessary for the completion of the Works, or f) change any specified sequence or timing of construction of any part of the Works. No such variation shall in any way vitiate or invalidate the Contract, but the effect, if any, of all such variations shall be valued in accordance with **ITB 15**. Provided that where the issue of an instruction to vary the Works is necessitated by some default of or breach of contract by the Contractor or for which he is responsible, any additional cost attributable to such default shall be borne by the Contractor.
44. Instructions for variations	44.1	The Contractor shall not make any such variation without an instruction of the Engineer. Provided that no instruction shall be required for increase or decrease in the quantity of any work where such increase or decrease is not the result of an instruction given under this Clause, but is the result of the quantities exceeding or being less than those stated in the Bill of Quantities.
45. Valuation of Variations	45.1	All variations and any additions to the Contract Price which are required to be determined in accordance with **ITB 15** (for the purposes of this Clause referred to as "varied work"), shall be valued at the rates and prices set out in the Contract if, in the opinion of the Engineer, the same shall be applicable. If the Contract does not contain any rates or prices applicable to the varied work, the rates and prices in the Contract shall be used as the basis for valuation so far as may be reasonable, failing which, after due consultation by the Engineer with the

		Procuring agency/Employer and the Contractor, suitable rates or prices shall be agreed upon between the Engineer and the Contractor. In the event of disagreement, the Engineer shall fix such rates or prices as are, in his opinion, appropriate and shall notify the Contractor accordingly, with a copy to the Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on-account payments to be included in certificates issued in accordance with **ITB 15.**
46. Notification of Award	46.1	Prior to the award of contract, the Procuring agency/Employer shall issue a Final Evaluation Report giving justification for acceptance or rejection of the bids.
	46.2	Where no complaints have been lodged, the bidder whose bid has been accepted will be notified of the award by the Procuring agency/Employer prior to expiration of the bid validity period in writing or through electronic means that provide record of the content of communication. However, the Procuring agency/Employer shall not award any procurement contract atleast for fifteen (15) days after the acceptance of bid. The notification letter (herein after and in the condition of the contract and contract form called “Letter of Acceptance” will specify the sum that the Procuring agency/Employer will pay the successful bidder in consideration for the execution and completion of the works as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price).
	46.3	The notification of award will constitute the formation of the Contract, subject to the bidder furnishing the Performance Security (or guarantee) in accordance with **ITB 48** and signing of the contract in accordance with **ITB 47.**
	46.4	Upon the successful bidder’s furnishing of the performance security (or guarantee) pursuant to **ITB 48**, the Procuring agency/Employer will promptly notify each unsuccessful bidder, the name of the successful bidder and the Contract amount and will discharge the Bid Security or Bid Securing Declaration of the bidder(s) pursuant to **ITB 19**.
47. Signing of Contract	47.1	Promptly after notification of award, Procuring agency/Employer shall send the successful bidder the draft agreement, incorporating all terms and conditions as agreed by the parties to the contract.
	47.2	Immediately after the Redressal of grievance by the GRC, and

		after fulfillment of all conditions precedent of the Contract Form, the successful bidder and the Procuring agency/Employer shall sign the contract.
	47.3	Where no formal signing of a contract is required, work order issued to the bidder shall be construed to be the contract.
48. Performance Security (or Guarantee)	48.1	After the receipt of the Letter of Acceptance, the successful bidder, within the specified time, shall deliver to the Procuring agency/Employer a Performance Guarantee in the amount and in the form stipulated in the **BDS and SCC**, denominated in the type and proportions of currencies in the Letter of Acceptance and in accordance with the Conditions of Contract.
	48.2	If the Performance Guarantee is provided by the successful bidder and it shall be in the form specified in the **BDS** which shall be in any of the following: (a) certified cheque, cashier's or manager's cheque, or bank draft; (b) irrevocable letter of credit issued by a scheduled bank of Pakistan or in the case of an irrevocable letter of credit issued by a foreign bank, the letter shall be confirmed or authenticated by a scheduled bank of Pakistan; (c) bank guarantee confirmed by a reputable local bank or, in the case of a successful foreign bidder, bonded by a foreign bank; or (d) surety bond callable upon demand issued by any reputable surety or insurance company. Any Performance Guarantee submitted shall be enforceable in Pakistan.
	48.3	Failure of the Most Advantageous Bidder to comply with the requirement of **ITB 47** shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security or declare blacklisted (in case bid securing declaration is submitted) in which event the Procuring agency/Employer may make the award to the next most advantageous bidder or reinitiate the procurement process afresh (as a case may be).
49. Advance Payment	49.1	Advance payment will be provided to the bidder in percentage and in the manner as agreed by the both parties in terms of Conditions of the Contract.
	49.2	The Procuring agency/Employer will provide an advance payment as stipulated in the Conditions of Contract, subject to a maximum amount, as stated and/or Conditions of the Contract.

		The advance payment request shall be accompanied by an advance payment security (guarantee) in the form provided in Section X. For the purpose of receiving the advance payment, the bidder shall make and estimate of, and include in its bid, the expenses that will relate to the purchase of equipment, machinery, materials, and on the engagement of labor during the first month beginning with the date of the Procuring agency/Employer's "Notice to Commence" as specified in the **SCC.**
50. General Performance of the Bidders	50.1	The Procuring agency/Employer reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts / works. The Procuring agency/Employer may seek information / report from the previous employer for consideration. However, the Procuring agency/Employer shall incorporate such parameters in the evaluation criteria and accordingly decide the fate of the bid submitted.
51. Corrupt & Fraudulent Practices	51.1	Procuring agencies (including beneficiaries of Government funded projects and procurement) as well as Bidders/Suppliers/Contractors under Government financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts, and will avoid to engage in any corrupt and fraudulent practices.

G. GRIEVANCE REDRESSAL & COMPLAINT REVIEW MECHANISM

52. Constitution of Grievance Redressal	52.1	Procuring agency/Employer shall constitute a Grievance Redressal Committee (GRC) comprising of odd number of persons with proper power and authorization to address the complaint. The GRC shall not have any of the members of Procurement Evaluation Committee. The committee must have one subject specialist depending the nature of the procurement.
53. GRC Procedure	53.1	Any party can file its written complaint against the eligibility parameters or any other terms and conditions prescribed in the prequalification or bidding documents found contrary to provision of Procurement Regulatory Framework, and the same shall be addressed by the GRC well before the bid submission deadline.

	53.2	Any bidder feeling aggrieved by any act of the Procuring agency/Employer after the submission of his bid may lodge a written complaint concerning his grievances not later than seven days of the announcement of technical evaluation report and five days after issuance of final evaluation report.
	53.3	In case, the complaint is filed against the technical evaluation report, the GRC shall suspend the procurement proceedings.
	53.4	In case, the complaint is filed after the issuance of the final evaluation report, the complainant cannot raise any objection on technical evaluation of the report: Provided that the complainant may raise the objection on any part of the final evaluation report in case where single stage one envelope bidding procedure is adopted.
	53.5	The GRC, in both the cases shall investigate and decide upon the complaint within ten days of its receipt.
	53.6	Any bidder or the Procuring agency/Employer not satisfied with the decision of the GRC may file Appeal before the Appellate Committee of the Authority on prescribed format after depositing the Prescribed fee.
	53.7	The Committee, upon receipt of the Appeal against the decision of the GRC complete in all respect shall serve notices in writing upon all the parties to Appeal.
	53.8	The committee shall call the record from the concerned Procuring agency/Employer or the GRC as the case may be, and the same shall be provided within prescribed time.
	53.9	The committee may after examination of the relevant record and hearing all the concerned parties, shall decide the complaint within fifteen (15) days of receipt of the Appeal.
	53.10	The decision of the Committee shall be in writing and shall be signed by the Head and each Member of the Committee. The decision of the committee shall be final.

H. MECHANISM OF BLACKLISTING

54. Mechanism of Blacklisting	54.1	The Procuring agency/Employer shall bar for not more than the time prescribed in Rule-19 of the Public Procurement Rules, 2004, from participating in their respective procurement proceedings, bidder or contractor who either: Involved in corrupt and fraudulent practices as defined in Rule-2 of Public Procurement Rules; i) Fails to perform his contractual obligations; and ii)Fails to abide by the id securing declaration;
	54.2	The show cause notice shall contain: (a) precise allegation, against the bidder or contractor; (b) the maximum period for which the Procuring agency/Employer proposes to debar the bidder or contractor from participating in any public procurement of the Procuring agency/Employer; and (c) the statement, if needed, about the intention of the Procuring agency/Employer to make a request to the Authority for debarring the bidder or contractor from participating in public procurements of all the procuring agencies.
	54.3	The Procuring agency/Employer shall give minimum of seven days to the bidder or contractor for submission of written reply of the show cause notice.
	54.4	In case, the bidder or contractor fails to submit written reply within the requisite time, the Procuring agency/Employer may issue notice for personal hearing to the bidder or contractor/ authorize representative of the bidder or contractor and the Procuring agency/Employer shall decide the matter on the basis of available record and personal hearing, if availed.
	54.5	In case the bidder or contractor submits written reply of the show cause notice, the Procuring agency/Employer may decide to file the matter or direct issuance of a notice to the bidder or contractor for personal hearing.
	54.6	The Procuring agency/Employer shall give minimum of seven days to the bidder or contractor for appearance before the designated officer of the Procuring agency/Employer for personal hearing. The designated officer shall decide the matter on the basis of the available record and personal hearing of the bidder or contractor, if availed.

	54.7	The Procuring agency/Employer shall decide the matter within fifteen (15) days from the date of personal hearing unless the personal hearing is adjourned to a next date and in such an eventuality, the period of personal hearing shall be reckoned from the last date of personal hearing.
	54.8	The Procuring agency/Employer shall communicate to the bidder or contractor the order of debarring the bidder or contractor from participating in any public procurement with a statement that the bidder or contractor may, within thirty (30) days, prefer a representation against the order before the Authority.
	54.9	Such blacklisting or barring action shall be communicated by the Procuring agency/Employer to the Authority and respective bidder or bidders in the form of decision containing the grounds for such action. The same shall be publicized by the Authority after examining the record whether the procedure defined in blacklisting and debarment mechanism has been adhered to by the Procuring agency/Employer.
	54.10	The bidder may file the review petition before the Review Petition Committee Authority within thirty (30) days of communication of such blacklisting or barring action after depositing the prescribed fee and in accordance with "Procedure of filing and disposal of review petition under Rule-19(3) Regulations, 2021". The Committee shall evaluate the case and decide within ninety (90) days of filing of review petition.
	54.11	The committee shall serve a notice in writing upon all respondent of the review petition. The notices shall be accompanied by the copies of review petition and all attached documents of the review petition including the decision of the Procuring agency/Employer. The parties may file written statements along with essential documents in support of their contentions. The Committee may pass such order on the representation may deem fit.
	54.12	The Authority on the basis of decision made by the committee either may debar a bidder or contractor from participating in any public procurement process of all or some of the procuring agencies for such period as the deemed appropriate or acquit the bidder from the allegations. The decision of the Authority shall be final.

SECTION III: BID DATA SHEET

Bid Data Sheet (BDS)

The following specific data for the for the procurement of works shall complement, supplement, or amend the provisions in the Instructions to Bidders (ITBs). Whenever there is a conflict, the provisions herein shall prevail over those in ITBs.

BDS Clause Number	ITB Number	Amendments of, and Supplements to, Clauses in the Instruction to Bidders
A. Introduction		
1.	**1.1**	Name of Procuring agency/Employer: Sialkot Tannery Association Guarantee Limited (STAGL) The subject of procurement is: Road and Finishing Works at CETP at Sialkot Tannery Zone, Sialkot Period for completion of the works 6 months. Commencement date execution of the works: Immediately after signing the contract. Type of Procurement: National / International competitive bidding using Single Stage One Envelope and Least Cost Based Selection
2.	**2.1**	Name of Project: Road and Finishing Works at CETP at Sialkot Tannery Zone, Sialkot
3.	**3.1**	Maximum number of members in the joint venture, consortium shall be: 2 members.

B. Bidding Documents

4.	**7.2**	The number of copies to be completed and returned is one original and two certified copies.
5.	**8.1**	The address for clarification of Bidding Documents is: Chief Executive Officer Sialkot Tannery Zone, 05 Km from Sialkot International Airport, Kuluwal Road, Chowk Khambranwala, Sialkot, Phone: 052 4365140 / 0336 5386442 Email: info@stagl-skt.com
	8.5	Pre-bid meeting will be held As notified on advertisement or EPADS.

C. Preparation of Bids

6.	**10.1**	The Language of all correspondences and documents related to the Bid is: English
7.	**11.1 (i)**	In addition to the documents stated in **ITB 11,** the following documents must be included with the Bid: As required under Evaluation Criteria.
8.	**11.5 (c)**	Other procurement specific documentation requirements are: Not Applicable.
9.	**15.5**	The bid price shall be adjusted in accordance with Appendix A – Formula for Price Adjustment.
10.	**15.6**	Name of the works: As specified under 1.1
11.	**16.1**	The currency of the Bid shall be*: Pakistani Rupees*
12.	**18.1**	The Bid Validity period shall be *120* days.
13.	**19.1**	The amount of Bid Security shall be **Rs. 1,600,000 (Rupees One Million Six Hundred Thousand Only).** The currency of the Bid Security shall be: Pakistani Rupees
14.	**19.3**	The Bid Security shall be in the form of: The Bid Security shall be, at the option of the bidder, in the form of Deposit at Call or a Bank Guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan or insurance bond from AA rated insurance company from PACRA/VIS in Pakistan in favour of the Employer valid for a period 28 days beyond the Bid Validity date.

15.	**19.3 (c)**	Other forms of security are: Not Appicable
16.	**20.1**	Alternative Bids to the requirements of the Bidding Documents will not be permitted.
17.	**20.2**	Not Applicable.
18.	**22.1**	The number of copies of the Bid to be completed and returned shall be one original and two copies.
19.	**22.2**	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: Chief Executive or Managing Director

D. Submission of Bids

20.	**23.2 (a)**	Bid shall be submitted: Chief Executive Officer Sialkot Tannery Zone, 05 Km from Sialkot International Airport, Kuluwal Road, Chowk Khambranwala, Sialkot, Phone: 052 4365140 / 0336 5386442 Email: info@stagl-skt.com
21.	**23.2 (b)**	Title of the subject Procurement or Project name: Road and Finishing Works at CETP at Sialkot Tannery Zone, Sialkot Time and date for submission: *As per advertisement or EPADS*
22.	**24.1**	The deadline for Bid submission is a) As specified in Advertisement or EPADS.

E. Opening and Evaluation of Bids

23.	**27.1**	The Bid opening shall take place at: As specified in Advertisement or EPADS.
24.	**33.2**	The currency that shall be used for Bid evaluation and comparison purposes to convert all Bid prices expressed in various currencies is: *[insert the currency]*

		The source of exchange rate shall be: TT&OD Selling Rates published or authorized by the State Bank of Pakistan prevailing on the date 28 days prior to the deadline for submission of bids.
25.	**33.3**	The bids shall be quoted in PKR (Pakistani Rupee)
26.	**34**	**Evaluation Techniques:** Least Cost Based Selection ***Least Cost Based Selection (LCBS)*** *After meeting the requirements of eligibility, qualification and substantial responsiveness, the bid in compliance with all the mandatory (drawings/ design/ technical specifications /requirements and/or requisite quality threshold (if any), and having lowest evaluated cost (or financial proposal) shall be considered highest ranked bid.* ~~***Quality and Cost Based Selection (QCBS)***~~ ~~*In such combination, there shall be some specific weightage of both the technical features (such as prescribed in* ***ITB 35.2****) and financial aspects of the proposal. The financial marks shall be awarded in accordance with the formula stipulated in the BDS or Evaluation Criteria prescribed in the bidding documents. The highest ranked bid shall be declared, on the basis of combined evaluation.*~~
27.	**34**	Specific criteria in case evaluating the bids submitted by JVs and consortium to be used in the evaluation and their evaluation method.
28.	34	In case of award to a single Bidder of multiple lots; the methodology of evaluation to determine the lowest evaluated Lot combinations, in the Form of Bid is not applicable.
29.	**35**	Domestic preference to apply. **or** Domestic preference not applicable. *[Delete the non-applicable option.]* Preference to domestic or national suppliers or contractors shall be provided in accordance with policies of the Federal Government and/or in accordance with the regulations issued by the Authority.

		The percentage for the domestic preference alongwith calculation formula is provided in the evaluation and qualification criteria.
30.	**38.2**	Sub-contracting not allowed without prior approval.
F. Award of Contract		
31.	**48**	The Performance Security (or guarantee) shall be *10 percent of the Contract Price*
32.	**48**	The Performance Security (or guarantee) shall be in the form of: Deposit at Call or a Bank Guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan or insurance bond from AA rated insurance company from PACRA/VIS in Pakistan in favour of the Employer.
G. Review of Procurement Decisions		
33.	**53.6**	The Address of PPRA to submit a **copy** of appeal: Grievance Redressal Appellate Committee, Public Procurement Regulatory Authority 1st Floor, G-5/2, Islamabad, Pakistan Tel: +92-51-9202254

Section IV. Eligible Countries

All the bidders are allowed to participate in the subject procurement without regard to nationality, except bidders of some nationality, prohibited in accordance with policy of the Federal Government.

Following countries are ineligible to participate in the procurement process:

1. India
2. Israel

Section V. Evaluation and Qualification Criteria

The Procuring agency/Employer shall evaluate the bids in accordance with predefined evaluation and qualification criteria mentioned in this document. No other factors, methods or criteria shall be used. The Bidder shall provide all the information requested in the forms included in the Bidding Forms.

Wherever a Bidder is required to state a monetary amount, Bidders should indicate the currency prescribed in the BDS. In case of foreign currency, the exchange rates shall be taken from State Bank of Pakistan on that bid opening day. Any error in determining the exchange rates in the Bid may be corrected in accordance with **ITB 32** (Correction of Arithmetic Errors)

1. Domestic Preference

If allowed in the BDS, a margin of preference shall be granted to domestic contractors, in accordance with policy of the Federal Government and guidelines issued by the Authority, and subject to, the following provisions:

(a) Contractors applying for such preference shall provide, as part of the data for qualification, such information, including details of ownership, as shall be required to determine whether, according to the classification established by the Procuring agency/Employer, a particular contractor or group of contractors qualifies for a domestic preference. The bidding documents shall clearly indicate the preference and the method that will be followed in the evaluation and comparison of bids to give effect to such preference.

(b) After bids have been received and reviewed by the Procuring agency/Employer, responsive bids shall be classified into the following groups:
   (i) Group A: bidder eligible for the domestic preference.
   (ii) Group B: other bidder.

(c) All evaluated bids in each group shall, as a first evaluation step, be compared to determine the most advantageous bid, and the most advantageous bids in each group shall be further compared with each other. If, as a result of this comparison, a bid from Group A is the most advantageous, it shall be selected for the award. If a bid from Group B is the most advantageous, as a second evaluation step, all bids from Group B shall then be further compared with the most advantageous bid from Group A. For the purpose of this further comparison only, the percentage of price preference of the respective bid price corrected for arithmetical errors, shall be added to the evaluated price offered in each bid from Group B. If the bid from Group A is the most advantageous, it shall be selected for award. If not, the most advantageous bid from Group B based on the first evaluation step shall be awarded the contract.

Evaluation

In addition to the criteria listed in **ITB 34.3** the following criteria shall be applied for the evaluation of bids:

2.1 Assessment of adequacy of Technical Proposal with Requirements

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section V Works Requirements.

2.2 Technical Alternatives:

Not applicable.

2.3 **Multiple Contracts**:

If works are grouped in multiple contracts and pursuant to **ITB 34**, the Procuring agency/Employer shall evaluate and compare Bids on the basis of a contract, or a combination of contracts, or as a total of contracts in order to arrive at the Most advantageous bid for the Procuring agency/Employer by taking into account bids offered by Bidders in case of award of multiple contracts. If a Bidder submits several successful (lowest evaluated substantially responsive) bids, the evaluation will also include an assessment of the Bidder's capacity to meet the following aggregated requirements as presented in the bid:

1) Average annual construction turnover,
2) Financial resources,
3) Equipment to be allocated, and
4) Personnel to be fielded

If permitted under ITB 34, will be evaluated as follows:

Award Criteria for Multiple Contracts:

Lots

If specified in the procurement planning and allowed in the BDS, the Procuring agency/Employer may ask to the bidder to bid for any one or more lots. Bids will be evaluated lot-wise for combined lots. The contract(s) will be awarded to the Bidder or Bidders offering the most advantageous bid to the Procuring agency/Employer for combined lots, subject to the selected Bidder(s) meeting the required qualification criteria for lot or combination of lots as the case may be.

Packages

If specified in the procurement planning and allowed in the BDS the bidder may choose to Bid for any one or more packages and for any one or more lots within a package.

Bids will be evaluated package-wise, for combined packages and/or lots within a package. The contract(s) will be awarded to the Bidder or Bidders offering the most advantageous bid to the Procuring agency/Employer for combined packages, subject to the selected Bidder(s) meeting the required qualification criteria for combination of packages and or lots as the case may be.

2.4 Specialized Subcontractors

Only the specific experience of sub-contractors for specialized works permitted by the Procuring agency/Employer will be considered. The general experience and financial resources of the specialized sub-contractors shall not be added to those of the Bidder for purposes of qualification of the Bidder.

The specialized sub-contractors proposed shall be fully qualified for their work proposed, and meet the following criteria: (*Specify Criteria below)*

Qualification

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	**Subject**	**Requirement**	**Single Entity**	**Joint Venture (existing or intended)**			**Submission Requirements**
				All Parties Combined	**Each Member**	**One Member**	
1. Eligibility							
1.1	**Nationality**	Nationality in accordance with **ITB 4.3**	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Forms ELI – 1.1 and 1.2, with attachments
1.2	**Conflict of Interest**	No conflicts of interest in accordance with **ITB 3.7**	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Letter of Bid
1.3	**Registration with SECP**	Firms should be Registered with SECP	Must meet requirement	Must meet requirement	Must meet requirement	Must Meet Requirement	Incorporation Certificate issued by SECP
1.4	**Registration with PEC**	Bidders should have valid PEC certification C-4 or above	C-4 or above	C-4 or above	C-4 or above	C-4 or above	PEC Registration Certificates (Valid)
1.5	**Valid Tax Registration**	FBR and PRA Registration and Active Status	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	FBR and PRA Registration and Proof of Active Status
1.6	**Availability of Engineers**	Bidders should include the following PEC registered engineers: 1 Civil Engineer 2 Other Engineers (Civil, Electrical, Mechanical, etc.)	Must meet requirement	Must meet requirement	At least one PEC registered Engineer	At least one PEC registered Engineer	PEC Card or Verification from PEC Website.

Eligibility and Qualification Criteria			**Compliance Requirements**				**Documentation**
No.	**Subject**	**Requirement**	**Single Entity**	**Joint Venture (existing or intended)**			**Submission Requirements**
				All Parties Combined	**Each Member**	**One Member**	
Historical Contract Non-Performance							
2.1	**History of Non-Performing Contracts**	Non-performance of a contract did not occur as a result of contractor default since inception of firm.	Must meet requirement	Must meet requirements	Must meet requirement	N/A	Form CON-2
2.2	**Pending Litigation**	Bidder's financial position and prospective long term profitability sound according to criteria established in 3.1 below and assuming that all pending litigation will be resolved against the Bidder	Must meet requirement	N/A	Must meet requirement	N/A	Form CON – 2
2.3	**Litigation History**	No consistent history of court/arbitral award decisions against the Bidder since **1st January *2016***	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Form CON – 2

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
3. Financial Situation and Performance							
3.1	**Financial Capabilities**	(i) The Bidder shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other financial means (independent of any contractual advance payment) sufficient to meet the construction cash flow requirements estimated as **PKR *150 Million*** for the subject contract(s) net of the Bidders other commitments	Must meet requirement	Must meet requirement	N/A	N/A	Form FIN – 3.1, with attachments
		(ii) The Bidders shall also demonstrate, to the satisfaction of the Procuring agency/Employer, that it has adequate sources of finance to meet the cash flow requirements on works currently in progress and for future contract commitments.	Must meet requirement	Must meet requirement	N/A	N/A	
		(iii) The audited financial statements acceptable to the Procuring agency/Employer for the last ***Three***	Must meet requirement	N/A	Must meet requirement	N/A	

Eligibility and Qualification Criteria			**Compliance Requirements**				**Documentation**
No.	**Subject**	**Requirement**	**Single Entity**	**Joint Venture (existing or intended)**			**Submission Requirements**
				All Parties Combined	**Each Member**	**One Member**	
		years shall be submitted and must demonstrate the current soundness of the Bidder's financial position and indicate its prospective long-term profitability.					
3.2	**Average Annual Construction Turnover**	Minimum average annual construction turnover of PKR ***150 Million***, calculated as total certified payments received for contracts in progress and/or completed within the last ***three*** **years,** divided by ***three*** **years**	Must meet requirement	Must meet requirement	Must meet *50%* of the requirement	Must meet *50%* of the requirement	Form FIN – 3.2

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
4. Experience							
4.1 (a)	**General Construction Experience**	Experience under construction contracts in the role of prime contractor, JV member, sub-contractor, or management contractor for at least the last ***Five*** **years.**	Must meet requirement	N/A	Must meet requirement	N/A	Form EXP – 4.1
4.2 (a)	**Specific Construction & Contract Management Experience**	(i) A minimum number of similar contracts **(Roads and Building works)** specified below that have been satisfactorily and substantially completed as a prime contractor, joint venture member, management contractor or sub-contractor in last ***Five years*****:** (i) Five contracts, each of minimum value ***Rs. 100 Million Each*****;** supported by **Completion Certificate**	Must meet requirement	Must meet requirement	N/A	N/A	Form EXP 4.2(a)
4.2 (b)		For the above and any other contracts completed and under implementation as prime contractor, joint venture member, management contractor or sub-contractor on or after the first day	Must meet requirements	Must meet requirements	N/A	Must meet the following requirements for the key activities listed below: **Road & Infrastructure > PKR 75 Million**	Form EXP – 4.2 (b)

Eligibility and Qualification Criteria			**Compliance Requirements**				**Documentation**
No.	**Subject**	**Requirement**	**Single Entity**	**Joint Venture (existing or intended)**			**Submission Requirements**
				All Parties Combined	**Each Member**	**One Member**	
		of the calendar year during the period stipulated in 4.2 (a) above, a minimum construction experience in the following key activities successfully completed: **Road & Infrastructure > PKR 100 Million Building Works > PKR 100 Million**				**Building Works > PKR 75 Million**	

Contractor's Representative and Key Personnel

The Bidder must demonstrate that it will have a suitably qualified Contractor's Representative and suitably qualified (and in adequate numbers) Key Personnel, as described in the Specification.

The Bidder shall provide details of the Representative and Key Personnel and such other Key Personnel that the Bidder considers appropriate to perform the Contract, together with their academic qualifications and work experience. The Bidder shall complete the relevant Forms in the Bidding Forms.

Equipment

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

[Specify requirements for each lot as applicable]

No.	Equipment Type and Characteristics	Minimum Number required
1		
2		
3		
4		
5		

The Bidder shall provide further details of proposed items of equipment using Form EQU in Section V.

SECTION V: WORKS REQUIREMENT, TECHNICAL SPECIFICATIONS, DRAWINGS, SUPPLEMENTARY INFORMATION AND BILL OF QUANTITIES

Scope of Works

Work includes various activities to be conducted at Common Effluent Treatment Plant (CETP) at Sialkot Tannery Zone, Sialkot. The works include:

a. Road Work and Earth Fill
b. Sewerage and Storm Drainage Works
c. Manholes
d. Plinth Protection
e. Miscellaneous Works (Paint, Furniture, TV, Firefighting, CCTV, etc.)

Technical Specifications

Enclosed as Volume-II.

Drawings

Enclosed as Volume-III.

Supplementary Information

N/A.

Bill of Quantities

Sample Bill of Quantities

A. Preamble

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General and Particular Conditions of Contract, Technical Specifications, and Drawings.
2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at the rates and prices bid in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract.
3. The rates and prices bid in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the Contract, include all Constructional Plant, labour, supervision, materials, erection, maintenance, insurance, profit, taxes, and duties, together with all general risks, liabilities, and obligations set out or implied in the Contract.
4. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of Items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
5. The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
6. General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities.
7. Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with Sub-Clauses 13.4 and 13.5 of the General Conditions.
8. The method of measurement of completed work for payment shall be in accordance with *[insert the name of a standard reference guide, or full details of the methods to be used]*.

B. Work Items

1. The Bill of Quantities usually contains the following part Bills, which have been grouped according to the nature or timing of the work:

Bill of Quantities
Daywork Schedule; and
Summary Bill of Quantities.

2. If ITB 16.1 applies, Bidders shall price the Bill of Quantities in the applicable currency or currencies (Local or foreign as the case may be).

Bill of Quantities is Appended at end of this document.

Daywork Schedule

General

1. Reference should be made to Sub-Clause 13.5 of the General Conditions. Work shall not be executed on a daywork basis except by written order of the Engineer. Bidders shall enter basic rates for daywork items in the Schedules, which rates shall apply to any quantity of daywork ordered by the Engineer. Nominal quantities have been indicated against each item of daywork, and the extended total for Daywork shall be carried forward as a Provisional Sum to the Summary Total Bid Amount. Unless otherwise adjusted, payments for daywork shall be subject to price adjustment in accordance with the provisions in the Conditions of Contract.

Daywork Labour

2. In calculating payments due to the Contractor for the execution of daywork, the hours for labour will be reckoned from the time of arrival of the labour at the job site to execute the particular item of daywork to the time of return to the original place of departure, but excluding meal breaks and rest periods. Only the time of classes of labour directly doing work ordered by the Engineer and for which they are competent to perform will be measured. The time of gangers (charge hands) actually doing work with the gangs will also be measured but not the time of foremen or other supervisory personnel.

3. The Contractor shall be entitled to payment in respect of the total time that labour is employed on daywork, calculated at the basic rates entered by the Contractor in the **Schedule of Daywork Rates: 1. Labour,** together with an additional percentage payment on basic rates representing the Contractor's profit, overheads, etc., as described below:

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

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

Daywork Materials

4. The Contractor shall be entitled to payment in respect of materials used for daywork (except for materials for which the cost is included in the percentage addition to labour costs as detailed heretofore), at the basic rates entered by the Contractor in the **Schedule of Daywork Rates: 2.**

Materials, together with an additional percentage payment on the basic rates to cover overhead charges and profit, as follows:

(a) the basic rates for materials shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, losses, etc., and shall provide for delivery to store for stockpiling at the Site. The basic rates shall be quoted in the currency specified in the BDS.

(b) the additional percentage payment shall also be made in the currency specified in BDS:

(c) the cost of hauling materials for use on work ordered to be carried out as daywork from the store or stockpile on the Site to the place where it is to be used will be paid in accordance with the terms for Labour and Construction in this schedule.

Daywork Contractor's Equipment

5. The Contractor shall be entitled to payments in respect of Contractor's Equipment already on Site and employed on daywork at the basic rental rates entered by the Contractor in the **Schedule of Daywork Rates, Contractor's Equipment.** Said rates shall be deemed to include due and complete allowance for depreciation, interest, indemnity, and insurance, repairs, maintenance, supplies, fuel, lubricants, and other consumables, and all overhead, profit, and administrative costs related to the use of such equipment.

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

(a) The basic rental rates for Contractor's Equipment employed on daywork shall be stated in the currency specified in the BDS and the payment to the Contractor will be made in the currency specified in BDS.

Schedule of Daywork Rates: 1. Labour

Item no.	*Description*	*Unit*	*Nominal quantity*	*Rate*	*Extended amount*
	Subtotal				
D122	Allow ___ percent of Subtotal for Contractor's overhead, profit, etc., in accordance with paragraph 3 (b) above.				
	Total for Daywork: Labour (carried forward to Daywork Summary, p. ___)				_____

Schedule of Daywork Rates: 2. Materials

Item no.	*Description*	*Unit*	*Nominal quantity*	*Rate*	*Extended amount*
	Subtotal				
	Allow ____ percent of Subtotal for Contractor's overhead, profit, etc., in accordance with paragraph 4 (b) above.				
	Total for Daywork: Materials (carried forward to Daywork Summary, p. ___)				_____

Schedule of Daywork Rates: 3. Contractor's Equipment

Item no.	*Description*	*Nominal quantity (hours)*	*Basic hourly rental rate*	*Extended amount*
	Allow _ percent[1] of Subtotal for Contractor's overhead, profit, etc., in accordance with BDS.			
Total for Daywork: Contractor's Equipment (carried forward to Daywork Summary, p. _)				

[1] To be entered by the bidder.

Daywork Summary

	Amount ( )
1. Total for Daywork: Labour	
2. Total for Daywork: Materials	
3. Total for Daywork: Contractor's Equipment	
Total for Daywork (Provisional Sum) (carried forward to Bid Summary, p. ___)	_____

Summary of Specified Provisional Sums

Bill no.	*Item no.*	*Description*	*Amount*
1			
2			
3			
4			
		[*To be entered by the Procuring agency/Employer; Delete if not applicable:]* provisional sums for additional ES outcomes.	
etc.			
Total for Specified Provisional Sums (carried forward to Grand Summary (B), p. _)			

Grand Summary

Contract Name:

Contract No.:

General Summary	*Page*	*Amount*
Bill No. 1:		
Bill No. 2:		
Bill No. 3:		
—etc.— *Subtotal of Bills*	*(A)*	
Total for Daywork (Provisional Sum)[2]	*(B)*	
Specified Provisional Sums included in subtotal of bills	*(C)*	*[sum]*
Total of Bills Plus Provisional Sums (A + B + C)[3]	*(D)*	
Add Provisional Sum for Contingency Allowance (if any)[4]	*(E)*	*[sum]*
Bid Price (D + E) (Carried forward to Letter of Bid)	*(F)*	

[2] For evaluation purposes, Provisional Sum, other than Daywork will be excluded

[3] All Provisional Sums are to be expended in whole or in part at the direction and discretion of the Engineer in accordance with Sub-Clauses 13.4 and 13.5 of the General Conditions except with respect to DAAB Fees and Expenses for which Sub-Clause 13.4 of the Particular Conditions – Part B shall apply.

[4] To be entered by the Employer.

Technical Proposal

- **Site Organization**
- **Method Statement**
- **Mobilization Schedule**
- **Construction Schedule**
- **Equipment**

Site Organization

Method Statement

Mobilization Schedule

In accordance with the Particular Conditions, Sub-Clause 4.1, the Contractor shall not carry out mobilization to Site unless the Engineer gives consent.

Construction Schedule

1.

Form EQU: Equipment

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section III, Evaluation and Qualification Criteria. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

Omit the following information for equipment owned by the Bidder.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

SECTION VI: STANDARD BIDDING FORMS

Table of Forms

Letter of Bid – Technical Proposal

INSTRUCTIONS TO BIDDERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE DOCUMENT

Place this Letter of Bid in the first envelope "TECHNICAL PROPOSAL".

The Bidder must prepare the Letter of Bid on stationery with its letterhead clearly showing the Bidder's complete name and business address.

Note: All italicized text in black font is to help Bidders in preparing this form and Bidders shall delete it from the final document.

Date of this Bid submission: [*insert date (as day, month and year) of Bid submission*]
RFB No.: [*insert number of Bidding process*]
Alternative No.: [*insert identification No if this is a Bid for an alternative*]

To: **[*insert complete name of Procuring agency/Employer*]**

We, the undersigned Bidder, hereby submit the first part of our Bid, the Technical Proposal

In submitting our Bid we make the following declarations:

(a) **No reservations:** We have examined and have no reservations to the bidding document, including addenda issued in accordance with Instructions to Bidders **(ITB 9);**
(b) **Eligibility**: We meet the eligibility requirements and have no conflict of interest in accordance with ITB 3;
(c) **Bid/Proposal-Securing Declaration**: We have not been suspended nor declared ineligible by the Procuring agency/Employer based on execution of a Bid Securing Declaration or Bid Securing Declaration in the Procuring agency/Employer's country in accordance with **ITB 3;**
(d) **Conformity:** We offer to execute works in conformity with the bidding document and in accordance with the works requirements: [*insert a brief description of the WORKS*];
(e) **Bid Validity Period**: Our Bid shall be valid for the period specified in **BDS 18.1** (as amended, if applicable) from the date fixed for the Bid submission deadline specified in **BDS 24.1** (as amended, if applicable), and it shall remain binding upon us, and may be accepted at any time before the expiration of that period;
(f) **Performance Security**: If our Bid is accepted, we commit to obtain a performance security in accordance with the bidding document;
(g) One Bid per Bidder: We are not submitting any other Bid(s) as an individual Bidder, and we are not participating in any other bid(s) as a Joint Venture member or as a subcontractor, and meet the requirements, other than Alternative Bids submitted in accordance with **ITB 20;**
(h) **Suspension and Debarment**: We, along with any of our subcontractors, suppliers, consultants, manufacturers, or service providers for any part of the contract, are not subject to, and not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by the Procuring agency/Employer. Further, we are not ineligible under Pakistan laws;
(i) **State-owned enterprise or institution**: [*select the appropriate option and delete the other*] [*We are not a state-owned enterprise or institution*] / [*We are a state-owned enterprise or institution*];
(j) **Binding Contract**: We understand that this Bid, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed;

(k) **Not Bound to Accept**: We understand that you are not bound to accept the Most Advantageous Bid or any other Bid that you may receive; and

(l) **Fraud and Corruption**: We hereby certify that we have taken steps to ensure that no person acting for us, or on our behalf, engages in any type of Fraud and Corruption.

Name of the Bidder: *[*insert complete name of Bidder*]

Country of Origin of the Bidder: *[insert country of origin, in case of JV country of origin of lead member]*

Name of the person duly authorized to sign the Bid on behalf of the Bidder: ** [*insert complete name of person duly authorized to sign the Bid*]

Title of the person signing the Bid: [*insert complete title of the person signing the Bid*]

Signature of the person named above: [*insert signature of person whose name and capacity are shown above*]

Date signed [*insert date of signing*] **day of** [*insert month*], [*insert year*]

*: In the case of the Bid submitted by a Joint Venture specify the name of the Joint Venture as Bidder.
**: Person signing the Bid shall have the power of attorney given by the Bidder. The power of attorney shall be attached with the Bid Schedules.

Letter of Bid - Financial Proposal

INSTRUCTIONS TO BIDDERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE DOCUMENT

Place this Letter of Bid - Financial Proposal in the second envelope marked "FINANCIAL PROPOSAL".

The Bidder must prepare the Letter of Bid - Financial Proposal on stationery with its letterhead clearly showing the Bidder's complete name and business address.

Note: All italicized text is to help Bidders in preparing this form.

Date of this Bid submission: [*insert date (as day, month and year) of Bid submission*]
Request for Bid No.: [*insert number of bidding process*]
Name of Project.: [*insert identification*]
Alternative No.: [*insert identification No if this is a Bid for an alternative*]

To: [*insert complete name of Procuring agency/Employer*]

We, the undersigned Bidder, hereby submit the second part of our Bid, the Financial Proposal

In submitting our Financial Proposal we make the following additional declarations:

(a) **Bid Validity Period**: Our Bid shall be valid for the period specified in **BDS 18.1** (as amended, if applicable) from the date fixed for the bid submission deadline specified in **BDS 24.1** (as amended, if applicable), and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(b) **Total Price:** The total price of our Bid is:

In case of only one lot, the total price of the Bid is [*insert the total price of the bid in words and figures, indicating the various amounts and the respective currencies*];

In case of multiple lots, the total price of each lot is [*insert the total price of each lot in words and figures, indicating the various amounts and the respective currencies*];

In case of multiple lots, total price of all lots (sum of all lots) [*insert the total price of all lots in words and figures, indicating the various amounts and the respective currencies*];

(c) **Commissions, gratuities and fees:** We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract: [*insert complete name of each Recipient, its full address, the reason for which each commission or gratuity was paid and the amount and currency of each such commission or gratuity*].

Name of Recipient	Address	Reason	Amount

(If none has been paid or is to be paid, indicate "none.")

(d) **Binding Contract:** We understand that this Bid, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed.

Name of the Bidder:*[*insert complete name of the Bidder*]

Name of the person duly authorized to sign the Bid on behalf of the Bidder: ** [*insert complete name of person duly authorized to sign the Bid*]

Title of the person signing the Bid: [*insert complete title of the person signing the Bid*]

Signature of the person named above: [*insert signature of person whose name and capacity are shown above*]

Date signed [*insert date of signing*] **day of** [*insert month*], [*insert year*]

*: In the case of the Bid submitted by a Joint Venture specify the name of the Joint Venture as Bidder.

**: Person signing the Bid shall have the power of attorney given by the Bidder. The power of attorney shall be attached with the Bid Schedules.

FORM ELI 1
Bidder Information Form

[The Bidder shall fill in this Form in accordance with the instructions indicated below. No alterations to its format shall be permitted and no substitutions shall be accepted.]

Date: *[insert date (as day, month and year) of Bid submission*]
RFB No.: *[insert number of Bidding process]*
Alternative No.: *[insert identification No if this is a Bid for an alternative]*

Page _____ of_ _____ pages

1. Bidder's Name *[insert Bidder's legal name]*
2. In case of JV, legal name of each member : *[insert legal name of each member in JV]*
3. Bidder's actual or intended country of registration: *[insert actual or intended country of registration]*
4. Bidder's year of registration: *[insert Bidder's year of registration]*
5. Bidder's Address in country of registration: *[insert Bidder's legal address in country of registration]*
6. Bidder's Authorized Representative Information Name: *[insert Authorized Representative's name]* Address: *[insert Authorized Representative's Address]* Telephone/Fax numbers: *[insert Authorized Representative's telephone/fax numbers]* Email Address: *[insert Authorized Representative's email address]*
7. Attached are copies of original documents of *[check the box(es) of the attached original documents]* ☐ Articles of Incorporation (or equivalent documents of constitution or association), and/or documents of registration of the legal entity named above. ☐ In case of JV, JV agreement, in accordance with ITB 3.3. ☐ Establishing that the Bidder is not under the supervision of the Procuring agency/Employer[in case of subsidiaries] 8. Included are the organizational chart, a list of Board of Directors, and the beneficial ownership.

ELI2
Bidder's JV Members Information Form

[The Bidder shall fill in this Form in accordance with the instructions indicated below. The following table shall be filled in for the Bidder and for each member of a Joint Venture]].
Date: *[insert date (as day, month and year) of Bid submission*]
RFB No.: *[insert number of RFB process]*
Alternative No.: *[insert identification No if this is a Bid for an alternative]*

Page _____ of_ _____ pages

1. Bidder's Name: *[insert Bidder's legal name]*
2. Bidder's JV Member's name: *[insert JV's Member legal name]*
3. Bidder's JV Member's country of registration: *[insert JV's Member country of registration]*
4. Bidder's JV Member's year of registration: *[insert JV's Member year of registration]*
5. Bidder's JV Member's legal address in country of registration: *[insert JV's Member legal address in country of registration]*
6. Bidder's JV Member's authorized representative information Name: *[insert name of JV's Member authorized representative]* Address: *[insert address of JV's Member authorized representative]* Telephone/Fax numbers: *[insert telephone/fax numbers of JV's Member authorized representative]* Email Address: *[insert email address of JV's Member authorized representative]*
7. Attached are copies of original documents of *[check the box(es) of the attached original documents]* ☐ Articles of Incorporation (or equivalent documents of constitution or association), and/or registration documents of the legal entity named above. 8. Included are the organizational chart, a list of Board of Directors, and the beneficial ownership.

Personnel

Form PER -1

Contractor's Representative and Key Personnel Schedule

Bidders should provide the names and details of the suitably qualified Contractor's Representative and Key Personnel to perform the Contract. The data on their experience should be supplied using the Form PER-2 below for each candidate.

Contractor' Representative and Key Personnel

1.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
2.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
3.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]

4.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
5.	**Title of position:**	
	Name of candidate	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
6.	**Title of position:** *[insert title]*	
	Name of candidate	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]

Form PER-2:
Resume and Declaration
Contractor's Representative and Key Personnel

Name of Bidder

Position [*#1*]: [*title of position from Form PER-1*]		
Personnel information	**Name:**	**Date of birth:**
	Address:	**E-mail:**
	Professional qualifications:	
	Academic qualifications:	
	Language proficiency:*[language and levels of speaking, reading and writing skills]*	
details		
	Address of Procuring agency/Employer:	
	Telephone:	**Contact (manager / personnel officer):**
	Fax:	
	Job title:	**Years with present Procuring agency/Employer:**

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

Project	**Role**	**Duration of involvement**	**Relevant experience**
[main project details]	*[role and responsibilities on the project]*	*[time in role]*	*[describe the experience relevant to this position]*

Declaration

I, the undersigned *[insert either "Contractor's Representative" or "Key Personnel" as applicable]* , certify that to the best of my knowledge and belief, the information contained in this Form PER-2 correctly describes myself, my qualifications and my experience.

I confirm that I am available as certified in the following table and throughout the expected time schedule for this position as provided in the Bid:

Commitment	**Details**
Commitment to duration of contract:	*[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]*
Time commitment:	*[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]*

I understand that any misrepresentation or omission in this Form may:

(a) be taken into consideration during Bid evaluation;

(b) result in my disqualification from participating in the Bid;

(c) result in my dismissal from the contract.

Name of Contractor's Representative or **Key Personnel: [*insert name*]**
Signature: _____

Date: (day month year): _____

Countersignature of authorized representative of the Bidder:

Signature: _____

Date: (day month year): _____

Form CON – 2

Historical Contract Non-Performance, Pending Litigation and Litigation History

Bidder's Name: _____
Date: _____
JV Member Name_____
ICB/NCB No. and title: _____
Page _____of _____pages

Non-Performed Contracts in accordance with Qualification Criteria			
☐ Contract non-performance did not occur January *[insert year]* ☐ Contract(s) not performed since [*insert year]*			
Year	**Non-performed portion of contract**	**Contract Identification**	**Total Contract Amount (current value, currency, exchange rate and PKR equivalent)**
		Contract Identification: Name of Procuring agency/Employer(PA): Address of PA: Reason(s) for nonperformance:	
Pending Litigation, in accordance with Qualification Criteria			
☐ No pending litigation ☐ Pending litigation			

Year of dispute	Amount in dispute (currency)	Contract Identification	Total Contract Amount
		Contract Identification: _____ Name of PA: _____ Address of PA: _____ Matter in dispute: _____ Party who initiated the dispute: ____ Status of dispute: _____	
Litigation History in accordance with Section III, Evaluation and Qualification Criteria of the Prequalification document			
☐ No Litigation History ☐ Litigation History			
Year of award	**Outcome as percentage of Net Worth**	**Contract Identification**	**Total Contract Amount (currency), PKR Equivalent (exchange rate)**
[insert year]	*[insert percentage]*	Contract Identification: *[indicate complete contract name, number, and any other identification]* Name of PA: *[insert full name]* Address of PA: *[insert street/city/country]* Matter in dispute: *[indicate main issues in dispute]* Party who initiated the dispute: *[indicate "Procuring agency/Employer" or "Contractor"]* Reason(s) for Litigation and award decision *[indicate main reason(s)]*	*[insert amount]*

Financial Situation

Form FIN – 3.1:

Financial Situation and Performance

Bidder's Name: _____
Date: _____
JV Member's Name_____
ICB No. and title: _____
Page _____of _____pages

1. Financial data

Type of Financial information in (currency)	**Historic information for previous** _____*years,* _____ **(amount in currency, currency, exchange rate*, PKR equivalent)**				
	Year 1	Year 2	Year 3	Year4	Year 5
Statement of Financial Position (Information from Balance Sheet)					
Total Assets (TA)					
Total Liabilities (TL)					
Total Equity/Net Worth (NW)					
Current Assets (CA)					
Current Liabilities (CL)					
Working Capital (WC)					
Information from Income Statement					
Total Revenue (TR)					
Profits Before Taxes (PBT)					
Cash Flow Information					
Cash Flow from Operating Activities					

*Refer to ITB 16 for the exchange rate

2. Sources of Finance

Specify sources of finance to meet the cash flow requirements on works currently in progress and for future contract commitments.

No.	Source of finance	Amount (PKR)
1		
2		
3		

2. Financial documents

The Bidder and its parties shall provide copies of financial statements for _____years pursuant to Evaluation and Qualifications Criteria, Sub-factor 3.1. The financial statements shall:

(a) reflect the financial situation of the Bidder or in case of JV member, and not an affiliated entity (such as parent company or group member).

(b) be independently audited or certified in accordance with local legislation.

(c) be complete, including all notes to the financial statements.

(d) correspond to accounting periods already completed and audited.

☐ Attached are copies of financial statements for the _____years required above; and complying with the requirements

Form FIN – 3.2:

Average Annual Construction Turnover

Bidder's Name: _____
Date: _____
JV Member's Name_____
ICB/NCB No. and title: _____
Page _____of _____pages

	Annual turnover data (construction only)		
Year	**Amount** **Currency**	**Exchange rate**	**PKR equivalent**
[indicate year]	*[insert amount and indicate currency]*		
Average Annual Construction Turnover *			

* See Section III, Evaluation and Qualification Criteria.

Form FIN – 3.3:

Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as specified in Section (Evaluation and Qualification Criteria)

Financial Resources		
No.	**Source of financing**	**Amount**
1		
2		
3		

Form FIN – 3.4:

Current Contract Commitments / Works in Progress

Bidders and each member to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments					
No.	**Name of Contract**	**Procuring agency/Employer's Contact Address, Tel, Fax**	**Value of Outstanding Work [PKR Equivalent]**	**Estimated Completion Date**	**Average Monthly Invoicing Over Last Six Months [PKR/month)]**
1					
2					
3					
4					
5					

Form FIN - 5:

Self-Assessment Tool for Bidder's Compliance to Financial Resources (Criterion 2.1 of Section 3)

This form requires the same information submitted in Forms FIN – 3.3 and FIN -3.4. All conditions of "Available Financial Resources Net of CCC ≥ Requirement for the Subject Contract" must be satisfied to qualify.

Form FIN - 5A: For Single Entities

For Single Entities: (A)	Total Available Financial Resources from FIN – 3.3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 3.4 (C)	Available Financial Resources Net of CCC D = (B - C)	Requirement for the Subject Contract (E)	Results: Yes or No [*D must be greater than or equal to E*] (F)
_____ (Name of Bidder)				. . . . _	

Form FIN - 5B: For Joint Ventures

For Joint Ventures: (A)	Total Available Financial Resources from FIN – 3.3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 3.4 (C)	Available Financial Resources Net of CCC D = (B - C)	Requirement for the Subject Contract (E)	Results: Yes or No [*D must be greater than or equal to E*] (F)
One Partner:					
_____ __ (Name of Partner)				. . . .	
Each Partner:					
_____ _ (Name of Partner 1)				. . . .	

_____ _ (Name of Partner 2)				. . . .	
_____ _ (Name of Partner 3)				. . . .	
All partners combined	∑ D = Sum of available financial resources net of current contract commitments for all partners		∑ D = _____	. . . .	

- Note -

Form FIN – 5 is made available for use by the bidder as a self-assessment tool, and by the employer as an evaluation work sheet, to determine compliance with the financial resources requirement as stated in 2.3.3. Failure to submit Form FIN - 5 by the Bidder shall not lead to bid rejection.

EXPERIENCE

Form EXP - 4.1

General Construction Experience

Bidder's Name: _____
Date: _____
JV Member's Name_____
ICB/NCB No. and title: _____
Page _____of _____pages

Starting Year	Ending Year	Contract Identification	Role of Bidder
		Contract name: _____ Brief Description of the Works performed by the Bidder: _____ Amount of contract: _____ Name of PA: _____ Address: _____	
		Contract name: _____ Brief Description of the Works performed by the Bidder: _____ Amount of contract: _____ Name of PA: _____ Address: _____	
		Contract name: _____ Brief Description of the Works performed by the Bidder: _____ Amount of contract: _____ Name of PA: _____ Address: _____	

Form EXP - 4.2(a)

Specific Construction and Contract Management Experience

Bidder's Name: _____
Date: _____
JV Member's Name_____
ICB/NCB No. and title: _____
Page _____of _____pages

Similar Contract No.	**Information**			
Contract Identification				
Award date				
Completion date				
Role in Contract	Prime Contractor ☐	Member in JV ☐	Management Contractor ☐	Sub-contractor ☐
Total Contract Amount			PKR equivalent	
If member in a JV or sub-contractor, specify participation in total Contract amount				
PA's Name:				
Address: Telephone/fax number E-mail:				

Form EXP - 4.2(a) (cont.)
Specific Construction and Contract Management Experience (cont.)

Similar Contract No.	Information
Description of the similarity in accordance with Sub-Factor 4.2(a) of Section III:	
1. Amount	
2. Physical size of required works items	
3. Complexity	
4. Methods/Technology	
5. Construction rate for key activities	
6. Other Characteristics	

Form EXP - 4.2(b)

Construction Experience in Key Activities

Bidder's Name: _____
Date: _____
Bidder's JV Member Name: _____
Sub-contractor's Name[5] (as per ITB 34.2 and 34.3): _____
ICB/NCB No. and title: _____

Page _____ of _____ pages

All Sub-contractors for key activities must complete the information in this form as per ITB 38 and Qualification Criteria and Requirements, Sub-Factor 4.2.

1. Key Activity No One: _____

	Information			
Contract Identification				
Award date				
Completion date				
Role in Contract	Prime Contractor ☐	Member in JV ☐	Management Contractor ☐	Sub-contractor ☐
Total Contract Amount			PKR equivalent	
Quantity (Volume, number or rate of production, as applicable) performed under the contract per year or part of the year	Total quantity in the contract (i)	Percentage participation (ii)		Actual Quantity Performed (i) x (ii)
Year 1				
Year 2				
Year 3				
Year 4				
PA's Name:				

[5] If applicable

	Information
Address: Telephone/fax number E-mail:	

2. Activity No. Two

3. ……

	Information
Description of the key activities in accordance with Section III:	

Form EXP - 4.2 (c)

Specific Experience in Managing ES aspects

[The following table shall be filled in for contracts performed by the Bidder, and each member of a Joint Venture]

Bidder's Name: *[insert full name]*
Date: *[insert day, month, year]*
Joint Venture Member Name: *[insert full name]*
ICB/NCB No. and title: *[insert ICB/NCB number and title]*
Page *[insert page number]* of *[insert total number]* pages

1. Key Requirement no 1 in accordance with 4.2 (c): _____

Contract Identification				
Award date				
Completion date				
Role in Contract	Prime Contractor ☐	Member in JV ☐	Management Contractor ☐	Subcontractor ☐
Total Contract Amount			PKR	
Details of relevant experience				

2. Key Requirement no 2 in accordance with 4.2 (c): _____
3. Key Requirement no 3 in accordance with 4.2 (c): _____
4. …

Appendix-A

Form of Bid Security

(Bank Guarantee)

[The bank shall fill in this Bank Guarantee Form in accordance with the instructions indicated.]

[Guarantor letterhead or SWIFT identifier code]

Beneficiary: *[Purchaser to insert its name and address]*

No.: *[Purchaser to insert reference number for the Request for Bids]*

Alternative No.*: [Insert identification No if this is a Bid for an alternative]*

Date: *[Insert date of issue]*

BID GUARANTEE No.: *[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _____ *[insert name of the Bidder, which in the case of a joint venture shall be the name of the joint venture (whether legally constituted or prospective) or the names of all members thereof]* (hereinafter called "the Applicant") has submitted or will submit to the Beneficiary its Bid (hereinafter called "the Bid") for the execution of _____ under Request for Bids No. _____ _ ("the RFB").

Furthermore, we understand that, according to the Beneficiary's conditions, Bids must be supported by a Bid guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ (_____) upon receipt by us of the Beneficiary's complying demand, supported by the Beneficiary's statement, whether in the demand itself or a separate signed document accompanying or identifying the demand, stating that either the Applicant:

(a) has withdrawn its Bid during the period of Bid validity set forth in the Applicant's Letter of Bid ("the Bid Validity Period"), or any extension thereto provided by the Applicant; or

(b) having been notified of the acceptance of its Bid by the Beneficiary during the Bid Validity Period or any extension thereto provided by the Applicant, (i) has failed to sign the contract agreement, or (ii) has failed to furnish the performance security, in accordance with the Instructions to Bidders ("ITB") of the Beneficiary's bidding document.

This guarantee will expire: (a) if the Applicant is the successful Bidder, upon our receipt of copies of the Contract agreement signed by the Applicant and the performance security issued to the Beneficiary in relation to such Contract agreement; or (b) if the Applicant is not the successful Bidder, upon the earlier of (i) our receipt of a copy of the Beneficiary's notification to the Applicant of the results of the Bidding process; or (ii) twenty-eight days after the end of the Bid Validity Period.

Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

_____

[Signature(s)]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

Appendix-B

Form of Bid-Securing Declaration

[The Bidder shall fill in this Form in accordance with the instructions indicated.]

Date: *[date (as day, month and year)]*
No.: *[number of bidding process]*
Alternative No.: *[insert identification No if this is a Bid for an alternative]*

To: *[complete name of Procuring agency/Employer]*

We, the undersigned, declare that:

We understand that, according to your conditions, Bids must be supported by a Bid-Securing Declaration.

We accept that we will be blacklisted and henceforth cross debarred for participating in respective category of public procurement proceedings for a period of (not more than) six months, if fail to abide with a bid securing declaration, however without indulging in corrupt and fraudulent practices, if we are in breach of our obligation(s) under the Bid conditions, because we:

(a) have withdrawn our Bid during the period of Bid validity specified in the Letter of Bid; or

(b) having been notified of the acceptance of our Bid by the Procuring agency/Employer during the period of Bid validity, (i) fail or refuse to sign the Contract; or (ii) fail or refuse to furnish the Performance Security (or guarantee), if required, in accordance with the ITB.

We understand this Bid Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) twenty-eight days after the expiration of our Bid.

Name of the Bidder*_____

Name of the person duly authorized to sign the Bid on behalf of the Bidder**_____

Title of the person signing the Bid_____

Signature of the person named above_____

Date signed _____ day of _____, _____

*: In the case of the Bid submitted by joint venture specify the name of the Joint Venture as Bidder
**: Person signing the Bid shall have the power of attorney given by the Bidder attached to the Bid

[Note: In case of a Joint Venture, the Bid-Securing Declaration must be in the name of all members to the Joint Venture that submits the Bid.]

Appendix-C

Formula for Price Adjustment

*[**Note to Procuring agency/Employer:** It is recommended that in the case of very large and/or complex works contracts, it may be necessary to specify several families of price adjustment formulae corresponding to the different works involved. **When finalizing the contract document, ensure that the finalized Schedule of Cost Indexation is attached to** **the Contract Agreement.**]*

a) Price Adjustment/ escalation shall not be applicable on Civil, Mechanical and Electrical projects /contracts having contract life less than 365 days from the date of the signing of the contract.

b) Procuring Agency/Employer is advised not to change any provisions hereof unless otherwise stated by the Authority.

c) No method, other than given in this formula will be applicable to compute the price adjustment.

d) This document will be applicable only for Price Adjustment in local currency (Pak. Rs.). Price Adjustment in foreign currency is not allowed.

e) Price Adjustment formula and corresponding references to be inferred for price adjustment shall be agreed and firmed up before signing of the contract. Procuring agency and contractor shall firm up the weightages and co-efficient for respective items before signing of the contract and there shall be no change permissible in the weightages after signing of the contract.

f) For imported plant/ equipment and materials quoted in local currency (Pak. Rs.), foreign currency, exchange rates shall be fixed at the respective interbank currency exchange rates, 28 days prior to the tender opening date. The change in foreign currency exchange rate will be applicable to the foreign currency component stated in the Letter of Credit established by the Contractor or his Vendor.

g) This procedure is to assist the Procuring agency/Employer and bidder for the preparation of provisions for price adjustment in their bidding / contract documents. All the coefficients of the price adjustment formula shall be specified in the bidding document at the time of advertisement.

[The formulae for price adjustment shall be of the following general type:]

$$\mathbf{P}n = \mathbf{A} + \mathbf{b}\frac{\mathbf{L}n}{\mathbf{L}o} + \mathbf{c}\frac{\mathbf{M}n}{\mathbf{M}o} + \mathbf{d}\frac{\mathbf{E}n}{\mathbf{E}o} + \text{.....}$$

where,

"**P**n" is the Price Adjustment factor for the work carried out in the period "n".

"**A**" is a constant or the Non-Adjustable Portion of the Price Adjustment Factor to be specified in Appendix-C to Bid, representing the Non-Adjustable Portion of the Contract Price.

"**b**, **c**, **d .....**" are Coefficients or weightages of the order of 0.xx (i.e., fractions rounded off to two decimals) for each specified element of adjustment in the Contract.The sum of **A**, **b**, **c**, **d**, etc., shall be one.

"Ln", "En", "Mn", ... are the current cost indices or reference prices for period "n", expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 28 days prior to the last day of the period (to which the particular Payment Certificate relates); and

"Lo", "Eo", "Mo", ... are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

1. Construction schedule should be provided by the contractor as required in the Contract. Price Adjustment shall be applicable as payable in full for the original scheduled completion period.

2. In the event the completion of contract exceeds the original scheduled period:

   2.1 In case of default on the part of the contractor causing delay in original scheduled completion, the rate of Price Adjustment will be frozen at the original scheduled date of completion; however Price Adjustment will be applicable till actual completion. While computing Price Adjustment beyond the scheduled completion period, in the event the rate is reduced, then that reduced rate will be applied.

3. The Price Adjustment will be payable in full for the extended period if the contractor has been granted an extension of time for no fault on the part of the contractor, duly approved by the Employer.

4. Unless specifically stated otherwise in the contract, the basis for compensation will be only those elements, which are specifically listed as specified items in the tender documents. This list will specify the elements for Civil, Electrical, Mechanical, Sanitary, HVAC, etc., separately.

5. Formula for Price Adjustment provided herein will be applicable for all the contracts such as Civil, Electrical, Mechanical, etc.

6. There shall be no Price Adjustment for the elements which the Employer has either supplied free of cost or at fixed prices as well as for those elements for which an umbrella *ex gratia* or escalation cover is provided by the Government through an Executive Order or Statutory Regulatory Order (SRO).

Weightages of Specified Items

Each of the cost elements, having cost impact of five (05) percent or higher can be selected for adjustment.

In determining the weightages, the following procedure shall be adopted:

a) Base Date Price alone of an element based on market rate shall be considered excluding cost of construction/ installation, overheads and profit.

b) Engineer's Estimate shall be prepared for complete project.

c) Appropriate Rate Analysis of the Engineer's Estimate shall be made to determine costs of the basic elements.

d) For such cost elements having various types of a particular element, individual cost of such family of the element used in the project to be determined and added to work out the element cost. (Grade-40 andGrade-60 steel shall be treated under same category).

e) Each cost element determined as above, shall be divided by the total amount of Engineer's Estimate to determine various weightages.

Weightage of Fixed Portion

Weightage of fixed portion (Non-adjustable portion of the estimated cost of the contract), shall be determined as under:

a) First the weightages of all the cost elements having value of five (5) percent or more to be added up to see whether the total is 75 percent or less. In that case the total is to be subtracted from one (01) to determine the weightage of the fixed portion,

b) In case total weightage of the cost elements including HSD and labour exceeds 75 percent, the element(s) having lowest weightage(s) other than HSD and labour, shall be excluded in considering the adjustable costs elements.

c) Fixed portion shall be 25 percent and in case the fixed portion exceeds 25 percent it shall be supported by calculations attached with the bidding documents.

d) Sum of fixed portion and weightages b, c, d, ….etc., of the adjustable portion shall always be one (01).

Base Date Price

The base date price (or base date index) of any element shall be the price of the element for the month on the day falling 28 days prior to the last day for submission of bids.

Current Date Price

The current date price (or current date index) of any element shall be the price of the element for the month falling on the day 28 days prior to the last day of the period to which the particular Payment Certificate relates.

Sources of Prices

The prices of elements subject to Price Adjustment shall be to the extent possible as given in the Statistical Bulletins published by Federal Bureau of Statistics (FBS), Statistical Division Government of Pakistan. Statutory notifications and official price from public sector organizations, where available, may be used at the option of the Employer. The source for prices of High Speed Diesel (HSD) shall be either Statistical Bulletins or Pakistan State Oil (PSO) or Oil and Gas Regulatory Authority (OGRA). However, for a particular adjustable element, the same source should be used throughout the currency of contract as also stipulated in the tender documents before issuing the tender documents.
The Base Date Prices and Current Date Prices of the specified elements shall be obtained from the sources specified in the contract.

Method for payment of bills

The billed amount of the Works for each calendar month will be obtained from the checked bills submitted by the Contractor. In case the billed amount is for more than one month, the amount of the bill shall be segregated for actual workdone in each month.

Coefficient or Weightages

a) The coefficient for each specified element shall be calculated and given in the bidding/tender documents. The coefficient for each specified adjustable element shall be determined by the user proportionate to its ratio in the total amount of the Engineer's Estimate, in accordance with the prescribed procedure. The sum of these coefficients shall form the adjustable portion of the Contract, which shall not exceed 0.75.

b) Coefficients for each adjustable item shall be agreed by both parties and shall be fixed and locked at the time of the signing of the contract and shall remain constant during the currency of the contract.

Price Adjustment for Lump Sum Contract

a) Formula of Price Adjustment shall be used in determining Price Adjustment for contracts having detailed breakdown of cost. However, when a contract is assigned on lump sum basis without detailed breakdown of quantities and cost, Price Adjustment for the Specified Elements in the contract will be computed as follows:

$$\text{Increase/ Decrease in Cost (Price Adjustment Factor)} = \frac{\text{Current Date Price} - \text{Base Date Price}}{\text{Base Date Price}}$$

b) If the resulting Price Adjustment Factor is positive (+ve), the price should be added tothe contractor's payable amount. If the result is negative (-ve), the price should be subtracted from the payable amount.

c) The executed quantities of the elements subject to Price Adjustment can be obtained from the actual measurement or from certified invoice of the contractor or any other mode agreed between the parties which shall be stipulated in the contract.

Section VIII. General Conditions (GC)

Red Book:

The Conditions of Contract are the "General Conditions" which form part of the "Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer ("Red book") Second edition 2017" published by the Federation Internationale Des Ingenieurs – Conseils (FIDIC) and the following "Particular Conditions" which shall complement the General Conditions of the Contract.

An original copy of the above FIDIC publication i.e. "*Conditions of Contract for Building and Engineering Works Designed by the Employer*" must be obtained from FIDIC.

International Federation of Consulting Engineers (FIDIC)

FIDIC Bookshop – Box- 311 – CH – 1215 Geneva 15 Switzerland

Fax: +41 22 799 49 054

Telephone: +41 22 799 49 01

E-mail: fidic@fidic.org

www.fidic.org

FIDIC code: ISBN13: 978-2-88432-084-9

Section IX. Special Conditions of the Contract

Special Conditions of the Contract

The Special Conditions of Contract (SCC) complement the General Conditions of Contract (GCC) to specify data and contractual requirements of the Procuring agency/Employer/ Employer, the engineer, the sector, the overall project, and the works. In the event of a conflict, the provisions herein shall prevail over those in the GCC.

Part A – Contract Data

Contract data of the SCC, includes data to complement the GCC in a manner similar to the way in which the Bid Data Sheet complements the Instructions to Bidders.

SCC Clause Number	GCC Clause Number	Amendments of, and Supplements to, Clauses in the GCC
General Provision (GCC 1)		
1.	1.3	**For notices** Procuring agency/Employer/ Engineer's Authorized representatives name and address: Chief Executive Officer Sialkot Tannery Association Guarantee Limited (STAGL) 05 Km from Sialkot International Airport, Kuluwal Road, Chowk Khambranwala, Sialkot, Phone: 052 4365140 / 0336 5386442 Email: info@stagl-skt.com Contractors Authorized representatives name and address:
2.	1.4	**Governing Law;** The Applicable Law shall be: Laws of the **Islamic Republic of Pakistan**
3.	1.4	**Communication Language:** The Communication Language shall be: **English**
4.	1.5	**Documents forming the contract listed:** (a) This form of Contract; (b) Letter of Acceptance; (c) the Form of Bid and the Price Schedule submitted by the Bidder; (d) the Works Requirements;

		(e) the Technical Specifications; (f) the Drawings; (g) the General Conditions of the Contract (h) the Special Conditions of Contract, (i) the completed schedule including Bill of Quantities;
The Employer/ Procuring agency/Employer (GCC Clause 2)		
5.	2.1	Time for access to the Site: Immediately after Commencement Date
The Engineer (GCC Clause 3)		
6.	3.2	Engineer's Duties and Authority: Variations resulting in an increase of the Accepted Contract Amount shall require approval of the Procuring agency/Employer.
The Contractor (GCC Clause 4)		
7.	4.2	Performance guarantee/ security will be in the form of as specified in BDS in the amount of **10%** as a percentage of the Contract Price.
8.	4.7.2(a)	**Clause 4.7 Setting out** Period for notification of errors in the items of reference ***28 Days***
9.	4.22	**Contractor's Operations on site**
Sub-Contracting (GCC Clause 5)		
10.	5.1(a)	Maximum allowable accumulated value of work subcontracted as prescribed in BDS.
11.	5.1 (b)	Sub-contracting is not permitted without prior approval.
Staff and Labour (GCC Clause 6)		
12.	6.5	Normal working hours *8am to 5pm.*
Plant, Material and Workmanship (GCC Clause 7)		
13.	7.2	Samples *[please specify if required]*
Commencement, Delays and Suspension (GCC Clause 8)		
14.	8.3	Number of additional paper copies of program *:* ***Three****.*
15.	8.8	Delay damages shall be payable for each day of delay shall be ***0.1%*** of the Contract Price per day, in the currency and proportions in which the Contract Price is payable. Maximum amount of delay damages is ***10%*** of the Contract Price

Measurement and Valuation (GCC Clause 12)		
16.	12.2	Method of measurement shall be ***as directed by Engineer Incharge.***
17.	12.3	Percentage profit ***10%.***
Variations and Adjustments (GCC Clause 13)		
18.	13.4 (b)(ii)	Percentage rate to be applied to Provisional Sums for overhead charges and profit is **25%**
19.	13.7	Adjustments for Changes in Cost: The Contract Price shall be adjustable during Contract Execution.
Contract Price and Payment (GCC Clause 14)		
20.	14.2	Total advance payment shall be up to 15% Percentage of the Accepted Contract Amount payable in the currency and proportion of the contract.
21.	14.2.3	Repayment of Advance payment: This Advance Payment shall be recovered by deducting 15% from each Interim Payment Certificate starting from 2nd Interim Payment certificate of the Contractor until the Advance Payment is recovered.
22.	14.3(iii)	Percentage of retention: **5%** Limit of Retention Money: **5%**
23.	14.5(b)(i)	Plant and Materials: N/A
24.	14.5(c)(i)	Plant and Materials: N/A
25.	14.6.2	Withholding (amounts in) an IPC: As per Employer direction.
26.	14.7(a)	Period of payment of Advance Payment to the Contractor **28 days**
27.	14.7b(i)	Period for the Procuring agency/Employer to make interim payments to the Contractor under Sub-Clause 14.6 (interim Payment) **30 days**
28.	14.7b(ii)	Period for the Procuring agency/Employer to make interim payments to the Contractor under Sub-Clause 14.13 (Final Payment): **60 days**
29.	14.7(c)	Period for the Procuring agency/Employer to make final payment to the Contractor: **56 days**

30.	14.8	financing charges for delayed payment (percentage points above the average bank short-term lending rate as referred to under sub-paragraph (a)) 0 %
31.	14.11.1(b)	Number of additional paper copies of draft Final Statement
32.	14.15	**Currencies of Payment** The Contract Price shall be paid in the currency or currencies named in the Contract Data. If more than one currency is so named, payments shall be made as follows: (a) if the Accepted Contract Amount was expressed in Local Currency only or in Foreign Currency only.
33.	14.15 (a)(i)	The proportions or amounts of the Local and Foreign Currencies, and the fixed rates of exchange to be used for calculating the payments, shall be as stated in the Contract Data, except as otherwise agreed by both parties.
34.	14.15 (c)	Payment of Delay Damages shall be made in the currencies and proportions specified in the Contract Data.
35.	14.15 (f)	If no rates of exchange are stated in the Contract Data, they shall be those prevailing on the Base Date and published by the central bank of the Country.
36.	17.2 (d)	**Liability for Care of the Works** Any operation of the forces of nature (other than those allocated to the Contractor in the Contract Data) which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventative precautions.
Insurance (GCC Clause 19)		
37.	19.1	Permitted deductible limits insurance required for the Works: _____ insurance required for Goods:_____ insurance required for liability for breach of professional duty:_____ insurance required against liability for fitness for purpose (if any is required):_____ insurance required for injury to persons and damage to property:_____

		insurance required for injury to employees: __ other insurances required by Laws and by local practice: _____
38.	19.2.1(b)	Additional amount to be insured (as a percentage of the replacement value, if less or more than 15%) _____*%*
39.	19.2.1(iv)	List of Exceptional Risks which shall not be excluded from the insurance cover for the Works
40.	19.2.2	Extent of insurance required for Goods Amount of insurance required for Goods
41.	19.2.3(a)	amount of insurance required for liability for breach of professional duty
42.	19.2.3(b)	Insurance required against liability for fitness for purpose Yes/No [*delete as appropriate*]
43.	19.2.3	Period of insurance required for liability for breach of professional duty
44.	19.2.4	Amount of insurance required for injury to persons and damage to property
45.	19.2.6	**Insurance** <u>Other insurances required by Laws and by local practice</u> The contractor shall provide all other insurances required by the Laws of the countries where (any part of) the Works are being carried out, at the Contractor's own cost. Other insurances required by local practice (if any) shall be detailed in the Contract Data and the Contractor shall provide such insurances in compliance with the details given, at the Contractor's own cost.
Dispute Avoidance/ Adjudication Board (GCC Clause 21)		
46.	21.1	Time for appointment of DAAB: The Accepted Contract Amount will be lesser than PKR one (01) billion. The appointment of the DAAB shall be made when Dispute arises between the Parties during the currency of the Contract.
47.	21.1	The DAAB shall comprise: The Accepted Contract Amount will be less than PKR one (01) billion. The appointment of the DAAB shall be made when Dispute arises between

		the Parties during the currency of the Contract.
48.	21.1	List of proposed members of DAAB The appointment of the DAAB shall be made when Dispute arises between the Parties during the currency of the Contract.
49.	21.2	Appointing entity (official) for DAAB members: Chairman Pakistan Engineering Council (PEC) from the list of PEC approved arbitrators published at its website

Part-B Special Provisions

The Procuring agency/Employer shall be required to draft the special provisions (particular conditions Part-B) by referring the concerned clauses as stipulated in the General Conditions of the Contract. These provisions should be drafted by keeping following guidelines in consideration:

i. Particular conditions must be drafted clearly and without any ambiguity;
ii. Party's duties, rights, obligations, roles and responsibilities shall be clearly described in line with General Conditions of the Contract, requirements as specified in the bidding document;
iii. While drafting special provisions realistic timelines must be provided for completion of the project / assignment;
iv. All disputes must be settled either through arbitration act 1940 or through International Chamber of Commerce.

Note: Special Provisions shall always over rule and supersede the respective provisions of General Conditions of the Contract. In order to conveniently trace the respective clause, reference of the concerned GCC clause must be provided.

Table: Summary of Sections (if any)

Description of parts of the Works that shall be designated a Section for the purposes of the Contract (Sub-Clause 1.1.73)	Value: Percentage[6] of Accepted Contract Amount (Sub-Clause 14.9)	Time for Completion (Sub-Clause 1.1.84)	Delay Damages (Sub-Clause 8.8)

[6] These percentages shall also be applied to each half of the Retention Money under Sub-Clause 14.9

SECTION VIII: CONTRACT FORMS

Notification of Award

(On Procuring agency/Employer's letterhead)

Letter of Acceptance

[Date]. . . . . .

To: . . . . .[Name and address of the contractor]

Subject: . . . . .[Notification of Award Contract No.]

This is to notify you that your Bid dated . . . . …….[date]. . . . . …… for execution of the . . . . .[name of the contract and identification number, as given in the Bid Data Sheet] . . . . . for the Accepted Contract Amount of the equivalent of . . . . . [amount in words and figures and name of currency]. . . . ., as corrected and modified in accordance with the Instructions to Bidders, is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract, using for that purpose the Performance Security Form included in Section 9 (Contract Forms) of the Bidding Document.

Authorized Signature: .....

Name and Title of Signatory: .....

Name of Agency: .....

Attachment: Contract Agreement

Form of Contract

THIS AGREEMENT made the _____ day of _____ 20_____ between *[name and address of Procuring agency/Employer]* of Pakistan (hereinafter called "the Procuring agency/Employer") of the one part and *[name of Contractor]* of *[city and country of Contractor]* (hereinafter called "the ") of Contractor other part:

WHEREAS the Procuring agency/Employer desired that the works *[brief description of works]* should be executed by the contractor, and has accepted a Bid by the contractor for the execution and completion of these works and remedying of any defects therein, in the sum of *[contract price in words and figures]* (hereinafter called "the Contract Price").

NOW THIS CONTRACT WITNESSETH AS FOLLOWS:

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

2. The following documents shall be deemed to form and be read and construed as part of this Contract, In the event of any ambiguity or conflict between the Contract Documents listed below, the order of precedence shall be the order in which the Contract Documents are listed below:-

(j)	This form of Contract;
(k)	Letter of Acceptance;
(l)	the Form of Bid and the Price Schedule submitted by the Bidder;
(m)	the Works Requirements;
(n)	the Technical Specifications;
(o)	the Drawings;
(p)	the General Conditions of the Contract
(q)	the Special Conditions of Contract,
(r)	the completed schedule including Bill of Quantities; and
(s)	[*add here: any other documents*]

3. In consideration of the payments to be made by the Procuring agency/Employer to the contractor as mentioned in this contract, the contractor hereby covenants with Procuring agency/Employer to execute the works to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Procuring agency/Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, 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 to be executed in accordance with their respective laws the day and year first above written.

Signed, sealed, delivered by _____the _____ (for the Procuring agency/Employer)	Signed, sealed, delivered by _____the _____ (for the Contractor)
Witness to the signatures of the Procuring agency/Employer ……	Witness to the signatures of the Contractor ……

Performance Guarantee Form

To: *[name of Procuring agency/Employer]*

WHEREAS *[name of Contractor]* (hereinafter called "the contractor") has undertaken, in pursuance of Contract No. *[reference number of the contract]* dated *[insert date]* for the execution of *[insert name of the works and its brief description] (*hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the contractor shall furnish you with a Bank Guarantee by a reputable bank for the sum specified therein as security for compliance with the Contractor's performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the Contractor a guarantee:

THEREFORE, WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Contractor, up to a total of *[amount of the guarantee in words and figures],* and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the Contract and without cavil or argument, any sum or sums within the limits of *[amount of guarantee]* as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the: *[insert date]*

Signature and seal of the Guarantors

_____

[name of bank or financial institution]

_____

[address]

_____

[date]

Advance Payment Security

Demand Guarantee

_____

Beneficiary: _____

Date: _____

ADVANCE PAYMENT GUARANTEE No.: _____

Guarantor: _____

We have been informed that [Inset name of the Contractor] (hereinafter called "the Contractor") has entered into Contract No. _____ dated _____ with the [insert name of the Procuring agency/Employer] (hereinafter called "the Procuring agency/Employer") for the execution of _____ (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, an advance payment in the sum _____ (_____) is to be made against an advance payment guarantee.

At the request of the Contractor, we as Guarantor, hereby irrevocably undertake to pay the Procuring agency/Employer any sum or sums not exceeding in total an amount of _____ upon receipt by us of the Procuring agency/Employer's complying demand supported by the Procuring agency/Employer's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating either that the Applicant:

(a) has used the advance payment for purposes other than the costs of mobilization in respect of the Works; or

(b) has failed to repay the advance payment in accordance with the Contract conditions, specifying the amount which the Contractor has failed to repay.

A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Procuring agency/Employer's bank stating that the advance payment referred to above has been credited to the Contractor on its account number _____ at _____..

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as specified in copies of interim statements or payment certificates which shall be presented to us.

The Guarantee shall remain valid up to the aforesaid date and shall be null and void after the aforesaid date or earlier if the advance made to the Contractor is fully adjusted against payments from Interim Payment Certificates of the Contractor provided that the Guarantor agrees that the

aforesaid period of validity shall be deemed to be extended if on the above mentioned date the advance payment is not fully adjusted.

_____

[signature(s)]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

Retention Money Security
Demand Guarantee

_____ *[Guarantor letterhead or SWIFT identifier code]*

Beneficiary: _____ *[Insert name and Address of Procuring agency/Employer]*

Date: _____*[Insert date of issue]*

RETENTION MONEY GUARANTEE No.: *[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _____ *[insert name of Contractor, which in the case of a joint venture shall be the name of the joint venture]* (hereinafter called "the Contractor") has entered into Contract No. _____ *[insert reference number of the contract]* dated _____ with the Procuring agency/Employer, for the execution of _____ *[insert name of contract and brief description of* Works*]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, the Procuring agency/Employer retains moneys up to the limit set forth in the Contract ("the Retention Money"), and that when the Taking-Over Certificate has been issued under the Contract and the first half of the Retention Money has been certified for payment, payment of *[*insert the second half of the Retention Money *or if the amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money,* the difference between half of the Retention Money and the amount guaranteed under the Performance Security and, if required, the ES Performance Security*]* is to be made against a Retention Money guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ *[insert amount in figures]* (_____) *[amount in words]* upon receipt by us of the Procuring agency/Employer's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without your needing to prove or show grounds for your demand or the sum specified therein.

A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Procuring agency/Employer's bank stating that the second half of the Retention Money as referred to above has been credited to the contractor on its account number _____ at _____ *[insert name and address of Contractor's bank]*.

This guarantee shall expire no later than the …. day of ……, 2…, and any demand for payment under it must be received by us at the office indicated above on or before that date.

_____

[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

Integrity Pact

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

Contract Number: _____ Dated: _____
Contract Value: _____
Contract Title: _____

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

Without limiting the generality of the foregoing [Name of Contractor] represents and warrants that it has fully declared the brokerage, commission, fee 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 consultations fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

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

[Name of Contractor] accepts full responsibility and strict liability for making and false declaration, not making full disclosure, misrepresenting fact 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 right and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [Name of Contractor] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten 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 GoP.

_____ _____

[Procuring agency/Employer] [Contractor]

Bill of Quantities *(BOQ to be Filled by Bidders)*

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

Summary of Cost

Sr #	Description	Amount	Remarks
1	Road Work and Earth Fill		
2	Sewer Network, Manholes and Septic Tank		
a	Sewerage and Storm Drainage works		
b	Manholes		
3	Plinth Protection		
4	Miscellaneous Works (Paint, Furniture, TV, Firefighting, CCTV etc.)		
	Total Amount (inclusive of income tax but exclusive of PRA Sales tax)		
	Total Amount (inclusive of income tax and PRA Sales Tax)		

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

ROAD WORK

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
		Sub Base				
1	18/3-ii a+b	Providing and laying Sub-base Course of stone product of approved quality and grade, including placing, mixing, spreading and compaction of Sub-base Material to required depth, grade to achieve 100% maximum modified AASHO dry density, icluding carriage of all materials lead 210 km.	100 Cft	246.82		
2	1/1	Carriage of 100 Cft. (2.83 cu.m) of all materials like stone aggregate, spawl, kankar lime (unslaked), surkhi, etc. or 150 Cft. (4.25 cu.m) of timber, by truck or by any other means owned by the contractor.	100 Cft	271.50		
		1st km	100 Cft	271.50		
		2nd km	100 Cft	271.50		
		3rd km	100 Cft	271.50		
		4th km	100 Cft	271.50		
		5th km	100 Cft	271.50		
		6th km	100 Cft	271.50		
		7th km	100 Cft	271.50		
		8th km	100 Cft	271.50		
		9th km	100 Cft	271.50		
		10th km	100 Cft	271.50		
		11th Kms to 200Km (Note. The bidder will quote rate for 190 kilometer distance which is from 11 th km to 200 Km)	100 Cft	271.50		
		201 Kms to 250 Kms (The bidder will quote rate for 10 kilometer distance which is from 201 km to 210 Km)	100 Cft	271.50		
3	18/5	Providing and laying road edging of 3" (75 mm) wide and 9" (225 mm) deep brick on end, complete in all respects.	Rft	4,592.00		
4	18/4	Providing and laying Base Course of stone product of approved quality and grade, including placing, mixing, spreading and compaction of Base Material to required depth, grade to achieve 100% maximum modified AASHO dry density, icluding carriage of all materials lead 210 km.	100 Cft	246.82		
5	1/1	Carriage of 100 Cft. (2.83 cu.m) of all materials like stone aggregate, spawl, kankar lime (unslaked), surkhi, etc. or 150 Cft. (4.25 cu.m) of timber, by truck or by any other means owned by the contractor.		271.50		
		1st km	100 Cft	271.50		
		2nd km	100 Cft	271.50		
		3rd km	100 Cft	271.50		
		4th km	100 Cft	271.50		
		5th km	100 Cft	271.50		
		6th km	100 Cft	271.50		
		7th km	100 Cft	271.50		
		8th km	100 Cft	271.50		
		9th km	100 Cft	271.50		
		10th km	100 Cft	271.50		
		11th Kms to 200Km (Note. The bidder will quote rate for 190 kilometer distance which is from 11 th km to 200 Km)	100 Cft	271.50		
		201 Kms to 250 Kms (The bidder will quote rate for 10 kilometer distance which is from 201 km to 210 Km)	100 Cft	271.50		

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

ROAD WORK

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
6	18/6	Providing and laying bituminous priming coat, using 10 lbs. kerosene oil and 10 lbs. binder per 100 Sft. or 0.5 Kg kerosene and 0.5 Kg binder per square metre.	100 Sft	493.64		
7	18/10-(a) iv +b	a) Providing and laying plant premixed bituminous carpet, including compaction and finishing to required camber, grade and density.	100 Sft	987.28		
		iv) 4.5% Bitumen (2" Thick)				
8	1/1	Carriage of 100 Cft. (2.83 cu.m) of all materials like stone aggregate, spawl, kankar lime (unslaked), surkhi, etc. or 150 Cft. (4.25 cu.m) of timber, by truck or by any other means owned by the contractor.	100 Cft	83.92		
		1st km	100 Cft	83.92		
		2nd km	100 Cft	83.92		
		3rd km	100 Cft	83.92		
		4th km	100 Cft	83.92		
		5th km	100 Cft	83.92		
		6th km	100 Cft	83.92		
		7th km	100 Cft	83.92		
		8th km	100 Cft	83.92		
		9th km	100 Cft	83.92		
		10th km	100 Cft	83.92		
		11th Kms to 200Km (Note. The bidder will quote rate for 190 kilometer distance which is from 11 th km to 200 Km)	100 Cft	83.92		
		201 Kms to 250 Kms (The bidder will quote rate for 10 kilometer distance which is from 201 km to 210 Km)	100 Cft	83.92		
9	3/5 -ii	Earthowrk in ordinary soil for embankments lead upto 100 ft. (30 m), including ploughing, mixing and compaction by mechanical means at optimum moisture content and dressing to designed section, complete in all respects:- ii) 90% maximum modified AASHTO dry density.	100 Cft	29.86		
10	3/17	Transportation of earth all types when the total distance, including the lead covered in the item of work, is more than 1000 ft. (300 m)	100 Cft	35.83		
	(a)	a) upto ¼ mile (400 m).	100 Cft	35.83		
	(b)	for every 330 ft. (100 m) additional lead or part thereof, beyond ¼ mile (400 m) upto one mile. (1.6 Km.)	100 Cft	35.83		
	(c)	for every ¼ mile (400 m) additional lead or part thereof,beyond one mile (1.6 Km.) upto 5 mile (8 Km).	100 Cft	35.83		
	(d)	for every ½ mile (800 m) additional lead or part thereof, beyond 5 miles (8 Km).		35.83		

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

ROAD WORK

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
11	18/28 a ii	Providing & fixing Cat Eyes of size 4" x4" x3/4" duly casted with specified material having plastic strip containing mini retro-reflective glass beads of color white/red/yellow having specifid reflections, quality & shape i/c the cost of self built in 12 mm dia x120 mm long steel zinc plated nail, fixing to road with epoxy/ hammering with separate nail complete. a) Acrylic material 1) Dual-Directional (ii) 31x2=62 Glass beads a side	Each	500		
12	13/36	Painting Traffic Lane Marking of specified width 1.5mm thick), with Thermoplastic (TP) Paint including GlassBeads, completein all respect, as approved and directed by Engineer incharge.				
		ii) 6" wide	Rft	6,500.00		
		Total Road (to be added under Sr. 1 of Summary)				

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

OTHER ROAD WORK

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
1	18/4	Providing and laying Base Course of stone product of approved quality and grade, including placing, mixing, spreading and compaction of Base Material to required depth, grade to achieve 100% maximum modified AASHO dry density, icluding carriage of all materials to site of work except gravel and aggregate.	100 Cft	195.05		
2	1/1	Carriage of 100 Cft. (2.83 cu.m) of all materials like stone aggregate, spawl, kankar lime (unslaked), surkhi, etc. or 150 Cft. (4.25 cu.m) of timber, by truck or by any other means owned by the contractor.				
		1st km	100 Cft	214.56		
		2nd km	100 Cft	214.56		
		3rd km	100 Cft	214.56		
		4th km	100 Cft	214.56		
		5th km	100 Cft	214.56		
		6th km	100 Cft	214.56		
		7th km	100 Cft	214.56		
		8th km	100 Cft	214.56		
		9th km	100 Cft	214.56		
		10th km	100 Cft	214.56		
		11th Kms to 200Km (Note. The bidder will quote rate for 190 kilometer distance which is from 11 th km to 200 Km)	100 Cft	214.56		
3	18/6	Providing and laying bituminous priming coat, using 10 lbs. kerosene oil and 10 lbs. binder per 100 Sft. or 0.5 Kg kerosene and 0.5 Kg binder per square metre.	100 Sft	1,175.00		
4	18/8	Providing surface treatment to roads, including supply of bitumen and bajri/crushed stone aggregate of approved quality, including cleaning of road surface, heating, spraying bitumen,spreading bajri and rolling etc. complete including carriage of all materials to site of work except bajjri/crushed stone aggregate for which supply within 3miles(5.0km)is included in the rate.				
	1	By Mechanical means				
	a).1	**1st coat:**				
	i	40 lbs. bitumen, and 5.5 Cft. bajri of nominal size 1" (25mm) per 100 sq. feet or 1.96 Kg bitumen and 0.017 cu.metre bajri per square metre..	100 Sft	1,175.00		
	a.2)	**2nd coat:**				
	i	i) 25 lbs. bitumen, and 2.75 Cft. bajri of nominal size ½" (13 mm) per %sft or 1.23 Kg bitumen and 0.008 cu. metre bajri per sq.metre.	100 Sft	1,175.00		
	a.3)	**3rd coat:**				
		14 lbs. bitumen, and 1.5 Cft. bajri of nominal size ¼" (6 mm) per %sft or 0.69 Kg bitumen and 0.005 cubic metre bajjri per sq.metre.	100 Sft	1,175.00		
	b)	Subsequent carriage of crushed stone aggregate/ bajri				
5	1/1	Carriage of 100 Cft. (2.83 cu.m) of all materials like stone aggregate, spawl, kankar lime (unslaked), surkhi, etc. or 150 Cft. (4.25 cu.m) of timber, by truck or by any other means owned by the contractor. (Note.1st 5Km is included in rates of TST)				
		1st km	100 Cft	121.19		
		2nd km	100 Cft	121.19		
		3rd km	100 Cft	121.19		
		4th km	100 Cft	121.19		
		5th km	100 Cft	121.19		
		6th km	100 Cft	121.19		
		7th km	100 Cft	121.19		
		8th km	100 Cft	121.19		
		9th km	100 Cft	121.19		
		10th km	100 Cft	121.19		
		11th Kms to 200Km (Note. The bidder will quote rate for 190 kilometer distance which is from 11 th km to 200 Km)	100 Cft	121.19		
		201 Kms to 250 Kms (The bidder will quote rate for 10 kilometer distance which is from 201 km to 210 Km)	100 Cft	121.19		
		Total Other Road Work (to be added under Sr. 1 of Summary)				

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

SEWERAGE AND STORM DRAINAGE WORKS

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
1	3/43 -i/i	Earth work excavation in open cutting for water supply pipe lines, sewer lines and manholes as shown in drawing including back filling, shuttering of wooden vertical planks, struts and beams, including dressing to correct section and dimensions according to templates and levels and removing surface water in all type of soil except shingle, gravel and rock, complete in all respect by mechanical means. a) 0 ft. to 7.0 ft. (0 to 2.10 m) depth				
		in ordinary soil.	1000 Cft	34.820		
2	3/15	Filling, watering and ramming earth under floors:- i) with surplus earth from foundation, etc.	1000 Cft	34.82		
3	21/3-c	Providing and laying R.C.C. pipe sewers, moulded with cement concrete 4000 psi conforming to ASTM Specification C-76-20, specific class. Wall B, including carriage of pipe from factory to site of work, lowering in trenches to correct alignment and grade, jointing with rubber ring, cutting pipes where necessary, testing, etc.,complete.				
		RCC Pipe 15" Dia (4000 PSI)	Rft	2,100.000		
		RCC Pipe 12" Dia (4000 PSI)	Rft	1,500.000		
4	19/48 i	Providing, fixing, testing and commissioning of µ-PVC(Unplasticized Polyvinyl Chloride) sewerage pipe make of Dadex /Popular/Beta or approved equivalent manufacturer, plain/socket ended conforming to code EN-1401 of specified SDR(Standard Dimension Ratio)including the cost of specials and Solvents complete in all respect as approved and directed by the Engineer Incharge.				
		i) 6" dia 150mm Type (SDR 34/SN-8)	Rft	375.000		
		Total Sewerage & Drainage				

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

MANHOLES

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
1	3/43 -i/i	Earth work excavation in open cutting for water supply pipe lines, sewer lines and manholes as shown in drawing including back filling, shuttering of wooden vertical planks, struts and beams, including dressing to correct section and dimensions according to templates and levels and removing surface water in all type of soil except shingle, gravel and rock, complete in all respect by mechanical means. a) 0 ft. to 7.0 ft. (0 to 2.10 m) depth				
		in ordinary soil.	1000 Cft	9.600		
2	3/15	Filling, watering and ramming earth under floors:- i) with surplus earth from foundation, etc.	1000 Cft	6.00		
3	6/3/b	Cement concrete brick or stone ballast 1½ " to 2" (40 mm to 50 mm) gauge, in foundation and plinth:- Ratio 1: 4: 8	1000 Cft	11.400		
4	6/5/f	Cement concrete plain including placing, compacting, finishing and curing complete (including screening and washing of stone aggregate): (i) Ratio 1: 2: 4	1000 Cft	8.400		
5	6/6	Providing and laying reinforced cement concrete (including prestressed concrete), using coarse sand and screened graded and washed aggregate, in required shape and design, including forms, moulds, shuttering, lifting, compacting, curing, rendering and finishing exposed surface, complete (but excluding the cost of steel reinforcement, its fabrication and placing in position, etc.):-				
	a/iii	(c) Reinforced cement concrete in Pile cap, slab of rafts / strip foundation, base slab of column and retaining walls; etc and footing beams, other structural members other than those mentioned in 6(a-d)above not requiring form work (i.e. horizontal shuttering)				
		Type C (nominal mix 1: 2: 4)	Cft	2,763.60		
6	6/12-bii	Fabrication of mild steel reinforcement for cement concrete, including cutting, bending, laying in position, making joints and fastenings, including cost of binding wire and labour charges for binding of steel reinforcement (also includes removal of rust from bars):-				
		Deformed bars (Grade-60)	100kg	87.60		
7	11/8-b	Cement plaster 1:3 upto 30' (9.00 m) height:-3/4" (20 mm) thick	100 Sft	25.200		
		Total Manholes				

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

Plinth Protection

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
1	3/43 -i/i	Earth work excavation in open cutting for water supply pipe lines, sewer lines and manholes as shown in drawing including back filling, shuttering of wooden vertical planks, struts and beams, including dressing to correct section and dimensions according to templates and levels and removing surface water in all type of soil except shingle, gravel and rock, complete in all respect by mechanical means. a) 0 ft. to 7.0 ft. (0 to 2.10 m) depth				
		in ordinary soil.	1000 Cft	17.55		
2	3/15	Filling, watering and ramming earth under floors:- i) with surplus earth from foundation, etc.	1000 Cft	17.55		
3	6/3/b	Cement concrete brick or stone ballast 1½ " to 2" (40 mm to 50 mm) gauge, in foundation and plinth:- Ratio 1: 4: 8	1000 Cft	38.61		
		PCC 1:4:8				
4	10/43	Providing and laying Tuff Pavers, having 7000 PSI, crushing strength of approved manufacturer, over 2" to 3" sand cushion i/c grouting with sand in joints i/c finishing to require slope . complete in all respect. (50% Grey / 50% Coloured)				
	a	50-mm thick	Sft	11,700.00		
5	6/53/-b	Providing and fixing precast Edge KerbStone (100mm to 150mm thick), of 3500PSI Compressive Strength, embeded inPCC1:2:4over lean concrete 1:4:8 etc complete in all respect.				
		With painting				
	i	300x150x300mm high)	Rft	3,900.00		
		Total Plinth Protection				

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

MISC WORKS

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
1	13/33	Providing and applying weather shield paint of approved quality on external surface of building including preparation of surface, application of primer complete in all respect:				
		1st Coat (With Wall Putty)	100 Sft	714.79		
		2nd Coat	100 Sft	714.79		
2	13/31	Preparing surface and painting with emulsion paint:-				
		1st Coat (With Wall Putty)	100 Sft	265.50		
		2nd Coat	100 Sft	265.50		
3	13/5 c	Preparing surface and painting of doors and windows any type (including edges):-				
		1st Coat	100 Sft	40.56		
		2nd Coat	100 Sft	40.56		
4	25/35	Providing and fixing terrace railing of 2" (50 mm) i/d conduit pipe 16 SWG, welded with 5/8"x5/8" (16x16 mm) square bar 2.75 ft. (838 mm) high fixed at 5" (125 mm) center to center, in reinforced cement concrete slab with suitable arrangement, complete in all respects, as per design and drawing.	Rft	100.00		
5	25/10+11	Fabrication of heavy steel work, with angle, tees, flat iron round iron and sheet iron for making trusses, girders, tanks, etc., including cutting, drilling, revitting, handling, assembling and fixing, Erection and fitting in position iron trusses, staging of water tanks, etc.	100 Kgs	7.20		
6	6/5/f	Cement concrete plain including placing, compacting, finishing and curing complete (including screening and washing of stone aggregate): (i) Ratio 1: 2: 4	100 Cft	9.22		
7	7/5/i	Pacca brick work in ground floor:- i) Cement, sand mortar:- (Ratio 1:4)	100 Cft	2.88		
8	4/13	Dismantling brick work in lime or cement mortar.	100 Cft	9.60		
9	11/9-b	Cement plaster 1:4 upto 30' (9.00 m) height:-1/2" (13 mm) thick	100 Sft	72.00		
10	11/7	Cement plaster 1:2 upto 20' (6.00 m) height:				
	c	¾" (20 mm) thick	100 Sft	108.37		
11	11/43	Providing and Fixing MS Diamond Wire Mesh of 24 guage (6"Wide) for horizontal and vertical joints of concrete interfacing masonry with nails, washers etc., i/c cost of all type labour and material, as shown on drawings, as per spicifications, complete in all respects, ,as approved and directed by the Engineer Incharge.	Rft	1,806.11		
12	4/49	Scraping:-	100 Sft	108.37		
13	b	Ordinary distemper, oil bound distemper or paint of wall.				
	4/48	Removing cement or lime plaster.	100 Sft	108.37		
14	10/16-e	Providing and laying topping of cement concrete 1:2:4, including surface finishing				

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

MISC WORKS

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
		(e) 2"(50 mm) thick	100 Sft	132.00		
15	19/47	4" Upvc Down Pipe (Including Specials) and Fixing	Rft	120.00		
16	Non-Scheduled	P/F Fiber Glass Shed in front of Doors, using 1" x 1" ms pipe frame (18 " c/c), including painting and Fixing complete in all respects	Sft	1,008.00		
17	Non-Scheduled	Landscapping as per drawings and specifications complete in all aspects.	Sft	8,130.00		
18	Non-Scheduled	Provision of furniture from Interwood or approved equivalent:	LS			
	i	Interwood Arc Desk or approved equivalent	No.	5.00		
	ii	Interwood Harp Manager Chair With Headrest or approved equivalent	No.	8.00		
	iii	Interwood Visitor Chair (Mesh) or equivalent	No.	8.00		
	iv	Interwood Omega Filing Cabinet or approved equivalent	No.	8.00		
19	Non-Scheduled	Provision, Installation, Laying of cables, fixing, Comissioning and Testing of CCTV System Vigilance Camera 4MP Day/night mode: Qty 30 Visible Range : 30M 8 port POE Switch, RJ 45 connector, 32 channel NVR with hard disk having one month backup Supply of water proof PVC Boxes Size 4 x 4. Qty 30 LED Monitor 65 inch with complete accessory Supply of Junction Box IP68 Poll mound Weather proof box. Size 12 x 12, as per site requirments 2-Pole 6 Amp breaker, PVC condutit 1", qty is at per site requirment Including all necessary accessories **Note (Clinet will only Provide CAT-6 cable), remaining all acessories / fittings / equipment is reaponsibility of bidder. For road crossing, lay cables & conducts underground.	LS	1.00		
20	Non-Scheduled	TCL V6C 4K Google TV 75 or approved equivalent TV for display of SCADA.	No.	1.00		
21		**Inverter A.c 1.5 Ton** (Heat & Cool option) (Wall Mounted) with complete solution (Media, Gree, TCL or equivalent) Cooling Capacity: 1.5 Ton,(18000 BTU or above) Heating Capacity: 1.5 Ton (19107 BTU or above) Compressor: T3 climate class & Dual -stage Rotary	Nos	4.00		
22		Inverter **A.C 2 Ton** (Heat & Cool option) (Floor Standing) with complete solution (Media Gree, TCL or equivalent) Cooling Capacity: 2 Ton - 24000 BTU or above Heating Capacity: 2 Ton - 24600 BTU or above Compressor: T3 climate class & Dual -stage Rotary	Nos	2.00		

SIALKOT TANNERY ASSOCIATION GUARANTEE LIMITED.

Road and Finishing Works at CETP at Sialkot Tannery Zone

MISC WORKS

Sr. No.	Bi-Annual Sialkot	Description	Unit	Quantity	Unit Rate (Rs)	Amount (Rs)
23		**Fire fighting Equipment**				
	i	Carbon dioxide Fire Extinguishers, 5Kg, with controlled discharged operating valve, pressure gauge, wall bracket and initial charge As per NFPA Standards or Equivalent, Certified by Pakistan Standards and Quality Control Authority	Nos	5.00		
	ii	Dry Powder Fire Exitinguishers (ABC), 5kg, with controlled discharged operating valve, pressure gauge, wall bracket and initial charge As per NFPA Standards or Equivalent, Certified by Pakistan Standards and Quality Control Authority	Nos	5.00		
	iii	Dry Powder Fire Exitinguishers (ABC),Portable 25 Kgs , with controlled discharged operating valve, pressure gauge, wall bracket and initial charge As per NFPA Standards or Equivalent, Certified by Pakistan Standards and Quality Control Authority	Nos	2.00		
	iv	Portable Clean Agent Fire Extinguishers – UL Listed N 05L FSA/FSB (5Lbs, 2.2Kgs)	Nos	3.00		
	v	Firefighter hammer best quality (certified)	Nos	2.00		
	vi	Fire Man Axe, with 24inch long insulated handle	Nos	2.00		
	vii	Emergency Torch, white light, battery operated, 1ft minimum	Nos	4.00		
	viii	Safety Walk Tape 2.5 inch wide , red & white	Nos	5.00		
	ix	Beam Lights with 90 Minutes Battery Backup	Nos	2.00		
	x	Shovel (bailcha), Flat type with wooden handle	Nos	2.00		
	xi	Safety Sign " Emergency exit " door sign of Size 10inch X 10inch of PVC water & light proof reflecting material	Nos	20.00		
	xii	Hose Reels & Cabinets Guage : 18 hose length of 20M to 25M	Nos	2.00		
	xiii	Eye Wash Station with Safety Shower Combinatio Specifications & Features: - Shower Head/Bowl: ABS Plastic, Safety Green Color - Shower Head Flow Control: 76.1 ml/min - Eyewash Flow Control: 12 l/min - Pipe Material: Galvanized Steel - Water Supply & Outlet: 1-1/4" IPS - Water Working Pressure: 0.2–0.8 MPA - Water Input: Clean Water or Treated Water - Shower Valve: 1" Stainless Steel Ball Valve - Eyewash Valve: 0.5" Brass Ball Valve - Packaging Dimensions: 81.3 x 27.7 cm Carton - Net Weight: 13.5 kg - Included Accessories: - Installation Instructions - Universal Emergency Sign - Yellow Warning Tape - Recommended Use: Emergency Eyewash Station Unit	Nos	2.00		
		Total of Miscellaneous Works				

SIALKOT TANNERY ZONE

SIALKOT TANNERIES ASSOCIATION (GUARANTEE) LIMITED (STAGL)

ROADS AND FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE SIALKOT

TENDER DOCUMENTS

Volume-2
Technical specifications

April, 2026

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

CIVIL WORKS

SECTION - 0120
CONTRACTOR'S CAMP

1. SCOPE

The work to be done under this item consists of construction, erection, installation and maintenance of the Contractor's Project Site Offices or main camp and the Contractor's sub-camps or temporary camps, if any, and shall include all offices, shops, warehouses, and other operational buildings; all housing and related facilities including accommodations for the Contractor's personnel.

The location of the Contractor's camps, including all buildings, utilities and facilities therefor, and of the camps or establishments of all persons/parties in the vicinity operating or associated with the Contractor, shall be subject to approval of the Engineer.

The work to be done under this item will terminate upon the actual Completion Date. However, if directed by the Engineer or the Employer, the Contractor shall continue such work to the extent required by the Contractor's personnel during the period of maintenance. No compensation shall be paid for the continued operation and maintenance of the Contractor's Camps during the period of maintenance.

Upon completion of the Works, or at such time within the period of maintenance as directed by the Engineer, the Contractor shall remove all buildings utilities and other facilities from the Site and restore all camp areas to a neat and clean condition.

The construction, operation and maintenance of all camps of the Contractor shall comply with all applicable provisions of current Pakistan Labour Camp Rules.

The Contractor shall furnish, make arrangements for, and carry out proper and adequate maintenance of the Contractor's camp areas at each camp to provide a neat, well-kept camp in all respects with pleasant and healthy surroundings and conditions for all occupants of their camp. The Contractor's camps shall be kept clean, well-graded, free from under growth and bushes and adequately drained. Roads and streets shall be kept in good condition. All utilities shall be adequately and properly operated and maintained to provide service and conditions meeting the requirements of these specifications in all respects.

Adequately equipped and properly staffed portable first aid stations or dispensaries shall be provided by the Contractor at camps and other strategic locations to administer first aid treatment at any time required and free of charge to all persons on the Site, including employees of the Engineer and the Employer.

2. PAYMENT OF WORK

No payment shall be made for the works involved within the scope of this section of Specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

SECTION - 0130
STAKE-OUT SURVEY

1 SCOPE

The work to be done under this item consists of making the stake- out survey for construction purposes with competently qualified men, consistent with the current practices. The work shall proceed immediately upon the award of the contract and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the Engineer. The Contractor shall keep the Engineer fully informed as to the progress of the stake-out survey. The scope of this section of specifications is covered by detailed specifications as laid down herein.

2 MATERIAL AND EQUIPMENT

All instruments, equipment, stakes and other material necessary to perform all work shall be provided by the Contractor. These instruments and equipment shall be available to Engineer at all times for the purpose of checking the work of the Contractor.

All stakes used shall be of a type approved by the Engineer, clearly and permanently marked so as to be legible at all times. It shall be the Contractor's responsibility to maintain these stakes in their proper position and location at all times. Any existing stakes or markers defining property lines and survey monuments which may be disturbed during construction shall be properly tied into fixed reference point before being disturbed and accurately reset in their proper position upon completion of the work.

3 CONSTRUCTION

The Contractor shall trim trees, bushes and other interfering objects, not consistent with the plan, from survey lines in advance of all survey work to permit accurate and unimpeded work by his stake-out survey crews and the Engineer's survey crews. The exact position of all work shall be established from control points which are shown on the plans or modified by the Engineer. Any error, apparent discrepancy in or absence of data shown or required for accurately accomplishing the stake-out survey shall be referred to the Engineer for interpretation or furnishing when such is observed or required.

The Contractor shall be responsible for the accuracy of his work and shall maintain all reference points, stakes, etc. throughout the life of the contract. Damaged, destroyed or inaccessible reference points, bench marks or stakes shall be replaced by the Contractor. Existing or new control points that will be or are destroyed during construction shall be re-established and all reference ties recorded thereon shall be furnished to the Engineer. All stake-out survey work shall be referenced to the centre lines shown on the Plans. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey notes and other records necessary to accomplish the work shall be kept neatly and made available to the Engineer upon request and furnished to the Employer upon Contract completion.

The Engineer may check all or any portion of the stake-out survey work or notes made by the Contractor and any necessary correction to the work shall be immediately made. Such checking by the Engineer shall not relieve the Contractor of any of his responsibilities for the accuracy or completeness of his work.

Reference points, base lines, stakes and bench marks for borrow pits shall be established by the Contractor.

All required right-of-way and easement limits shall be established, staked and referenced by the Contractor concurrent with the construction stake-out survey.

The Contractor shall place at least two offset stakes or references at each centre lines station and at such intermediate stations as the Engineer may direct. From computations and measurements made by the Contractor, these stakes shall be clearly marked with the correct centre line, station number, offset and cut or fill so as to permit the establishment of the true centre line location during construction. He shall locate and place all cut, fill, slope, line grade or other stakes and points as the Engineer may direct to be necessary for the proper progress of the work.

4 PAYMENT OF WORK

No payment shall be made for the Works involved within the scope of this section of Specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

SECTION – 0140

REMOVAL OF TREES

1. SCOPE

The work done under this section of specifications consist of the removal of trees and stumps to a depth not less than fifty (50) centimeters or as designated by the Engineer to ensure complete removal of roots and stumps and their disposal.

2. CONSTRUCTION REQUIREMENTS

Such individual trees as the Engineer may designate and mark in white paint shall be left standing uninjured. All other trees to be removed.

When necessary to prevent injury to other trees or structures or to minimize danger, trees shall be cut in sections from top downwards.

Hole or loose earth resulting from the removal of trees shall be filled and re-compacted to a degree of compaction of adjoining area. Any extra material required for such purpose shall be at the cost of the contractor.

3. GENERAL REQUIREMENTS

Contractor shall prevent damage to all under ground utilities, such as pipes cables or conduits etc. For this purpose if so required, removal of trees shall be carried out manually. Any under ground or over ground property damaged by the contractor shall be immediately repaired by the contractor at his own expense.

4. PROPERTY OF MATERIALS

All the removed trees shall be the property of the contractor and shall be disposed off from the site.

5. MEASUREMENTS AND PAYMENS

No. Measurement and payment will be made to the contractor, it is deemed that price of removed trees materials are in excess to the price of removal and other liabilities of the contractor as mentioned above, therefore contractor will credit/ pay a lump sum amount to the employer as quoted in the Bill of Quantities.

SECTION-1000
DEMOLITION WORKS

1 SCOPE

– The work covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances and performing all operations as required to dismantle existing single storied structures at the site of proposed project

2 SUBMITTALS

2.1 Method Statement and Details

For all Demolition works the Contractor shall submit for the prior approval of the Engineer, the methodology and list of plant and equipment to be employed on the Works. No work shall be commenced until the methodology, plant and equipment to be used in the Works is approved by the Engineer.

3 DISMANTLING PROCEDURES

3.1 Demolitions shall be performed in an orderly manner and the Contractor shall take all necessary precautions and expedients to prevent damages to the adjacent structures.

3.2 Explosives shall not be used to remove or demolish the Plain and Reinforced Cement Concrete Structures unless otherwise directed by the Engineer.

4 EXECUTION

4.1 Description of Site

The Contractor shall take sufficient steps/ actions/ measures for the safety of the adjoining building and shall be responsible for any damage to the existing superstructures and substructures caused due to demolition.

Where approval has been given to the Contractor for carrying out demolition operations at night or in places where day light is excluded, the Contractor shall provide adequate lighting at all points where demolition and transportation is in progress.

4.2 Notice to Commence Work

The Contractor shall give reasonable notice that he intends to commence any demolition works and he shall submit to the Engineer full details of his proposals. The Engineer may require modifications to be made if he considers the Contractor's proposals to be unsatisfactory and the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

4.3 Demolitions near Existing Buildings

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

4.4 **Shoring, Planking and Strutting**

Shoring, where required during demolition, shall be installed to protect workmen and adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor elects to adopt, with prior approval of the Engineer. Any damage to the property on account of Contractor's fault shall be solely on his account.

4.5 **Utility Lines**

Existing utility lines that are visible or the locations of which are made known to the Contractor prior to demolition and that are to be retained, as well as utility lines constructed during dismantling if damaged, shall be repaired by the Contractor at his own expense. Any existing utility lines which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during demolition, shall be repaired by the Contractor and adjustment in payment will be made as approved by the Engineer. The utility lines, which are to be removed, are encountered within the area of operations the Contractor shall notify the Engineer in ample time for the necessary measures to be taken to prevent interruption of the service.

4.6 **Stockpiling of Demolished Materials**

Demolished material suitable for reusable may be stockpiled as directed by the Engineer.

5 **DISPOSAL**

5.1 The demolished/rejected debris materials shall be broken to pieces not larger than 25 to 75mm

5.2 All materials resulting from Demolition shall be disposed off out of Municipal limits along the most direct route from the boundary of the project and/or as directed by the Engineer

5.3 All carts, trucks or other vehicles used by the Contractor for transportation of the Dismantled/Demolished material shall be suitably constructed or lined so as not to permit any leakage of materials while the vehicles are on the move. These would be so loaded and arranged as not to spill on the Site and public roads. Whenever any vehicle so used is found leaking and unsuitable it shall be immediately withdrawn from the Work.

5.4 The disposal of Dismantled/Demolished debris material shall include loading, unloading, transporting, spreading and leveling as directed by the Engineer

6 **PROPERTY OF MATERIAL**

All the materials designated as reusable Except Electrical & Mechanical fixtures at the opening date of tender shall be the property of the Contractor and stacked/stored in an approved manner at a place within the site area as approved by the Engineer.

7 MEASUREMENT AND PAYMENT

7.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under-mentioned works related to the relevant BOQ item.

7.1.1 Timber shoring, planking, strutting and providing slope for upholding the sides of demolished work.

7.1.2 Stacking of reusable materials.

7.1.3 Operations and the steps taken for the safety of the existing adjoining structures including danger direction/ diversion sign boards of appropriate size and temporary segregating the area with corrugated sheet steel plates or with brick masonry in mud.

7.1.4 Temporary diversion of existing utility lines.

7.1.5 Disposal of demolished debris materials out of Municipal limits including loading unloading and spreading.

7.1.6 Arrangement of water and power supply for the works, if required.

7.1.7 Tools, Plants and equipments used for the demolition.

7.1.8 Any damage caused to the structures and installation due to negligence of the Contractors during dismantling operations and their repair/replacement. to the satisfaction of the Engineer.

7.1.9 Cleaning and restoring the site to the satisfaction of the Engineer.

7.2 Measurement and payment

No payment will be made to the contractor. It is deemed that price of reusable materials such as bricks, Doors, Windows, etc; are in excess to the price of demolition and other liabilities of the contractor as mentioned above therefore the contractor will credit a lump sum amount to the Employer as quoted in Bill of Quantities.

SECTION - 1100
EARTHWORKS

1 SCOPE

The work to be done under this section of the specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with earth works of carrying out excavation in all type of soil for basement, structural foundations underground supplies and services for all structural units, stock piling of suitable excavated material, disposal of unsuitable and surplus excavated material, fill and backfill using suitable excavated material or imported material obtained from approved sources or by blending the excavated material and compaction of fill and backfill in accordance with this section of specifications, the applicable drawings and subject to terms and Conditions of the Contract. The scope of this section of specifications is also covered with detailed specifications as laid down herein.

2 CODES AND STANDARDS

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

ASTM D-1556-74	Test for density of soil in place by the sand cone method.
ASTM D-1557-78	Test for moisture-density relations of soils and soil aggregate moisture using 4.5 Kg rammer and 457 mm drop.
BS 1377-75	Methods of tests for soils for civil engineering purposes.

3 GENERAL

3.1 Class, Nature or Condition of Soil

The Contractor shall acquaint himself with the nature of the ground, existing structures, foundations and subsoil which might be encountered during excavation or earthworks. The Employer does not guarantee or warranty in any way that the materials to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Report, Drawings or in any other Contract Documents or to material obtained from boring or trial holes. The Contractor shall be deemed to have made local and independent inquires as to, and shall take the whole risk of, the nature of the ground subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive an extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.

3.2 Lines, Levels and Grades

All excavations cut and fills shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Period of Maintenance the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Period of Maintenance any damage or defects in cuts and fills, in structures and other works, caused by slips, falls of wash-ins or any other ground movement due to the Contractor's negligence shall be made good by the contractor at his own cost.

3.3 **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 during the progress of the works, the Contractor shall at his own expense rectify such error, to the satisfaction of the Engineer.

The Contractor shall construct and maintain accurate bench marks so that the Lines and Levels can be easily checked by the Engineer.

The Contractor shall construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction.

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

3.4 **Authorized Outlines**

Unless otherwise specified or directed by the Engineer in writing, all earthworks, i.e. excavation of basement trenches and pits for foundations and filling under floors etc. shall be executed to the width, depths, lengths, alignments, grades and levels shown on the Drawings or as directed by the Engineer.

4 EXCAVATIONS

4.1 Excavation shall include the removal of all material of every name and nature. Excavations shall be carried out in accordance with excavation plans and sections shown on the Drawings and as directed by the Engineer.

The major portion of excavations shall be carried out by mechanical excavators and excavated materials disposed off to stock on spoil as per Drawings or as directed by the Engineer. The excavation which cannot be done by mechanical means shall be done by manual tools. Unless otherwise specified by the Engineer, leveling, trimming and finishing to the required levels and dimensions shall be done manually. The material suitable for fill and backfill if approved by the Engineer shall be stockpiled within the free haulage limit of the project boundary of the works.

4.2 The Contractor shall give reasonable notice that he intends to commence any excavation and he shall submit to the Engineer full details of his proposals. The Engineer may require modifications to be made if he considers the Contractor's proposals to be unsatisfactory and the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

4.3 For major excavations, the Contractor shall submit for the prior approval of the Engineer full details and drawings showing the proposed method or procedure, supporting and strutting, etc. The design, provision, construction, maintenance and removal of such temporary works shall be the responsibility of the Contractor and all cost in these respects shall be included in the quoted unit rate for the permanent work.

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

4.5 The Contractor shall preserve the completed excavation from damage due to slips and earth movements, ingress of water from any source whatsoever and deterioration by exposure to the sun and the effects of the weather.

4.6 All excavation of every description, in whatever material encountered shall be performed to the elevations and dimensions shown on the Drawings in such a manner as to avoid interruption to work in other parts of the site. The Contractor shall be responsible for injury to the permanent works caused by excavation on other parts of the works.

4.7 Excavation shall extend to adequate distance from walls and footings to allow for placing and removal of forms, installations of services and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces. Undercutting will not be permitted. The additional excavation for placing and removal of forms, installation of services, for inspection and generally for working area on slopes for stability shall not be measured for payment and shall be deemed to be included in the rates for excavation as measured net.

4.8 All excavations in foundations shall be taken to 150 mm (6") above the final excavation elevations shown on the drawings and the last 150 mm (6") shall be trimmed carefully to a smooth and level surface. Immediately after trimming to the final elevation, a layer of blinding concrete shall be placed to the thickness shown on the drawings. All excavations for foundations which have been trimmed and disturbed shall be compacted and covered by lean concrete by the end of the day. It is specifically brought to the notice of the Contractor that any excavation taken down to the trimmed elevation which is left over-night or for any length of time thereafter, uncovered by the blinding concrete, shall be required to be trimmed to such lower elevation as directed by the Engineer and any extra work or any consequent increase in the quantities caused thereby shall not be paid to the Contractor.

4.9 No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the Engineer and his permission to proceed is given.

4.10 If excavations for sub-structures are carried below the required level, as shown on the Drawings or as directed by the Engineer, the surplus depth shall be filled in with concrete of same grade as of blinding concrete at the sole cost of the Contractor.

4.11 All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry and the Contractor shall have sufficient dewatering equipment for this purpose. The Contractor shall design, provide and maintain effective dewatering system during excavation and construction of foundations upto plinth level so as to keep the foundation area dry. Adequate precautions shall be taken to prevent any erosion due to undercutting from underneath the previously constructed adjoining foundations.

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

4.13 Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation and that are to be retained, as well as utility lines constructed during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his own expense. Any existing utility lines which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor and adjustment in payment will be made as approved by the Engineer. When utility lines which are to be removed, are encountered within the area of operations the Contractor shall notify the Engineer in ample time for the necessary measures to be taken to prevent interruption of the service.

4.14 Excavated material suitable for use as fill and backfill shall be stockpiled within free haulage limit of the project boundary as directed by the Engineer. This stockpiled material shall be transported back to places requiring fill or backfill.

Excavated material unsuitable for use as fill and backfill shall be disposed off by the Contractor at locations approved by the Engineer within specified free haulage limit.

4.15 Where applicable the excavation work shall include the excavation in above water table and excavation below water table. The Contractor shall submit the proposal for dewatering from the areas of excavation for the approval of the Engineer and shall provide all plant, equipment, pumps, sheeting, well points as required to keep the water table 3 feet (1.0 meter) below the deepest foundation as shown on the drawings till the completion of foundation works.

4.16 The Contractor shall make independent inquiries and perform and make independent observations to ascertain the water table in the areas of excavations during the period when the construction works are in progress. The Contractor shall take whole risk of any nature for fluctuation of the water table from his own findings. The Employer does not bind himself in any way and shall not be responsible for any information given by him or any information, observations or values obtained from his reports, Drawings, and Documents or anywhere in this Document.

4.17 Excavation for pits, cable trenches, equipment- foundations and other structures shall be taken out to the levels and dimensions shown on Drawings or such other levels and dimensions as the Engineer may direct.

4.18 Before starting the excavation, the Contractor shall ensure the correct alignment of the pipeline on the ground the depth and width of excavation of the trench, all in accordance with the Drawings and instructions of the Engineer. The Contractor shall make profile with cement concrete pillars.

4.19 Excavation shall be carried out true to lines, levels, grades and widths as shown on the drawings or as directed by the Engineer ensuring proper laying of the pipe line, the bedding fill, construction of chambers for appurtenances and any other structures. The trench bottom shall be graded to provide even and substantial bearing over the specified bedding and of the structure.

4.20 The Contractor, at his cost shall provide to the satisfaction of the Engineer all timbering, approved supports, shores and bracing to the sides of the excavated trench and foundations in such a manner so as to secure the sides of the trench and excavations from falling or adverse movement. All responsibility connected with such shoring shall rest with the Contractor.

4.21 Adequate clearance/working space on both sides of the structure/pipe line shall be provided for which no payment shall be made.

4.22 Without the written permission of the Engineer, not more than 200 meter (650 feet) of the trench shall be opened in advance of the completed pipeline.

4.23 The bottoms of all excavations shall be carefully leveled. Any pockets of soft or loose material in the bottoms of the pits and trenches shall be removed and the cavities so formed filled with lean concrete at the Contractor's expense.

4.24 It is expected that rock and other hard material will be encountered during excavation. The rate of excavation shall include the removal of all sub surface material of every name and nature and no classification of sub-surface material shall be made.

4.25 The Engineer may require the Contractor to excavate below the elevations shown on the drawings or he may order him to stop above the elevations shown depending upon the suitable foundation material encountered.

4.26 If for any reason, the levels, grades or profiles of the excavations are changed adversely, the Contractor shall, at his own cost, be liable to bring the excavations to the required levels and profiles as shown on the drawings or as directed by the Engineer.

5 EXCAVATION TOLERANCES

Excavation shall be performed within the tolerances for excavation limits indicated on the drawings. Where no tolerance limits are indicated excavation shall be performed to tolerances established by the Engineer as acceptable for the design and type of work involved.

6 FILL AND BACKFILL

6.1 After completion of foundation footing, foundations, walls, and other construction below the elevation of the final grades and prior to filling forms shall be removed and the excavation shall be cleaned of trash and debris.

6.2 The backfilling shall include filling under the floors, around the foundation trenches, pipes, conduits, ducts and channels.

6.3 The backfilling shall include loading, unloading, transporting, placing, stacking, spreading of earth, watering, rolling, ramming and compacting, etc., complete as specified herein.

6.4 Filling shall be approved selected material obtained from outside sources. It shall be predominantly granular material and free from slurry mud, organic or other unsuitable matter and capable of compaction by ordinary means.

6.5 The excavated material if found suitable shall be stockpiled within the free haulage limit of the Project Boundary. This material shall be used for filling/back- filling if approved by the Engineer and shall be transported by the Contractor anywhere required for the purpose of filling/back-filling work in this Contract.

6.6 The Contractor shall provide the approved quality of backfill and fill material required to complete the fill and backfilling work from the places as designated by the Engineer.

6.7 Filling in trenches and foundations shall be placed in 200mm layers and compacted at optimum moisture content by mechanical means or other means as approved by the Engineer.

6.8 Filling around pipes and cables shall be carefully placed with fine material to cover the pipe or cable completely before the normal fill is placed.

6.9 Material for backfilling shall be as approved by the Engineer and shall be placed in layers not exceeding 150 mm (6 inch) measured as compacted

material and saturated with sufficient water and compacted to produce in-situ density not less than 95% of the maximum dry density at optimum moisture content, achieved in Test No.15 of BS 1377 : 1975.

6.10 All filled areas shall be left neat, smooth and well compacted, the top surface consisting of the normal site surface soil, unless otherwise directed.

6.11 Depending on the depth of fill the Engineer may instruct increased thickness of successive layers to be placed.

6.12 Fill shall not be placed against foundation walls prior to the approval by the Engineer. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the top of footing.

6.13 In case the Contractor is instructed to arrange for the fill material, the quality of the fill material will be subject to the approval of the Engineer. The Engineer shall require the Contractor to carry out various tests of the fill material. All such tests shall be made at an approved laboratory at the cost of the Contractor. Once a material from a specific source has been approved, the material of the same quality and from the same source only shall be used. Any fill material from borrow pits which has not been approved or the quality of which differs from the approved material shall be rejected without recourse. The Engineer reserves the right to order removal of any such materials brought to the site of the works at his discretion at Contractor's expense. In order to ensure satisfactory compaction, it will be necessary to carry out, depending upon the type of material, particle size distribution tests, liquid limit, plastic limit and determination of organic contents tests, maximum and minimum density tests and determination of optimum moisture content for the fill material.

6.14 The method of compaction, namely type of compactor, type of roller, weight of roller and number of passes proposed by the Contractor for any particular fill material shall be subject to the approval of the Engineer after the completion of satisfactory field tests, subsequent to the laboratory analysis using the materials and equipment proposed to be used for the earthwork in conditions similar to those likely to be encountered during construction. The final selection of the soil moisture content, the thickness of layers, the type of compaction equipment and the number of passes shall be decided after these tests, which shall be conducted at Contractor's expense.

6.15 Having established the method of compaction to be used, no departure from this approved method shall be permitted without the prior approval of the Engineer. The adequate control of the fill and compacting operations shall be ensured by in-situ density tests and in order to obtain significant results, not less than two tests shall be carried out per one hundred square meters of area compacted. The frequency of tests shall be determined on site and may be varied at the discretion of the Engineer's Representative as the work proceeds. Tests shall be carried out in accordance with British Standard 1377:1975 or to such other standards as approved by the Engineer. The standard of acceptance of the compacting will not be less than 95% in-situ density with respect to the maximum dry density at optimum moisture content achieved in Test No 15 of BS 1377: 1975 or the standard referred in the drawing.

6.16 The exact thickness of layers and the method of placing and compacting the fill shall be determined by the field tests, as stated above, but notwithstanding the results of these trials, fill shall not be placed in loose layers exceeding 200 mm (8 inch) in thickness. In order to maintain control of the thickness of layers, timber profiles shall be used wherever feasible. The profiles of each

layer of fill shall be checked by the supervisory staff of the Engineer. The Contractor shall provide adequate supply of water and sufficient capacity of mechanical water carriers to ensure uniform and uninterrupted operation of compaction. The Engineer may forbid the Contractor to proceed with placing and/or compaction of fill and/or order removal and re- compaction of such fill when he finds that the Contractor has insufficient or defective equipment or that the fill has been improperly laid and/or compacted.

6.17 Backfilling of trenches/foundations shall be carried out only after the pipe line/structural works within the excavations have been inspected, tested and approved by the Engineer.

6.18 Before the start of fill and backfill, the Contractor shall satisfy himself as to the levels and slopes of the fills and backfill shown on the Drawings, the requirements of compaction, the possibility of settlement and all other particulars whatsoever in connection with the filling works.

6.19 Backfilling for pipelines shall proceed as rapidly as practicable. Backfill shall be placed in horizontal layers and shall be compacted as follows:

6.20 Layers upto an elevation of 300 mm (12 inch) above the top of the bedding shall not be more than 150mm (6 inch) in loose thickness and the remainder of the layers above that elevation shall not be more than 150 mm (6 inch) of compacted thickness.

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

7 Sand Filling Under Floors

7.1 Unless otherwise specified the base of all ground floors shall be constructed in accordance with the following specification.

7.2 Sand filling shall be done in layers not more than 4 inches. (100mm) thick and shall be rammed after saturation to such an extent that 4 inch. (100mm) Layer is reduced to about 3 inch. (75mm) after compaction.

7.3 Density achieved should correspond to 95% of the compaction obtained by ASTM 1557 at optimum moisture content.

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

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

8 TOLERANCES

The stabilization of compacted backfill/fill surface shall be smooth and even and shall not vary more than 0.5 inch. In 10feet (10 mm in 3 meters) from true profile and shall not be more than ½ inch. (12.5 mm) from true elevation.

9 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

9.1 The rejected unsuitable material and surplus excavated material shall be disposed off within 25 kilometer lead measured along the most direct route from boundary of the Project, or as directed by the Engineer.

9.2 All carts, trucks or other vehicles used by the Contractor for transportation of the material shall be suitably constructed or lined so as not to permit any leakage of soil while the vehicles are on the move. These would be so loaded and arranged as not to spill on the Site and public roads. Whenever any

vehicle so used is found leaking and unsuitable it shall be immediately withdrawn from the Work.

9.3 The disposal of surplus/unsuitable excavated material shall include loading, unloading, transporting, stacking, spreading and leveling as directed by the Engineer.

10 MEASUREMENT AND PAYMENT

10.1 General

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

10.1.1 Timber shoring, planking, strutting and providing slope for upholding the sides of excavations.

10.1.2 Any fill with approved material necessitated by over excavation due to fault or convenience of the Contractor.

10.1.3 Stockpiling the excavated material at approved location within free haulage limit of the Project Boundary and transporting back suitable material to places requiring backfill.

10.1.4 Specified foundation bed preparation.

10.1.5 Excavation involved in providing adequate working space around sides of foundation and service line trenches.

10.1.6 Rolling, leveling, watering & compacting the fill and backfill to required density.

10.1.7 All laboratory and field tests stipulated in these specifications.

10.1.8 Disposal of rejected surplus and unsuitable excavated material within 25-kilometer free haulage limit measured along the most direct route from boundary of the Project.

10.2 Excavation

10.2.1 Measurement

Quantities of excavation shall be calculated/measured from the pre-work levels of leveled and graded ground taken jointly by the Contractor and the Engineer before commencement of the work.

The quantities set out for excavation and its subsequent disposal shall be deemed to be the bulk quantity before excavating and no allowance shall be made for any subsequent variations in bulk or for any extra excavation.

Unless otherwise shown on the Drawings quantities of excavation shall be measured of acceptably completed works on the basis of vertical excavations required for the nominal concrete dimensions of the structural members of foundations.

Quantities of excavation for laying service line trenches shall be measured for payment on the basis of vertical excavation faces for the specified width for the trench as shown on the drawings.

Measurement for acceptably completed excavation works shall be made on the basis of number of cubic feet of material excavated for

foundation and service trenches as shown on the Drawings or as directed by the Engineer.

10.2.2 **Payment**

Payment will be made for acceptably measured quantity of excavation on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

10.3 **Filling by Sand from outside approved Source**

10.3.1 **Measurement**

Measurement for acceptably completed compacted Filling by Sand from outside approved Source will be made on the basis of number of Cubic feet of compacted Filling by approved Source in position in accordance with the lines, levels, grades and compaction requirements as shown on the drawing or as directed by the Engineer.

10.3.2 **Payment**

Payment will be made for acceptably measured quantity of Filling by Sand from outside approved Source on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 1200
DEWATERING

1 SCOPE

The work for dewatering shall consist of lowering the ground water to the required predetermined ground elevation and includes:

a) Dewatering foundations and care of water to maintain all excavations and access free of water as required for the proper construction of the Works including designing of the dewatering system.

b) Protecting the excavated areas and structures to be constructed from damage by rains, surface run off and infiltration of sub-soil water into the areas of construction during the entire construction period including construction and maintenance of drains ditches and sumps.

2 SUBMITTALS

Prior to commencement of Works, the Contractor shall submit the following to the Engineer for his approval:

a) Complete plans and sketches for dewatering of surface water if any and dewatering of the required excavations including system for disposal of this water to areas designated by the Engineer.

b) Detailed design calculations where required.

c) Proposed plan for protection of Works including the design of the protective works and allied facilities.

3 CONTRACTOR'S RESPONSIBILITY

All plans and works provided for dewatering and removal of impounded water shall be subject to approval of the Engineer but nothing in the Contract shall relieve the Contractor from full responsibility of such operations. The Contractor shall be responsible for and repair at his expense any damage to the Works resulting from failure of his operations. Failure of protection works or similar events which may occur in the area during the entire construction period shall be corrected by the Contractor at his expense.

The Contractor shall neither interrupt nor interfere with the natural or normal flow of any channel, watercourse or drain for any reason or purpose without the written approval of the Engineer.

4 PRODUCTS

4.1 GENERAL

The Contractor shall furnish tubewells, well points, pumping equipment, disposal lines, coffer-dams, ditches, drains, sumps, weirs, bunds, or any other work, material or equipment required to protect the Works against water.

4.2 PROTECTIVE WORKS

The Contractor shall construct and provide the protective works as may be required to protect the excavated areas and all other works from rains, surface run-off and infiltration of subsoil water into the areas of constructions.

4.3 DEWATERING SYSTEMS

The overall dewatering system shall include the Basic Dewatering System, the Standby Dewatering System, Power Supply Systems, Monitoring devices and all associated equipment as specified herein.

The Basic Dewatering System shall be the minimum required to achieve the specified results.

The Standby Dewatering System shall be that system which may be required to achieve the specified results in case a part or all of the Basic Dewatering System becomes ineffective for any reason.

Power Supply System shall consist of supply of power to various points for running the two dewatering systems and to provide lighting required to perform the work at night.

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

4.4 ALARM SYSTEM

The Contractor shall supply an alarm system which will alert responsible personnel at the time of power failure and at the same time will automatically activate the Standby Power Units.

5 EXECUTION

5.1 DEWATERING OPERATIONS

The Contractor shall install, maintain and operate all the systems as required for dewatering the various parts of the Works and for maintaining the foundations free from water. The Contractor's method of removal of water from the foundations shall be as approved by the Engineer. Dewatering shall be accomplished in a manner that will prevent loss of fines from the foundation, will maintain stability of excavated slopes, will result in all construction operations being performed free from standing water and will result in all foundations being sufficiently dry for proper bonding of the backfill material with the foundations and proper compaction of the material placed. The Contractor shall be required to control the seepage along the bottom of the foundations and elsewhere to prevent the accumulation of standing water.

5.2 PROTECTION OF WORKS

Particular care shall be taken in all dewatering operations to ensure that the removal or lowering of water impounded in and around structures is at all times controlled and done in a manner that shall not result in sloughing of banks or damage to excavations and structures during the entire construction period.

5.3 MONITORING

The Contractor shall constantly keep watch on the sub- surface water levels and likely flooding from surface run off. He shall install piezometers if required and arrange recording of water levels data and correlate this data with dewatering operations on a continuous basis to ensure the dewatering as required.

5.4 PRECAUTIONS

The Dewatering System shall be designed in such a manner that all or parts of the Standby System can be directly connected to the Basic System, if during construction it becomes necessary to make this connection.

The Standby Dewatering System shall be operated for a period of at least 3 hours duration each week to demonstrate its complete effectiveness.

5.5 CLEARANCE

After having served their purpose, all protective works, dewatering and power supply systems shall be removed or leveled and graded to a sightly appearance so as not to interfere in any way with the operation or functions of the completed Works. Holes left from well points tubewells, piezometers or other dewatering installations shall be grouted to the satisfaction of the Engineer.

6 MEASUREMENT AND PAYMENT

6.1 GENERAL

Except as otherwise stated the payment for dewatering item shall be made on a lump sum basis. The payment shall include, but not be limited to, all costs incurred in connection with provision, installation, operation, maintenance and removal of the complete Dewatering System consisting of Basic Dewatering System, Standby Dewatering System together with power supply arrangements. The item also includes transportation of all plant, equipment, supplies and personnel to the Site; making all the necessary arrangements for satisfactory performance of the Dewatering System throughout the Contract period; grouting holes as required, cost of provision and maintenance of protective Works and ditches, drains and sumps required for the Work.

6.1.1 The cost of providing power supply to run the system and the cost incurred on designing of the Dewatering System shall be deemed to be included in the price for the item.

6.2 - Measurement

No measurement will be made. Execution of the Contractor's plan for the respective item as approved by the Engineer shall be the basis of payment of lump sum amount for the item.

6.3 Payment

6.3.1 Interim payments for dewatering shall be made in lump sum in accordance with the following provisions:

6.3.2 The first payment equal to 25% of the lump sum amount of dewatering item shall be made after the Contractor has brought on Site all the materials, plant and equipment in accordance with his approved scheme of dewatering.

6.3.3 The second payment equal to 25% of the lump sum amount of the dewatering item shall be made after the complete Dewatering System has been installed and the Contractor has demonstrated its performance to the satisfaction of the Engineer.

6.3.4 Further payments amounting to 40% of the lump sum amount of dewatering item shall be paid in equal monthly installments starting one month after the second installment and ending at the completion of dewatering operations to the satisfaction of Engineer.

6.3.5 Balance 10% of the lump sum amount of dewatering item shall be paid after removal of the system on completion of dewatering operations, grouting of holes, if any and clearance of Site.

SECTION - 1600

TERMITE CONTROL TREATMENT

1 SCOPE

The scope of work for anti termite treatment includes injection of insecticide in sides and bottom of foundation trenches, spraying on stockpiled backfill material and injections of the insecticide in floor sub-grade of the building. The scope also covers treatment of all wood works with insecticides before installation in position.

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.

3 SUBMITTALS

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

3.2 Method statement for application of anti-termite chemical.

4 QUALITY ASSURANCE

4.1 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.

4.2 Application

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

4.3 Guarantee

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 ten years from the date of acceptance of the building.

In the event of any damage caused within the guaranteed period, the Contractor shall replace at his own cost such 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.

5 MATERIAL

5.1 An emulsible concentrated insecticide shall be used for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent. Provide a working solution of one of the following chemical with clean portable water in ratio 1:40 unless other wise specified by the manufacturer/ supplier.

5.1.1.1 Termidor

5.1.1.2 Biflex

5.1.1.3 Dursban

5.2 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 verified by the Engineer.

5.3 Pure turpentine shall be used for dilution of insecticide, in approved proportion for application to woodwork where such application is required.

6 METHOD AND EXTENT OF APPLICATION

6.1 Insecticide solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150psi to all applications to, on or in earth.

6.2 Soil treatment shall begin after all work of preparation of earth prior to installation of concrete has been done. After application, no additional earth moving or work upon sub grade should be done. No covering of earth or concrete should be applied over soil treatment until at least 24 hours after treatment has been made. 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 liter /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 25-mm minimum in porous earth at bottom and 50 mm to 75 mm at sides of excavations.

6.3 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.

6.4 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.

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

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

7 MEASUREMENT & PAYMENT

7.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the 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.

7.1.1 Termite control treatment on wood works.

7.1.2 Turpentine & Water required for mixing insecticide solution.

7.1.3 Transportation of material and storage at site.

7.1.4 Anti-termite treatment on stock piled backfill material.

7.1.5 Tool, plant & equipment required for Termite control treatment

7.2 Termite Control Treatment

7.2.1 Measurement

Measurement of acceptably completed works of termite control treatment will be made on the basis of number of square feet of the plinth area treated by measuring the two dimensions (length & breadth) of treated surface. Measurement will be considered for once for all steps of the process.

7.2.2 Payment

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

SECTION - 2100
CONCRETE FORMWORK

1 SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the design, supply and installation of formwork for the purpose of shuttering in concrete work, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2 GENERAL

It shall be the responsibility of the Contractor to perform the work by engaging well trained and experienced staff or by the sub contractor who shall have enough number of well trained and experienced staff to coordinate his activities with the other operations. However the Contractor shall be responsible for the quality of work performed by the sub-contractor as per the requirements of these specifications.

3 MATERIALS

The Contractor shall use the following formwork materials for different purposes as stated below:

3.1 Timber

Form framing, sheathing and shoring.

3.2 Plywood

Form sheathing and panels.

3.3 Steel

- Heavy forms and false work
- Column and joint forms
- Permanent forms
- Welding of permanent forms

3.4 Form Ties Anchors and Hangers

For securing formwork against placing loads and pressures.

3.5 Coatings

Facilitate form removal.

3.6 Steel Joints

For formwork support.

3.7 Steel frame shoring

For formwork support.

4 DELIVERY AND STORAGE

4.1 Delivery

The delivery of formwork materials shall be done in such a manner that damage can be prevented.

4.2 **Storage**

Form work should be stored, after cleaning and preparing for reuse if used before in such a manner that access to all different materials is available.

Material which can be affected by weathering shall be stored in appropriate building or under covers and shade.

5 WORKMANSHIP

5.1 Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

Where required, details and locations of special forms to be used are set out on the drawings. The Engineer shall refuse any work in any part of the building, which has been constructed with a non-approved formwork. The Engineer shall refuse any concreting which will not be perfect or may not conform to the approved model.

5.2 Earth cuts shall not be used as forms for vertical surfaces of reinforced concrete work unless required as such or and permitted by the Engineer.

5.3 Mud centering shall not be permitted without the prior approval of the Engineer.

5.4 Formwork shall be of wrought timber, steel, plywood, proprietary building boards and such special materials, as may be shown on the drawings or approved by the Engineer, which give the required finish to the surface of concrete. Wooden formwork shall be free from loose knots and shall be well seasoned.

5.5 The formwork shall conform to the shape, lines and dimensions as shown on the plans, 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.

The design and Engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. Where necessary, to maintain the specified tolerances, the formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads.

5.6 The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used as references for checking upon tolerances.

5.7 Requirements for 'facing materials' are given in the Section relevant to 'Finishing of Formed Surfaces'. The maximum deflection of facing material reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

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

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

5.10 Where panels for as-cast surfaces are separated by recessed or otherwise emphasized joints, the structural design of the forms shall provide for locating form ties, where possible, within the joints so that patches of tie holes will not fall within the panel areas.

5.11 Forms shall not be re-used if there is any evidence of surface wear and tear or defect which would impair the quality of the surface finish. Forms shall be thoroughly cleaned and properly coated before re-use.

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

5.13 Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Unless otherwise specified in the Contract Documents chamfer strips shall be placed in the corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on such surfaces and the edges of formed joints will not require beveling unless required by the Contract Documents.

5.14 Positive means such as wedges or jacks for accurate adjustment and for proper removal of shores and struts shall be provided and all settlement shall be monitored during concrete placing operation. Forms shall be securely braced against lateral deflections.

5.15 Where concreting of thin members is required to be carried out within formwork of considerable depth, temporary openings in the sides of the formwork shall be provided where necessary to facilitate the placing and consolidation of concrete. Small temporary openings shall also be provided at the bottom of the formwork for columns, walls and deep beams to permit the cleaning out of debris and observation immediately before concrete is deposited.

5.16 Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 times diameter or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view and in no case shall this distance be less than 20 mm. When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut off flush with the formed surfaces.

5.17 Through bolts may be permitted, provided that they are greased to allow for easy withdrawal and the holes subsequently made good. Through bolts are not to be used on water-retaining structures.

5.18 At construction joints contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by no less than 25 mm. The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint so as to maintain a true surface.

5.19 Wood forms for wall opening shall be constructed to facilitate loosening, if necessary to counteract swelling of the forms.

5.20 Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check.

5.21 Formwork shall be so anchored to shores or to other supporting surfaces or members that upward or lateral movement of any part of the formwork system during concrete placement will not occur.

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

5.23 All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before placing fresh concrete.

5.24 Forms shall be sufficiently tight to prevent leakage of grout or cement paste. Board forms having joints opened by shrinkage of the wood shall be removed and replaced. Plywood and other wood surfaces not subject to shrinkage shall be sealed against absorption of moisture from the concrete by either (I) a field applied, approved form oil or sealer, or (2) a factory applied non-absorptive liner. When forms are coated to prevent bond with concrete, it shall be done prior to placing of the reinforcing steel. Excess coating material shall not be allowed to stand in puddles in the forms nor allowed to come in contact with the concrete against which fresh concrete will be placed. Care shall be taken that such approved composition is kept out of contact with the reinforcement. Where as-cast finishes are required, materials which will impart a stain to the concrete shall not be applied to the form surfaces. Where the finished surface is required to be painted, the material applied to form surfaces shall be compatible with the type of paint to be used.

5.25 For reinforced concrete, in no circumstances shall forms be struck until the concrete attains strength of at least twice the stress to which the concrete may be exposed at the time of striking.

The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions, and cured under conditions of temperature and moisture similar to those obtaining in the work. Where possible, the formwork should be left for longer time as it would assist the curing.

I n normal circumstances (generally where temperatures are above 20^{O}C and where ordinary cement is used, forms may be struck after expiry of the following periods.

- Walls, columns and vertical sides of beams : 48 hours or as may be decided by the Engineer.

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- Side of slab (shores of props left under). : 6 days
- Beams soffits (shores or props left under). : 12 days.

- Removal of shores or props to slabs.
  1. Spanning upto 4 meter 10 days.
  2. Spanning over 4 meter 16 days.
- Removal of shores or props to beams.
  1. Spanning upto 6 meter. 18 days
  2. Spanning over 6 meter 25 days

For rapid hardening cement 3/7 of the above period will be sufficient in all cases except vertical sides of slabs, beams and columns which should be retained for a minimum of 24 hours.

The number of shores or props, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab and beams, as the case may be.

Proper allowance shall be made for the decrease in rate of hardening of concrete in cold weather and the above minimum duration must be increased when the mean daily temperature is below $20^{O}C$.

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

5.27 Top forms on sloping surfaces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once and be followed by the specified curing.

5.28 Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete.

5.29 All formwork shall be removed without such shock or vibration as would damage the reinforced concrete. Before the top plank and struts are removed, the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened. Proper precautions shall be taken to allow for the decrease in the rate of hardening that occurs with all cement in the cold weather.

5.30 When reshoring or repropping is permitted or required, the operations shall be planned in advance and shall be subject to approval. While reshoring is underway no live load shall be permitted on the new construction.

In no case during reshoring shall concrete in beam, slab, columns or any other structural member be subjected to combined dead and construction loads in excess of the load permitted by the Engineer for the developed concrete strength at the time of reshoring.

Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of working day on which stripping occurs.

Reshores shall be tightened to carry their required loads without overstressing the construction. Reshores shall remain in place at least until tests representative of the concrete being supported have reached the strength specified in sub- clause 5.23 hereof.

5.31 Floors supporting props or shores under newly placed concrete shall have their original supporting props or shores left in place or shall be reshored. The reshoring system shall have a capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one half the capacity of the shoring system above. The reshores shall be located directly under a shore position above unless other locations are permitted.

5.32 The reshoring or re-propping shall extend over a sufficient number of storeys to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that the design superimposed loads of the floors supporting shores or props are not exceeded.

5.33 It is generally desirable to give forms for reinforced concrete an upward camber to ensure that the beams or slabs (specially cantilever slabs) do not have sag when they have taken up their deflection, but this should not be done unless permitted by the Engineer.

5.34 No loads, other than man and light plant required in connection with the actual work in hand, shall be allowed on suspended floors until 28 days after concreting where ordinary Portland Cement is used and 14 days when rapid hardening Portland Cement is used.

5.35 The formwork and shuttering for pre-stressed concrete beams shall be well and stoutly constructed from steel clad timber or steel. It shall be fully capable of supporting all the loads due to the fresh concrete and due to construction equipment and operations, including vibration, without deformation or deflection that will affect the dimensions of the concrete member beyond the tolerance stipulated hereinafter.

5.35.1 It is expressly stipulated that in view of precision and powerful vibration required in casting the pre-stressed concrete girders and pre-cast members particularly in the zones of end blocks or around anchorages, specially designed formwork and supporting systems shall be required.

5.35.2 All details of formwork of girders and the supporting systems shall be submitted to the Engineer who shall check their safety and approve and/or amend the same, provided however that the approval of the formwork shuttering and supporting system by the Engineer, shall not in any way affect or diminish the Contractor's sole responsibility for fully satisfactory performance of the work.

5.35.3 All joints between formwork boards and/or panels shall be flush and tight. Internal ties shall be used as few as possible and shall, when unavoidable, be in steel, located at such positions which will not disturb the reinforcement or pre-stressing steel. The use of spacer blocks for the reinforcement shall be prohibited whenever the same effect can be achieved by properly dimensioned spacer rings mounted directly on the reinforcement. All spacer blocks and rings shall be of the same strength as the concrete in which they are embedded and shall be adequately cured before use.

5.35.4 Prior to placing concrete, all forms shall be inspected and all debris and extraneous matter removed. The form oil or release agent shall not react with concrete to affect the strength nor shall it give any colour. It shall be applied in such a manner as not to contaminate the reinforcement and other fixtures to be embedded in concrete.

6 MEASUREMENT AND PAYMENT

6.1 No payment will be made for the works involved within the scope of this section of the specifications unless otherwise specifically stated in the Bills of Quantities or herein.

6.2 The cost thereof shall be deemed to have been included in the quoted unit rate of relevant items of the Bills of Quantities.

SECTION - 2200

REINFORCEMENT

1. SCOPE

The work under this section of specifications consists of furnishing, cutting, fabricating, bending and placing steel reinforcement and Welded wire fabric in concrete structures or elsewhere 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.

2. APPLICABLE STANDARDS

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

Pakistan Standards

PS 2674	Tensile Testing of Metals.
PS 2031	Bend test for Metallic Materials.
PS 607	General technical delivery requirement for steel.
PS 1612	Cold worked steel deformed bars for reinforcement of Concrete.
PS 1879	Deformed and Plain billet steel bars for concrete reinforcement (Metric)

British Standard

BS 4482	Specifications for cold reinforced steel wire for the reinforcement of concrete.
BS 5135	Specification for arc welding of carbon and carbon manganese steel.
BS 4449	Hot rolled steel bars for reinforcement of concrete
B.S 4461	Cold worked steel bars for reinforcement of concrete.
BS 4466	Bending dimensions, cutting and scheduling of steel reinforcement for concrete.
BS 4483	Steel fabric for the reinforcement of concrete.

ASTM Standard

A 305	Minimum requirement for the deformations of deformed steel bars for concrete reinforcement.
A 615	Deformed billet steel bars for concrete reinforcement.

ACI Standard

ACI 301	Specification for structural concrete for buildings.
ACI 315	Manual of standard practice for detailing reinforced concrete structures.

In addition to the above, the latest editions of other Pakistan Standards, British Standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other standard as may be specified by the Engineer for Special Material and construction are also relevant.

3. MATERIAL AND SIZE OF BARS

3.1 Reinforcement for concrete shall conform to the respective Pakistan, British, ASTM, or other Standards as specified in the Drawings and in the Contract Documents or as may be specified by the Engineer.

3.2 Unless otherwise specified, all grade 40 reinforcing bars shall comply with the requirements of ASTM-A 615 Deformed Billet steel bars and shall have minimum yield strength of 40,000 Psi.

3.3 Unless otherwise specified, all grade 60 reinforcing bars shall comply with the requirements of ASTM-A 615M for Deformed steel bars and shall have minimum yield strength of 60,000 Psi.

3.4 Steel wire mesh reinforcement shall conform to requirements of ASTM Designation A 185-64 or BS. 4482 and 4483, Standard Specifications for Welded Steel Wire Fabric for concrete reinforcement. It shall be used where shown on the Drawings.

3.5 Binding wire shall be 16 gauge Soft iron wire.

3.6 Reinforcement shall be obtained only from manufacturers approved by the Engineer. Each consignment of reinforcement steel shall be accompanied by the manufacturer's certificate or shall refer to a previous certificate, if the consignment is from the same batch, showing that the reinforcement steel complies with the specified requirement. If such certificate is not made available or if the Engineer considers that the manufacturer's tests are inadequate, samples shall be taken for acceptance test from different consignments as the Engineer may direct and shall be tested at the contractor's cost. Should the result of such tests show that the sample does not meet with the specifications the whole consignment shall be rejected and removed from the site at the Contractor's cost.

3.7 Reinforcement shall be free from all loose or flaky rust and mill scale, or coating, and any other substance that would reduce or destroy the bend. Reduced section steel reinforcement shall not be used.

4. DELIVERY & STORAGE

4.1 Delivery

Steel reinforcement bars shall be kept in bundles firmly secured and tagged. Each bar or bundle of bars shall be identified by marks stamped on hot or cold or painted on or by any other means. The identifying marks shall contain the following information:

- Name of the producer or his trade.
- Standard to which the bars have been manufactured.
- The class type and strength .
- The diameter.
- The number of the test certificate.

4.2 Storage

The method of storage shall be approved by the Engineer. Reinforcing bars shall be stored and shall be protected from mud, scaling, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works. Bars of different diameters and grades of steel reinforcement shall be kept separately.

5. BAR BENDING SCHEDULES

The Contractor shall prepare bar bending schedules of all the reinforcing steel bars and these bar bending schedules shall be submitted to the Engineer for his approval. The Contractor shall obtain approval of the bar bending schedules before starting actual bar bending works.

6. CUTTING, BENDING AND PLACING

6.1 The Contractor shall furnish, cut bend and place all reinforcement.

6.2 Reinforcement is to be accurately placed as shown in the drawings, and secured against displacement by using 16 gauge G.I wire ties or suitable slips at intersections and supported from the formwork by using concrete, or metal chairs and spacers or hangers of an approved pattern. Where concrete blocks are used for ensuring the cover, they shall be made of mortar not less than 1 part of cement to 2 parts of sand. All reinforcement including dowels, remaing exposed in the work shall be suitable protected against corrosion by a thick coat of cement slurry until embedded in concrete.

6.3 Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the bar bending schedule approved by the Engineer.

6.4 The cutting tolerance for all bars shall be $\pm$ 1 inch.

6.5 Where an overall or an internal dimension of a bent bar is specified in the schedule, the bending tolerance, unless otherwise stated, shall be as in Table-1..

Table-1

Bending Tolerances

Description	Tolerance	
	Plus	**Minus**
	Inch.	Inch.
Bars up to 3 ft. long	¼	¼
Bars 3 ft. to 6 ft. long	¼	½
Bars over 6 ft. long	¼	¼

6.6 - Bars shall be placed to the following tolerances:

– Concrete cover to formed surfaces : ±1/4 inch.

– Minimum spacing between bars : ±1/4 inch.

– Top bars in slabs and beams : ± 2 inch.

Members 8 inch deep or less : ±1 inch.

Members more than 8 inch but not over 24 inch deep : ±1/4 inch.

Members more than 24 inch deep. : ±1/4 inches.

6.7 Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval of the Engineer.

6.8 Vertical bars in columns shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all column dowels.

6.9 Reinforcement shall not be bent or straightened in a manner that will injure the material.

6.10 No bars shall be bent twice in the same place, nor shall they be straightened after bending.

6.11 Unless permitted by the Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete.

6.12 No splice of reinforcement shall be made except as shown on the working drawings unless approved by the Engineer.

6.13 Welding shall be permitted for bars only under suitable conditions and with suitable safeguards in accordance with BS 693, BS 1856, or AWS D12.1, provided the type of reinforcement bar has the required welding properties. Tack welding may be used to fix in position bars that cross each other, only with prior approval of the Engineer.

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

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

6.16 All detailing shall be done as per American Concrete institute standards ACI-315 and ACI-318.

7 CONCRETE COVER

All reinforcing steel shall be held firmly in place before and during the placing of concrete by means of wires and supports adequate to prevent displacement during the course of construction.

8 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. 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 concerted.

9 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. Embedded items shall be free from oil and other foreign matter such as loose coatings of rust, paint and scale. The embedding of wood or other perishable materials in concrete is prohibited unless specifically authorized or directed.

10 MEASUREMENT AND PAYMENT

10.1 General

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

10.1.1 Providing and installing chairs, supports, hooks, spacers, binding wires, and laps not shown on Drawings including wastage and rolling margin.

10.1.2 Furnishing , delivering , storing, handling bending, cutting and cleaning of reinforcement

10.1.3 Plants, tools , labour and equipment required for the completion of the works at any elevation

10.1.4 Welded splices done by the Contractor for his convenience.

10.2 Furnish and install reinforcing Steel

10.2.1 Measurement

Measurement for acceptably completed works of steel reinforcement shall be made on the basis of number of M.Ton of reinforcing steel placed on the basis of the lengths of bars installed in accordance with the approved Drawings or bar schedules or as directed by the Engineer. Length of each size of bars shall be converted to weights use of the unit weights per linear meter for each size as stated below. Steel laps indicated on the Drawings and as required by the Engineer will be measured for payment.

Nominal Bar Diameter (Nos.)	Weight Lbs/ft.
#2	0.167
#3	0.375
#4	0.667
#5	1.043
#6	1.502
#7	2.044
#8	2.670
#9	3.380
#10	4.172
#11	5.049

2204.6 lbs = 1.00 M.Ton (1000 Kg)

10.2.2 Payment

Payment will be made for acceptable measured quantity of reinforcement as provide above on the basis of unit rate per M.Ton quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 2300

PLAIN AND REINFORCED CONCRETE

1 SCOPE

The work under this section of the specification consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in connection with the supply and installation of plain and reinforced concrete work complete, in accordance with this section of the specifications and the applicable drawings, and subject to the terms and conditions of the Contract. The scope of this section of specification is covered with detailed specifications as laid down herein.

2 GENERAL

2.1 Full co-operation shall be given to trades like electrical, mechanical and other services.

2.2 Suitable templates or instructions or both shall be provided for setting out items not placed in the forms. Embedded items and other materials for mechanical and electrical operations shall have been completed, inspected, tested and approved before concrete is placed.

2.3 Shop drawings shall be prepared by the Contractor at his own cost. Approval of shop drawings as well as that of actual samples of concrete finish shall be obtained before work is commenced.

3 CODES AND STANDARDS

The work shall conform to the requirements of the following latest Codes and Standards, unless otherwise specified.

ACI 301-latest	Specifications for structural concrete for buildings.
ACI 304-latest	Guide measuring, mixing, transporting and placing concrete.
ACI 308-latest	Standard practice for curing concrete.
ACI 309-latest	Guide for consolidation of concrete.
ACI 325.9R	Guide for construction of concrete pavements and concrete bases.
ACI 318-latest	Building code requirements for structural concrete.
ASTM C 31-latest	Practice for making and curing concrete test specimens in the field.
ASTM C 33-latest	Standard specifications for concrete aggregates.
ASTM C 39-latest	Standard test methods for compressive strength of cylindrical concrete specimens.
ASTM C 42-latest	Standard test, method for obtaining and testing drilled cores and sawed beams of concrete.
ASTM C 78-latest	Standard test method for flexural strength of concrete (using simple beam with third point loading).
ASTM C 136-latest	Standard test method for sieve analysis of fine and coarse aggregates.
ASTM C 143-latest	Standard test method for slump of Portland cement concrete.
ASTM C 150-latest	Standard specifications for Portland cement.

ASTM C 260-latest	Standard specifications for air-entraining admixtures for concrete.
ASTM C 309-latest	Specification for liquid membrane-forming compounds for curing concrete
ASTM C 404-latest	Standard specifications for aggregate for masonry grout.
ASTM C 494-latest	Standard specifications for chemical admixtures for concrete.
ASTM C 566-latest	Standard test method for total moisture content of aggregate by drying.
ASTM C 869-latest	Standard specifications for foaming agents used in making preformed foam for cellular concrete.
ASTM D 596-latest	Reporting results of water analysis.
ASTM D 1190-latest	Standard specifications for concrete joint sealer, hot-poured elastic type.
ASTM D 1751-latest	Standard specifications for preformed expansion joint filler for concrete paving and structural construction (non-extruding and resilient bituminous types).
ASTM D 1752-latest	Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction.
BS 12-latest	Specifications for ordinary and rapid hardening Portland cement.
BS 3148-latest	Methods of tests for water for making concrete.
PS 232-latest	Portland cement (ordinary, rapid hardening and high strength)
PS 243-latest	Concrete coarse and fine aggregates from natural sour.
PS 279-latest	Abrasion of coarse aggregates by the use of Los Angeles machines.
PS 280-latest	Method of test for determination of aggregates crushing value
PS 281-latest	Method of test for organic impurities in sand for concrete aggregates.
PS 283-latest	Method of test for soundness of aggregates by the use of sodium sulphate or magnesium sulphate.
PS 284-latest	Sampling aggregates for concrete
PS 285-latest	Method of test for sieve or screen analysis of fine and coarse aggregates
PS 286-latest	Description and classification of mineral aggregates
PS 421-latest	Sampling of fresh concrete
PS 560-latest	Making and curing concrete compression test specimen in the field
PS 612-latest	Sulphate resisting Portland cement type 'A'
PS 716-latest	Mixing and sampling of fresh concrete in the laboratory
PS 717-latest	Test for concrete compacting factor
PS 849-latest	Making and curing concrete compression test cubes
PS 1638-latest	Fresh concrete, determination of consistency slump test.

4. SUBMITTALS

4.1 Delivery and Storage Record

The Contractor shall submit the following to the Engineer in such form as he may require:

- Accurate records of deliveries of cement and its use in the Works.
- Details of transport, plant, equipment for winning, transporting, manufacturing of aggregate.
- Manufacturer's literature and certification for compliance with the requirements for admixtures and other materials required for concrete work.

4.2 Details of Constructional Plants

Particulars and details of major constructional plants such as mixers, lifts, hoists and cranes, alongwith the general layout plans and flow diagrams for the Engineer's review and prior approval.

4.3 Shop Drawings

Shop drawings including, but not limited to lifts in concrete, formwork, jacking, shoring, architectural concrete works etc., as required by the Engineer.

4.4 Methodology

Methodology for construction alongwith the scheduled programme of works and the Contractor's proposed arrangements for batching, mixing, conveying, placing and curing for review and approval by the Engineer.

The method statement shall also include proposals for:

- Construction joints if not shown on the Drawings
- Installation of water stops
- Sequence of concrete placement
- Arrangement for concreting during rain, hot or cold weather and during night
- Transportation, handling and erection and/or installation of precast concrete and/or prefabricated units etc.
- Welding, etc.

4.5 Samples and Specimens

The Contractor shall submit to the Engineer for his approval:

- Samples and specimens of all constructional materials together with the supplier/manufacturer's literature containing his instructions/ recommendations. Afterwards the approved samples of aggregate, admixtures and the embedded items shall be submitted properly labelled and identified for future reference.
- Samples of precast concrete units for inspection, testing and for the Engineer's review and approval.
- A minimum of two units or portions of units of each of the architectural and In-situ concrete, of a size as required by the Engineer, shall be submitted. These specimens will be reviewed and approved on the basis of colour, texture, dimensional accuracy, surface finish and general appearance.
- Samples/specimens, when accepted, will describe the allowable limits between which variation can be acceptable.
- Approved specimen/samples shall remain at Site, well protected from damage and dilapidation, as required by the Engineer.

4.6 Certificates and Mill-Test-Data

Manufacturer's or supplier's certificate of compliance with relevant standards/specifications shall be submitted for each consignment of the materials and items supplied for use in the Works including but not limited to the following:

Cement, reinforcing steel, admixtures, joint sealing compound, expansion joint material, water-proof membrane, PVC water stop and aggregates etc.

Calibration certificates in respect of scales, gauges, metres and other weighing and dispensing devices to be used on batchers and mixers shall be submitted for the first time immediately before their use in producing concrete and thereafter at every 6 week intervals or earlier if so directed by the Engineer.

4.7 Results of Routine Tests and Daily Reports

The routine shall include submission of the results of all the specified and required tests performed at the job site including, but not limited to, analysis of aggregate, slump test, compressive strength tests, etc., and detailed report of works performed on the preceding day.

4.8 Bar-Bending Schedule

Bar bending schedule shall be submitted for the Engineer's review and approval well in advance of cutting and bending of any reinforcing steel. This shall include corrections for elongations during bending.

4.9 Concreting Record

Daily returns of all concrete placed during the previous day shall be submitted in a format to be agreed with the Engineer.

The returns shall include but shall not be limited, to the following information:

For each specified grade and type of concrete

- Volume of concrete placed per batch and the total concrete.
- Volume of concrete wasted or rejected.
- Quantities of cement, aggregates, water, reinforcing steel, admixtures, embedded items used in the work.
- For each location, structure or part of structure
- The precise position or location of placement, (e.g. reference number, mark identification or element, structure, bay or lift).
- Concrete mixes placed.
- Total volume of each grade and type of concrete placed.
- Records of concrete works, detailing the date, time, humidity, temperature and weather conditions when each part of works was completed.

5. TOLERANCES

The Contractor is to complete all works including formwork, placement, curing, etc, and shall ensure that the concrete surfaces conform to the specified tolerance limits given in ACI 325.9R and 347. Where tolerances are not stated on the Drawings, maximum permissible deviations from established lines, grades and dimensions shall conform to the tolerances given hereinafter.

These tolerances are not cumulative.

Concrete work not meeting the tolerance requirements will be rejected unless an acceptable repair work is allowed by the Engineer.

5.1 Cast in Place Concrete

VARIATION FROM PLUMB: Variation from plumb in vertical lines and surfaces and from the batter in inclined lines and surfaces shall not exceed the limits given in the Table-A

Table-A

Columns,piers,walls and arrises		**Exposed corner columns, control joint grooves and other conspicuous lines**	
In any 10 ft length or height	¼ inch	In any bay or 20 ft length or height	3/8 inch
In any storey or 20 ft height	3/8 inch	Maximum for the entire length or height	½ inch
Maximum for the entire length	1 inch		

VARIATION FROM LEVEL OR GRADES: Variation from the Specified level and grades shall not exceed the limits given in Table-B.

Table-B

Columns,piers,walls and arrises		**Exposed corner columns, control joint grooves and other conspicuous lines**	
In any 10 ft length or height	¼ inch	In any bay or 20 ft length	¼ inch
In any bay or 20 ft height	½ inch	Maximum for the entire length	½ inch
Maximum for the entire length	¾ inch		

VARIATION FROM POSITION IN PLAN: Variation of the linear building lines from established position in plan and related position of columns, walls and partitions shall not exceed ½ inch any bay of 20 ft nor a maximum of 1 inch in the entire length.

VARIATION IN LOCATION OF OPENINGS: Variation in the sizes and locations of sleeves, floor openings, and wall openings shall not exceed a maximum of ½ inch.

VARIATION IN DIMENSIONS: Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls shall not exceed minus 1 inch nor plus ½ inch

VARIATION IN FOOTINGS: Variation in footings shall not exceed the limits given in Table-C

Table-C

Dimension in Plan	**Misplacement or eccentricity**	**Thickness**
Minus ½ inch Plus 2 inch	2% of footing width in the direction of misplacement but not more than 2 inch.	decrease 5% increase No limit

(Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.)

VARIATION IN STEPS: Variation in consecutive steps shall not be more than 1/16 inch in rise and 1/8 inch in tread. The maximum variation in the flight of stairs shall not be more than 1/8 inch in rise and ¼ inch in treads.

5.2 Precast Concrete

Forms must be true to size and dimensions of concrete members shown on the plans and shall be so constructed that the variation in the dimensions of the finished products, at the time of placement of these units in the structure, will be within the limits shown in Table-D unless otherwise noted on structural/architectural Drawings:

Table-D

–	**Variation in Overall dimensions of members**	**per 3 ft**	**1/16 inch**
–	Variation in Cross-sectional dimensions:		
	* sections less than 3 inches		1/16 inch
	* sections over 3 inches and less than 18 inches		1/8 inch
	* sections over 18 inches		¼ inch
–	Deviations from straight line in long sections	Not more than per 10 ft.	1/8 inch
–	Deviation from specified camber	10 ft of span	1/16 inch
–	Maximum differential between adjacent units in erected position		¼ inch

5.3 Pavements

Departure from specified lines, levels and grades shall not exceed the following limits:

- Established alignment ¼ inch
- Eestablished longitudinal grade on any line ½ inch
- Transverse template contour except at transverse joints 1/8 inch
- Transverse template contour at transverse joints in width of one traffic lane ¼ inch

6. QUALITY ASSURANCE

6.1 Cement

Cement shall be stored and sampled at Site and tested from time to time at the discretion of the Engineer in accordance with ASTM C-150 or its equivalent British or Pakistan Standards at the expense of the Contractor. If the tests prove that the cement has become unsatisfactory, it shall be removed from the Site immediately. Cement which has been in storage at the Site longer than three months, shall not be used until retesting proves it to be satisfactory.

6.2 Aggregate - Requirements

Aggregates shall conform to ASTM C-33. Following tests shall be carried out by the Contractor at his own cost to establish suitability of the material for the intended use.

- Mechanical properties
- Porosity
- Organic impurities
- Clay and Silt Contents
- Abrasion and Soundness tests
- Alkali Re-activity Potential
- Water soluble chloride contents

6.3 Sampling and Testing of Aggregate

During construction, aggregates shall be sampled and tested once for every 100 tonnes or part thereof as delivered to the mixer to determine compliance with the Specifications. The Contractor shall provide samples and test such samples in the presence and supervision of the Engineer using appropriate standard test methods selected by the Engineer. Testing of concrete aggregates by the Engineer shall not relieve the Contractor of his responsibility to maintain control and to ensure the production, stockpiling and handling of both fine and coarse aggregates in accordance with these Specifications. Tests shall be carried out only in laboratories approved by the Engineer.

6.4 Deleterious Substances

FINE AGGREGATE: The maximum percentages of deleterious substances in the fine aggregate as delivered to the mixer shall not exceed the values given in Table-E

Table-E

Item	Max.percent (by weight)
Material finer than 75 um (No. 200) sieve	3
Shale	1
Total of other deleterious substances (such as mica,chlorides, coated grains and soft flaky particles)	3

The sum of the percentages of all deleterious substances shall not exceed 5 per cent by weight.

COARSE AGGREGATE: The maximum percentages of deleterious substances in any size of coarse aggregate, as delivered to the mixer, shall not exceed the values given in Table-F

Table-F

Substances	Maximum percent by weight
Material passing 75 um (No.200) sieve	1
Shale	1
Clay lumps	1/2
Other deleterious substances	1

The sum of the percentages of all deleterious substances in any size, as delivered to the mixer, shall not exceed 3 per cent by weight.

6.5 Moisture Control

All fine aggregate and smallest size group of the coarse aggregate shall remain dry during storage at the Site for at least 72 hours immediately prior to use. The free moisture content of the fine aggregate and of the smallest size group of coarse aggregate, as delivered to the mixer, shall be controlled so as not to exceed 4% and 1% respectively, by weight of the saturated surface dry aggregates unless higher limits are allowed by the Engineer. The moisture content of the other size of the coarse aggregates shall be controlled so that the aggregates are delivered to the mixers with the least amount of free moisture and the least variation in free moisture practicable under the job conditions. The moisture content of the aggregate shall be determined in accordance with ASTM C-566. In addition to the limits on the maximum amounts of free moisture in aggregates, the moisture content shall be controlled so that for each size the variation in the percent of free moisture will not be more than 0.5 percent during any one hour of mixing plant operation and not more than 2.0 percent during any 8 hour period of mixing plant operation. Under no conditions shall the aggregate be delivered to the mixing plant dripping wet.

The Contractor may accomplish the required moisture control by use of freely-drained storage, covered transportation and storage, mechanical dewatering devices or any other means or combination of means acceptable to the Engineer.

6.6 Admixtures

No admixtures shall be used without the approval of the Engineer for which the following procedure shall be followed:

- Intention to use admixtures shall be submitted with reasons justifying its use supported by manufacturer's literature, past experience and applicable standards.
- If approved, trial mixes shall be prepared to arrive at a control mix design with admixtures and with suitable characteristics for the job.
- Control mix shall be used on the job only if and where approved by the Engineer.

The admixtures shall be sampled at the source of supply and tested by an approved laboratory. An admixture which has been in storage at the Site for longer than 6 months or which has been subjected to freezing shall not be used until retest proves it to be satisfactory. Additional tests shall be made by the Contractor under the supervision of the Engineer.

6.7 Testing Facilities

The Contractor shall make arrangement for testing of cylinders to be fixed by the Engineer from time to time shall be tested from an approved laboratory.

Concrete strength shall be determined on the basis of test cylinders, however with the approval of the Engineer compressive strength may also be controlled on the basis of test cubes. The cube strength in such case shall be multiplied by a relevant factor shown in Table-M or as agreed by the Engineer to arrive at the cylinder strength.

7. CONCRETE MIX DESIGN

Concrete shall be composed of Portland cement, fine and coarse aggregate, water and any admixtures as specified.

The concrete mixes for each grade of concrete shall be designed by the Contractor under the supervision of the Engineer. The proportions of concrete components for each grade of concrete once agreed by the Engineer would be changed only with the approval of the Engineer or as directed by him during progress of the Work.

8. INSPECTION AND TESTING

8.1 Inspection

Concrete batching, mixing, delivery and all other construction work shall be inspected at intervals decided by the Engineer to ensure compliance of all operations with Specifications and other provisions of the Contract.

No concrete shall be placed until all forms and all items to be embedded in concrete are inspected and approved by the Engineer in writing.

Completed concrete work which fails to meet one or more of the requirements of the Specifications and/or other Contract documents shall either be rejected or repaired to the Engineer's satisfaction.

8.2 Testing of Concrete

All tests shall be carried out at laboratories approved by the Engineer. The Engineer's Representative shall be present during testing if so required by the Engineer.

STRENGTH TESTS DURING THE WORK: Strength tests of the concrete placed during the course of the work shall be made by the Contractor. The Contractor shall test, for control purposes, such number of cylinders as the Engineer may direct. In general three set of three cylinders shall be taken from each 250 cubic feet or fraction thereof or from each day's pour, whichever is less, of each class of concrete placed. Test specimens shall be made and cured in accordance with the applicable requirements of ASTM C-31. Specimens shall be cured in the manner and environments as the pertinent structure.

Cylinder shall be tested in accordance with the applicable requirements of ASTM C-39 and ASTM C-78. The test result shall be based on the average of the strength of the test specimens except that if one specimen in a set of three shows manifest evidence of improper sampling, moulding or testing, the test result shall be based on the average of the remaining two specimens. If two specimens in a set of three show such defects, the results of the set will be discarded and average strength determined from test results of the other two sets.

The standard age of test shall be 28 days, but 7-day tests may be used at the discretion of the Engineer, based on the relation between the 7-day and 28-day strengths of the concrete as established by tests for the materials and proportions used. If the average of the strength tests of the specimens for any portion of the work falls below the minimum allowable compressive strength at 28-days required for the class of concrete used in that portion, the Contractor may change the proportions of the constituents of the concrete, as necessary to secure the required strength for the remaining portions of the work.

TESTS OF HARDENED CONCRETE IN OR REMOVED FROM THE STRUCTURE: Where the results of the strength tests of the control specimens indicate that the concrete as placed does not meet Specification requirements, or where there is other evidence that the quality of the concrete is below Specification requirements, core-boring tests will be made by the Engineer in accordance with the applicable requirements of ASTM C-42. If the concrete in the structure will be more than superficially wet under

service conditions, the cores shall be immersed in water for at least 48 hours and tested wet. In the event that the core-boring test indicates that the concrete placed does not conform to the Drawings and Specifications, measures as prescribed by the Engineer shall be taken to correct the deficiency. However, the Engineer shall have the authority to prescribe such corrective measures, and the Contractor shall take such measures if in the Engineer's opinion the results of the test specimens, without coring, warrant such action. If a strength deficiency is found and is in the opinion of the Engineer due to the Contractor's fault or negligence, the entire cost of replacing faulty concrete or carrying out prescribed corrective measures shall be borne by the Contractor who shall also reimburse the Employer for the cost of making tests. Otherwise, payment for removing and replacing faulty concrete or carrying out prescribed corrective measures will be made under applicable Items of the Bill of Quantities as determined by the Engineer.

RELATION BETWEEN ALLOWABLE STRENGTH AND CONTROL TEST CYLINDER STRENGTH: Where cylinders are made by wet screening of concrete with aggregate greater than 1-1/2 inch size, such as 3 inch aggregate concrete, the cylinders will be required to have a compressive test strength greater than the allowable strength shown on the Drawings, to indicate that the respective concrete in place in the work has the allowable strength shown. The mix design shall be such that the average strength of the specimens tested is greater than the allowable strength shown on the Drawings for the (3 inch aggregate) concrete. Such increments over the allowable strength shown will be established by the Engineer after the mix design has been done and prior to mixing of concrete, and shall be approximately ten per cent.

9. DELIVERY AND STORAGE

9.1 Transportation of Cement

Transoration of the cement from the factory to the Site stores and to the point of use shall be accomplished in such a manner that the cement is completely protected from exposure to moisture. Cement which has been adversely affected by moisture, as determined by the Engineer, shall be rejected. Cement in sacks shall be delivered in strong, well made sacks, each plainly marked with the manufacturer's name, brand, type of cement and the weight of cement continued therein. Packages varying from the standard weight marked thereon may be rejected and if the average weight of packages in any consignment as shown by weighing fifty packages taken at random, is less than that marked on the packages, the entire consignment may be rejected. Packages received in broken or damaged condition shall be rejected or may be accepted only as fractional packages as determined by the Engineer.

9.2 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. Adequate storage capacity shall be furnished to provide sufficient cement to meet the peak needs of the project.

The Contractor shall use cement in the approximate chronological order in which it is received at the Site.

Cement storage facilities shall be emptied and cleaned by the Contractor when so directed.

Suitable, accurate scales shall be provided by the Contractor to weight the cement in stores and elsewhere on the Site, if required, and he shall also furnish all necessary test weights.

9.3 Storage of Aggregates

Aggregate shall be stored at the Site in such a manner as to prevent its contamination. Aggregate which has deteriorated or which has been contaminated shall not be used for concrete. All methods employed by the Contractor for loading, unloading, handling and stockpiling aggregates shall be subject to the approval of the Engineer. Sufficient quantities of aggregate shall be maintained at the Site at all times to assure continuous placement and completion of any lift of concrete started.

10. MATERIALS

10.1 CEMENT

10.1.1 General

Cement shall be fresh, furnished in sacks as approved by the Engineer. 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. Cement recovered through cleaning of sacks shall not be used.

10.1.2 Portland Cement

Portland cement shall be of Pakistan origin and manufacture unless otherwise approved by the Engineer. Portland cement shall conform to Pakistan Standard PS-232 or to British Standard BS-12 or to ASTM C 150 type-I. Portland cement conforming to ASTM C-150, Rapid hardening type-III or sulphate resistant type-V may also be used in certain parts of the Works as directed by the Engineer.

10.2 AGGREGATES

10.2.1 Requirements

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 embedments. These limitations may be waived if, in the judgement of the Engineer, workability and method of consolidation be such that the concrete can be placed without honey-combs or voids.

10.2.2 Composition

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

10.2.3 Source

The Contractor shall obtain concrete aggregate from deposits of natural sand and gravel or shall procure crushed aggregate from approved quarries which produce aggregates meeting with the Specifications contained herein.

10.2.4 Processed Aggregates

The Contractor in procuring the processed aggregates or in planning his aggregate processing operations shall ensure that the aggregates, as delivered to the mixer, consist of clean, hard and uncoated particles; light weight elements (chalk, clay, coal) are separated by segregation under water by vibration where required and the fines are removed from the coarse aggregate by adequate washing. The coarse aggregate shall be rescreened just prior to delivery to the concrete mixer bins. The moisture content shall conform to the provisions of sub-section 6.5 "Moisture Control". Compliance with the aggregate grading and uniformity requirements shall be determined before the material is delivered at the mixer. All aggregates shall be sieved and washed with clean water. The aggregates shall conform to the specific requirements given hereinafter.

10.2.5 Fine Aggregate

The grading of fine aggregate as delivered to the mixers shall conform to the requirements given in Table-G

Table-G

eve size Standard square mesh	***rcentage passing (by weight)***
3/8 inch	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No.100	2 to 10

Te Fineness Modulus shall range between 2.31 and 2.51

10.2.6 Coarse Aggregate

The grading of the coarse aggregate as delivered to the mixer shall conform to the requirements given in Table-H

TABLE-H Grading Requirements for Coarse Aggregate

		Amounts Finer than Each Laboratory Sieve (Square openings) Weight Percentage												
	Nominal Size (Sieves with Square Openings)	4”	3½”	3”	2½”	2”	1½”	1”	¾”	½”	3/8”	No.4	No.8	No.100
	3½” to 1½”	100	90 to 100	------	25 to 60	------	0 to 15	------	0 to 5	------	------	------	------	------
	2½” to 1½”	------	------	100	90 to 100	35 to 70	0 to 15	------	0 to 5	------	------	------	------	------
	2” to 1”	------	------	------	100	90 to 100	35 to 70	0 to 15	------	0 to 5	------	------	------	------
	2” to No.4.	------	------	------	100	95 to 100	------	35 to 70	------	10 to 30	------	0 to 5	------	------
	1½” to ¾”	------	------	------	------	100	90 to 100	20 to 55	0 to 15	------	0 to 5	-----	------	------
	1½” to ¾”	------	------	------	------	100	95 to 100	------	35 to 70	------	10 to 30	0 to 5	------	------
	1” to ½”	------	------	------	------	------	100	90 to 100	20 to 55	0 to 10	0 to 5	-----	------	------
	1” to ¾”	------	------	------	------	------	100	90 to 100	40 to 85	10 to 40	0 to 15	0 to 5	------	------
	1” to No.4.	------	------	------	------	------	100	95 to 100	------	25 to 60	-----	0 to 10	0 to 5	------
	¾” to 3/8”	------	------	------	------	------	------	100	90 to 100	20 to 55	0 to 15	0 to 5	-----	------
	¾” to No.4.	------	------	------	------	------	------	100	90 to 100	-----	20 to 55	0 to 10	0 to 5	------
	½” to No.4.	------	------	------	------	------	------	------	100	90 to 100	40 to 70	0 to 15	0 to 5	------
	3/8” to No.8.	------	------	------	------	------	------	------	-----	100	85 to 100	0 to 30	0 to 10	0 to 5

10.2.7 Particle Shape

The shape of the particles in fine and coarse aggregate shall generally be spherical or cubical. The quantity of flat and elongated particles in the separated size groups of coarse aggregate, as defined and determined by standard tests approved by the Engineer, shall not exceed 15 per cent by weight in any size group. A flat particle is one having a ratio of width to thickness greater than three. An elongated particle is one having a ratio of length to width greater than three.

10.2.8 Soft Particles

The Contractor in procuring processed aggregates or in planning his aggregate processing operations shall make whatever provisions are necessary, as regards methods and equipment, to ensure effective elimination of soft particles from all aggregates to the degree that the percentage of soft particles present in the processed coarse aggregate does not exceed 3 per cent by weight when determined in accordance with the applicable requirements of ASTM C-851, or other standard test methods selected by the Engineer. Test samples shall be representative of each size group of processed aggregate specified in Table-H, obtained according to ASTM C-851. Weight of samples for each size group shall be as given in Table-I

Table-I

Size No.	Nominal Size	Weight of Sample in Kilograms
8.	3/8" to No.8	0.6
7.	1/2" to No.4	1.0
6.	3/4" to 3/8"	1.5
5.	1" to 1/2"	3.0
4.	1-1/2" to 1"	4.5
3.	2" to 1"	7.0
2.	2-1/2” to 1-1/2”	16.0

10.3 WATER

Water for washing aggregates and for mixing and curing concrete shall be fresh, clean and free from injurious amounts of oil, acid, alkali, salt, organic matter, or other deleterious substances as determined by ASTM D-596.

The water for curing concrete should have a pH value between 6 to 8 and shall not contain impurities which cause discoloration of concrete.

10.4 ADMIXTURES

10.4.1 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. All tests for the evaluation and approval of an admixture shall be made by the Contractor as specified in sub-section 6.6 of these Specifications.

10.4.2 Air-Entraining Admixtures

The source and brand of air-entraining admixture, if required, shall be proposed by the Contractor and approved by the Engineer. The air-entraining admixture will be an approved substance or compound conforming to the requirements of ASTM C-260, which will produce entrained air in the concrete as hereinafter specified. The air-entraining admixture shall be added to the batch in solution in a portion of the mixing water. This solution shall be batched by means of a mechanical batcher capable of accurate measurement and in such a manner as to ensure uniform distribution of the admixture throughout the batch during the specified mixing period.

10.4.3 Water-Reducing Admixtures

The source, brand, types of suitable water reducing cement dispersing admixtures, if required, shall be proposed by the Contractor and approved by the Engineer. The water-entraining admixture will be compatible with the air-entraining admixture specified above and shall be batched and added to the concrete in the manner specified for the adding of air-entraining admixture but separate from the portion of the mixing water containing the air-entraining admixture. The quantities of water-reducing, cement-dispersing admixture to be used shall be in accordance with the instructions of the manufacturers as approved by the Engineer. Water reducing admixture shall conform to the requirements of ASTM C-494.

10.5 WATERSTOPS

10.5.1 PVC Waterstops

PVC (Polyvinylchloride) waterstops shall be extruded from an elastomeric plastic compound, the basic resin of which shall be polyvinylchloride. The compound shall contain such additional resins, plasticizers, stabilizers or other materials needed to ensure that when the material is compounded and extruded to the shapes and dimensions shown and tested it shall have the physical characteristics when tested by the U.S Corps. Of Engineer test method as shown in Table-J.

Table-J

Corps of Engrs.Tests Method No.	No. of Specimens Tested	Physical characteristics	Requirement
1	2	3	4
568	5	Tensile strength using die III, not less than	1750 psi
573	5	Ultimate elongation using die III, not less than	350%
570	3	Low temperature brittleness, no sign of failure such as cracking or chipping at	-37^{O} C
571	3	Stiffness in flexure 1/2 inch span, not less than	400 psi

10.6 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.

10.7 EXPANSION JOINT FILLER

Expansion Joint filler material shall be premoulded asphalt impregnated fiber board, to be applied over the full joint-width, except as otherwise indicated on the Drawings, and shall conform to ASTM D-1751 where non-extruding and resilient bituminous type is indicated but where non-extruding and resilient non-bituminous is required the expansion joint filler shall consist of sponge rubber, self-expanding cork or any other material and type as directed by the Engineer, meeting the requirements of ASTM D-1752.

10.8 NON-SHRINK GROUT

Non-shrink grout of a thickness less than one inch shall consist of one part cement, one part clean sharp sand and 1:22000 to 1:15000 part of grained aluminium powder containing non-polishing agent. Non-shrink grout one inch or more in thickness shall be proportioned as above except that 1.5 parts of 3/8 inch to ¼ inch (pea-size) gravel shall be added to the mix. The above composition may be varied if so required by the Engineer. In each case, however, the Contractor shall, at his own cost, prepare optimum mix design and conduct testing of the grout composition for strength and non- shrink performance. Pre-mix non-shrink grout from approved manufacturers my also be used as required by the Engineer.

10.9 EPOXY CONCRETE AND MORTAR

10.9.1 General

Epoxy concrete for installation adjacent to embedded metal and epoxy concrete and/or mortar for the replacement of faulty concrete or for other special purposes as ordered or approved by the Engineer shall conform to the requirements specified hereunder. Epoxy concrete and epoxy mortar shall be mixed in the proportions by such methods and with such equipment as are recommended by the manufacturer of the epoxy resin and approved by the Engineer. The proportions of epoxy mortar and epoxy concrete and the methods of mixing and placing will be subject to change to meet field requirements. The individual batch size of epoxy concrete and mortar which may be prepared at one time shall not exceed the amount that may be mixed, placed and finished in accordance with the manufacturer's instructions as approved by the Engineer.

10.9.2 Materials

EPOXY RESIN: Epoxy resin shall be subject to approval by the Engineer.

AGGREGATES FOR EPOXY CONCRETE: The aggregates used for epoxy concrete shall be clean, dry, crushed river cobble gravel ¾ inch maximum size. Except for gradation, fine and coarse aggregates shall meet the requirements of ASTM C-33. Gradation of fine aggregate shall be the same as specified in sub-section 10.2.5, except that the percentage passing a No. 100 sieve shall be held to the lower limit specified to the greatest extent practicable. The fine and coarse aggregates used in preparation of epoxy resin concrete shall be oven dry and shall be conditioned to a temperature of 15^{O}C to 21^{O}C prior to mixing the epoxy resin binder. Gradation of the coarse aggregate shall conform to the requirements of Table-K when tested in accordance with ASTM C-136.

Table-K

Sieve Size Standard Sq. Mesh	**Per cent passing (by weight)**
3/4 inch	100
1/2 inch	90 - 100
3/8 inch	40 - 70
No.4	0 - 15
No.8	0 - 5

The aggregates shall be well graded from coarse to fine.

AGGREGATES FOR EPOXY MORTAR: Except for gradation, fine aggregates for use in epoxy mortar shall conform to the requirements of ASTM C-404. The aggregate used in the preparation of the epoxy resin mortar shall be oven dry and shall be conditioned to a temperature of 15^{o}C to 21^{o}C prior to mixing the epoxy resin binder. Gradation of the fine aggregate shall conform approximately to the requirements of Table-L when tested in accordance with ASTM C-136.

Table L

Sieve Size Standard Sq.mesh	Percentage Passing (by weight)
No. 4	100
No. 8	95 - 100
No. 16	60 - 100
No. 30	35 - 70
No. 50	15 - 35
No. 100	2 - 5
No. 200	0 - 2

The aggregates shall be well graded from coarse to fine and the material passing the No. 100 sieve shall be held to a minimum.

10.10 VAPOR BARRIER

Vapor barrier shall be polyethylene building film, visqueen standard or approved equal. The film shall be 100 gauge thick. The quality of material shall be approved by the Engineer prior to use in the works.

Vapor barrier shall be laid in position wherever shown on the Drawings.

The material shall be supplied in rolls and laid by rolling over the prepared surface at the levels and position in the areas shown on the Drawings. Where joint is necessary at the side or end of a sheet, this shall be a double weld folded joint made by placing the edges together and folding over twice continuously taking the top edge prior to concreting. The Contractor shall protect the film sheets from damages during laying and subsequent operations and shall replace at his own cost all damaged film sheets to the satisfaction of the Engineer.

Manufacturer's recommendations and instructions alongwith the sample of material shall be submitted to the Engineer for his approval.

11. EXECUTION

11.1 PROPORTIONING OF CONCRETE

11.1.1 General

Trial mixes and tests shall be made by the Contractor for the purpose of designing the mixes and for quality control with regard to the required strength, density and durability. The proportions shall be changed whenever such change is necessary to maintain the standard of quality required for the structures and to meet the varying conditions encountered during construction.

All materials composing the concrete shall invariably be measured by weight or if approved by the Engineer as an exception by volume.

11.1.2 Cement Content

The cement content of concrete for various grades shall be established by trial mixes and shall depend on the size, type and gradation of aggregate used, water cement ratio required for the structure and on the requirements of concrete strength, durability and workability.

11.1.3 Aggregate Content

The maximum size of aggregate (MSA) to be used in the various parts of the structure shall be as shown on the Drawings and where not shown, shall be as directed by the Engineer. Concrete mixes shall be designed to use the largest size and maximum amount of coarse aggregate practicable keeping in view the requirements of sub-section 10.2.1

11.1.4 Water Content

The amount of water to be used shall be governed by the following considerations:

WATER CEMENT RATIO: In general, the mix design shall provide for water cement ratios by weight with aggregate at saturated surface dry condition, which will be determined on the basis of producing concrete having suitable workability, density, impermeability, durability and the required strength without the use of excessive amount of cement.

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 concrete for higher strength concrete.

CONSISTENCY: The amount of water used in the concrete shall be regulated as required to produce concrete of proper consistency taking into account the effect of any variation in either or both the moisture contents or grading of the aggregates as they enter the mixer. Addition of water to compensate for stiffening of concrete before placing shall not be permitted. Uniformity in concrete consistency from batch to batch shall be ensured.

11.1.5 Concrete Strength

Various classes of concrete shall have 28 day compressive strength of 6 inch x 12 inch test cylinders at least equal to the values given in Table-M except as otherwise indicated on the Drawings or directed by the Engineer.

Table -M

Class	Cylinder Stgrength Psi
A	4000
B	3000
C	1000

11.1.6 Slump

In general, the slump of the concrete, after concrete has been deposited but before it has been consolidated, shall not exceed the values specified below for the structures and/or parts thereof unless otherwise directed by the Engineer. Check slumps shall be taken at the mixer and at locations of placement and or as directed by the Engineer. The Engineer may order the placement of concrete having lesser slump, wherever concrete of such lesser slumps can be consolidated readily into place by means of the specified vibrations. The use of buckets, chutes, hoppers, or other equipment of types that will not readily handle and place concrete of such lesser slumps will not be permitted. The slump will be determined in accordance with ASTM C-143.

The minimum slump shall be ¾ inch in all cases, except when plasticisers are used with the Engineer's approval. The maximum slump shall not exceed the undermentioned limits:

Mass concrete	2 inch
Slabs, floors and foundations	2 inch
Columns, beams, walls, parapets etc.	4 inch
Other parts	3 inch

11.2 BATCHING AND MIXING

11.2.1 Type and Capacity

All concrete shall be produced in a batching and mixing plant or by means of a mechanical mixer as approved by the Engineer.

The capacity of the plant shall be such that the proposed arrangement will produce adequate quantity of concrete to meet with all the other requirements of these Specifications and the construction schedule. The batched materials shall be thoroughly combined into a uniform mixture before the addition of water and admixtures. The water shall be added gradually and the mixer operated for specified duration of time so as to obtain a thoroughly mixed concrete of uniform colour and quality.

11.2.2 Mixers

Hand mixed concrete shall not be used; however, the Engineer may allow concrete to be mixed in small mixers. The mixers provided by the Contractor shall be capable of combining the materials into a uniform mixture and of discharging without segregation. Mixers shall not be charged in excess of the capacity recommended by the manufacturer and shall not be recharged before completely discharging the previous batches. Overmixing requiring additions of water will not be permitted. The mixers shall be operated at a drum speed designated by the manufacturer. The mixers shall be cleaned frequently and maintained in satisfactory operating condition, and mixer drums shall be replaced when worn down more than 10 per cent of their length and or thickness.

11.2.3 Water Batcher

A suitable water measuring device shall be provided by the Contractor which shall be capable of measuring water within the specified requirements for each batch. The mechanism for delivering water to the mixer shall be such that no leakage will occur when the valves are closed.

11.2.4 Locations

The concrete plant/mixer shall be installed at the Site at locations selected by the Contractor and approved by the Engineer.

11.2.5 Arrangement

Separate bins and compartments shall be provided for each size or type of aggregate and Portland cement. The compartments shall be of adequate size and so constructed that the materials will be maintained separated under all conditions. Batching equipment/ arrangement shall be capable of delivering concrete within the following limits of accuracy as shown in Table-N

Table-N

Material	Per cent by weight
Cement	+1%
Water +1%	
Aggregate smaller than ¾ inch	+2%
Aggregate larger than ¾ inch	+3%

11.2.6 Cooling

Adequate cooling facilities shall be provided to ensure that the temperature of concrete when discharged from the mixers is sufficiently low to meet the temperature requirements as specified in sub-section 11.4.2. Cool mixing water, ice, precooled aggregate, shading the stockpiles with roofing or any other arrangements may be used to ensure the pre-cooling of the concrete, subject to the approval of the Engineer, but approval shall not in any way relieve the Contractor of his responsibility of placing concrete at temperatures at or below the specified limits.

11.2.7 Scales

Adequate weight and volume batching facilities, as approved by the Engineer, shall be provided by the Contractor for the accurate measurement and control of each of the materials entering each batch of concrete. The accuracy of the weighing equipment shall conform to the requirements of applicable standards. The weighing equipment shall be arranged so that the concrete plant operator and Engineer can observe the dials or indicators. Volumetric measurements, if approved by the Engineer, shall be made by means of accurate measuring boxes.

11.2.8 Mixing Time

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

Table -O

Capacity of	Mixer Mixing Time
upto 2.0 cubic yards	2.0 minutes
from 2.0 to 3.25 cubic yards	2.5 minutes

11.3 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 ACI-304. Any wet batch hopper through which the concrete passes shall be conical in shape. There shall be no vertical drop greater than three feet except where the use of such equipment is approved in writing by the Engineer, in advance of any use. Each type or class of concrete shall be visually identified by placing a coloured tag or marker on the bucket as it leaves the mixing plant so that the concrete may be positively identified and placed in the structure forms in the desired position.

11.4 PLACING

11.4.1 General

No concrete is to be placed until all the preparatory works have been satisfactorily completed and the reinforcement and embedded items have been checked and approved by the Engineer. Concrete placing shall follow the practice given in ACI-304.

No concrete shall be placed until all formwork, reinforcement, installation of parts to be embedded, bracing of forms and preparation of surfaces involved in the placing and the method of placement have been approved by the Engineer. Approval of the method of placement proposed will not relieve the Contractor of his responsibility for its adequacy and he shall remain solely responsible for the satisfactory construction of all work under the Contract. Before concrete is placed, all surface upon or against which concrete is to be placed shall be free from standing water, mud, debris or any loose material. All surfaces of forms and embedded material that have become

encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed. The surfaces of absorptive materials against or upon which concrete is to be placed shall be moistened thoroughly so that the moisture will not be drawn from the freshly placed concrete. Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the material to segregate. Concrete shall be deposited as close as possible to its final position in the forms. The depositing of concrete shall be regulated so that the concrete may be effectively compacted with a minimum of lateral movement into horizontal layers approximately 18 inches in thickness. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited in the structure, nor shall retampered concrete be used unless approved by the Engineer. The surfaces of construction joints shall be kept continuously wet for at least eighteen hours during the twenty-four hour period prior to placing concrete except as otherwise directed by the Engineer. All free water shall be removed and the construction joint shall be completely surface dry prior to placement of concrete. All concrete placing equipment and methods shall be subject to approval of the Engineer. Concrete placement will not be permitted, if in the opinion of the Engineer, weather conditions prevent proper placement and consolidation.

11.4.2 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. In any case, concrete shall be placed and compacted well within the initial setting time.

11.4.3 Placing Temperature

Placing temperature shall conform to the requirements herein specified for thin and moderate sections. The Engineer's determination as to the type of section and applicable placing temperatures shall govern. Concrete shall be placed at temperatures as follows:

THIN SECTIONS: Concrete for thin sections shall be delivered to the forms at the coolest temperature which is practicable to produce under current conditions but in no case at a temperature in excess of $30^{O}C$. Except as otherwise determined by the Engineer, sections to which this provision shall apply shall be less than 18 inches in thickness.

MODERATE SECTIONS: Concrete for moderate sections shall have a temperature of not more than $21^{O}C$ when placed. A moderate section will be one that is greater than 18 inches but less than 36 inches in thickness.

11.4.4 Blinding Concrete

Where concrete is to be placed on a flat excavated surface or on an excavated surface inclined at not more than 1V: 1.75 H, a 3 inch layer of blinding concrete, if not otherwise shown on the Drawings, shall be placed immediately after completion of excavation and cleaning. The upper surface of the blinding concrete shall not be higher than the required cover below the lowest layer of the reinforcing steel. The final excavated level shall be calculated to allow for the 3 inch thickness of the blinding layer.

11.4.5 Lifts In Concrete

Concrete shall be placed in lifts or depths as directed by the Engineer. The placement of concrete shall be carried on at such a rate and in such a manner that formation of cold joints is prevented. Slabs shall be placed in one lift, unless otherwise authorized or directed. In walls, lifts shall terminate at such levels as shall conform to structural details. Where slabs and beams are placed continuously with walls and columns, the concrete in walls and columns shall have been in place for at least two hours, or for a longer period when directed by the Engineer, before placing concrete in the slabs and beams. The top surface of vertically formed lifts shall be generally levelled. The concrete in columns shall be placed in one continuous operation, unless otherwise authorized. In general, the construction joints in beams and slabs shall be located as shown on the Drawings and concrete shall be placed in the sequence indicated on the Drawings or as authorized by the Engineer. The maximum differential in height between the various pours of the structure shall be as shown on the Drawings or as directed by the Engineer.

11.4.6 Elapsed Time between Placement of Lifts

Except as otherwise approved on the basis of lift drawings submitted by the Contractor, a minimum of 72 hours shall elapse between the placing of successive lifts of walls and thin sections and 120 hours shall elapse between placing lifts of moderate sections. Thin and moderate sections are defined in sub-section 11.4.3.

11.4.7 Time between Adjacent Pours

The time between adjacent pours shall be defined as the time elapsing from the end of the striking off of one pour to the start of placing the next pour. The minimum time elapsing between adjacent pours shall be five days for thin and moderate sections and fourteen days for mass section.

11.4.8 Concrete for Blockouts

Blockouts for equipment and fittings and for such other work as indicated or directed shall be provided as indicated on the Drawings. After the said equipment and fitting have been installed and adjusted in their final location, the blockout recesses shall be filled with concrete. Before installing the components to be embedded in blockout concrete and before depositing any blockout concrete, the concrete surfaces of the blockout shall be cleaned in the manner specified for cleaning construction joints.

11.4.9 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, 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 5/8 inch.

11.4.10 Vibration of Concrete

Recommended Practice given in ACI-309 shall be followed for concrete consolidation. Concrete shall be compacted with mechanical vibrating equipment supplemented by handspading and tamping. In no case shall vibrators be used to transport concrete inside the forms. The vibrating equipment shall be of internal type and shall at all times be adequate in number of units and power of each unit to properly consolidate all the concrete. Form or surface vibrators shall not be used unless specifically approved. The intensity (amplitude) of vibration shall be sufficient (frequency not less than 6,000 impulses per minute) to produce satisfactory consolidation. The duration of vibrations shall be limited to that necessary to produce satisfactory consolidation. Excessive surface working will not be permitted.

11.4.11 Precast Cement Concrete

The work to be done under this item consists of manufacturing, storing, handling, transporting and laying precast concrete members as may be required. Materials and methods for precast concrete work shall conform to the applicable requirements of these Specifications - Plain and Reinforced Concrete. Except as otherwise shown or specified, maximum size of coarse aggregate shall be ¾ inch. Concrete shall be mechanically vibrated in placing. Slump shall be limited to 1-1/2 inch. Precast concrete shall be water cured for 14 days. Precast units shall not be removed until they have attained at least 75% of their required 28 days strength and shall be picked up only by their lifting hooks. The precast members which are subjected to overstress or otherwise injured during curing or handling shall be removed from the Site by the Contractor.

11.5 EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS

11.5.1 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. The construction joints shall be prepared as per satisfaction of the Engineer.

CLEANING: 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. Approved wet sandblasting equipment shall be provided. If the surface of a lift is congested with reinforcing steel and is relatively inaccessible or if for any other reason it is considered undesirable to disturb the surface of a lift before it has hardened, surface cutting by means of air-water jets will not be permitted and the use of wet sandblasting will be required.

AIR WATER CUTTING: Air-water cutting of a construction joint shall be performed when approved by the Engineer. The surface shall be cut with a high-pressure air-water jet to remove all laitance and to expose clean, sound aggregate, but not so as to undercut the edges of the larger particles of the aggregate. The air pressure used in the jet shall be 0.7 MPa plus or minus 10% (100 psi) and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. The surface shall again be washed with an air-water jet while the concrete is still green, say well within 6 hours of concreting, (depending upon the atmospheric conditions of humidity and temperature) prior to placing the succeeding lift. Where necessary to remove accumulated laitance, coatings, stains, debris and other foreign material, wet sandblasting will be required immediately before placing the next lift to supplement air-water cutting. When approved by the Engineer, a retarder may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, the Contractor shall furnish technical data and samples of the retarder to be used and shall demonstrate the method to be used in its application.

WET SANDBLASTING: When employed in the preparation of construction joints, wet sandblasting shall be performed immediately before placing the following lift. The operation shall be continued until all laitance, coating, stains, debris and other foreign materials are removed. The surface of the concrete shall then be washed thoroughly to remove all loose material.

JOINTS: Vertical construction joints shall be prepared similar to the horizontal construction joints. Where allowed by the Engineer, the inner surface of the formwork may be coated with an approved set-retarder to facilitate the preparation of the vertical construction joint.

WATER DISPOSAL: The method used in disposing of water employed in cutting, washing and rinsing of concrete surfaces shall be such that the waste water does not stain, discolour, or effect exposed surfaces of the structure. Methods of disposal shall be subject to approval by the Engineer.

11.6 INSTALLATION OF WATER STOPS

11.6.1 General

Except as otherwise shown on the Drawings, waterstops 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. All waterstops shall be installed and carefully positioned so as to form a continuous water tight diaphragm in each joint. All splices shall be neat with the ends of the joined materials in true alignment.

Concrete shall be carefully placed and vibrated around water stops to ensure maximum concrete imperviousness and density, the complete filling of the forms in the vicinity of the waterstop and complete contact between the concrete and all surfaces of water stop.

11.6.2 PVC Waterstops

Splices in the continuity or at the intersections of run of PVC waterstops shall be performed by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations or as directed by the Engineer. A thermostatically controlled electric source of heat shall be used to make all splices . The correct temperature at which splices should be made will differ with the material used but should be sufficient to melt but not char the plastic. After splicing, a remoulding iron with ribs and corrugations to match the pattern of the waterstop shall be used to reform the ribs at the splices. The continuity of the characteristic components of the cross-section of the waterstop design (ribs, tubular center axis, protrusions, and the like) shall be maintained across the splice. The splices joints shall be tested in accordance with the applicable standards and as directed by the Engineer.

11.7 CURING

11.7.1 General

All concrete including concrete repair work shall be cured by an approved method or combination of methods in accordance with ACI-308. The Contractor shall have all equipment and materials needed for adequate curing and protection of the concrete on hand and ready to use before actual concrete placement begins. Means shall be provided for the protection of concrete from the sun, drying winds and traffic until the specified curing has been completed.

The curing medium shall be applied so as to prevent loss of moisture from the concrete. Concrete shall be protected from heavy rains for 24 hours. All concrete shall be adequately protected from damage. No fire or excessive heat, including the heat resulting from welding, shall be permitted near or in direct contact with the concrete at any time. All galleries, conduits and other formed openings through the concrete shall be closed during the curing period.

If during the specified minimum period of curing, the surface temperature of the concrete falls below 10^{O}C, the period of curing shall be extended to allow the concrete to reach sufficient maturity. The period of extension shall be as approved by the Engineer.

11.7.2 Moist Curing

Concrete shall be moist-cured maintaining all surfaces continuously (not periodically) wet for 14 days immediately following the placing or until covered with fresh concrete. Precast elements shall also be water-cured for 14 days. Curing water shall be removed without allowing stagnant pools of water to form on the exposed lift surface. Water for curing shall comply with the applicable requirements of sub-section 10.3 “Water”. Where forms of tongue-and groove or shiplap sheating are used and are left in place during curing, the sheathing shall be kept wet at all times. When in contact with concrete, steel forms shall be kept wet. Horizontal construction joints and finished horizontal surfaces cured with sand shall be covered with a minimum uniform thickness of 2 inch of sand and kept continuously saturated with water.

11.7.3 Liquid Curing Membrane

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. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proven that the curing compound will not prevent bond or unless positive measures are taken to remove it completely from such areas.

11.8 REPAIR OF CONCRETE

11.8.1 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 drypack mortar, or concrete, as hereinafter specified. Repair of concrete shall be performed only by skilled workmen and within 24 hours of removal of forms. The Contractor shall keep the Engineer advised as to when repair of concrete will be performed. Unless an inspection is waived in each specific case, repair of concrete shall be performed only in the presence of the Engineer. Repairs shall be made in accordance with the procedures approved by the Engineer.

11.8.2 Materials

All materials used in the repair of concrete shall conform to the applicable requirements of the Specifications.

11.8.3 Protrusions

Where bulges and abrupt irregularities protrude outside the specified limits on formed surfaces not to be concealed permanently, the protrusions shall be reduced by bush-hammering and grinding so that the surface irregularities are within the specified limits.

11.8.4 Depressions

GENERAL: All fillings for depressions shall be bonded tightly to the surfaces of holes and shall be sound and free from shrinkage cracks and drummy areas after the fillings have been cured and have dried. All fillings in surfaces of structures prominently exposed to public view shall contain sufficient white Portland cement to produce the same colour as that of the adjoining concrete. Repairs shall be made with non-shrink grout, guniting or drypack filling except where repairs with epoxy concrete and/or epoxy mortar are directed to be made by the Engineer. Concrete, mortar, grouting, guniting or drypack mortar filling as the case may be shall each be mixed in proportions approved by the Engineer to produce a repair at least equivalent in strength density and durability to the concrete in which the repair is required and shall match with the adjacent surfaces in texture, colour and shade.

CONCRETE FILLING: Concrete filling shall be used for holes extending entirely through concrete sections; for holes in which no reinforcement is encountered and which are greater in area than 1.0 square feet and deeper than 4 inch; and for holes in reinforced concrete which are greater than 0.5 square feet in area and which extend beyond the reinforcement.

MORTAR FILLING: Mortar filling, placed under impact by use of a mortar gun, may be used for repairing defects on surfaces, not

exposed to public view where the defects are too wide for drypack filling and too shallow for concrete filling and no deeper than the far side of the reinforcement that is nearest to the surface.

DRYPACK MORTAR FILLING: Drypack mortar fillings shall be used for filling holes having a depth nearly equal to, or greater than, the least surface dimension; for narrow slots cut for repair of cracks; for grout pipes recesses; and for tie rod fastener recesses as specified. Drypack mortar shall not be used for filling behind reinforcement or for filling holes that extend completely through a concrete section. If removal of the ends of form ties results in recesses, the recesses shall be filled with drypack mortar provided that filling of recesses in surfaces upon or against which fill material or concrete is to be placed will be required only where the recesses are deeper than 1 inch in walls less than 12 inch thick.

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.

11.9 EPOXY CONCRETE AND MORTAR

11.9.1 Mixing and Batching

EPOXY BINDER: Prior to mixing, the two components of the epoxy resin binder shall be conditioned to 15^{O}C to 21^{O}C. The two components shall be combined with constant stirring, and the stirring shall be continued until a uniform mixture is obtained. The rate of mixing should be such that entrained air is held to a minimum. A power-driven (air or sparkproof) mixer with propeller-type blade operating at a maximum of 500 rpm shall be used for mixing the two components of the epoxy resin binder and a hemispherical bottomed polyethylene or metal container shall be used for the mixing.

EPOXY CONCRETE: Epoxy binder shall be prepared as specified above, and after the two components have been thoroughly mixed, shall be transferred to large metal pans and the aggregates added in recommended and approved proportion as specified in sub- section 10.2.6.

The fine aggregate shall be added to the epoxy resin binder and the material shall be mixed until a rich mortar consistency is attained. The coarse aggregate shall then be added and the epoxy concrete thoroughly mixed.

MORTAR: Epoxy binder shall be prepared as specified above in para - Epoxy Binder. After the two components have been thoroughly mixed, the binder shall be transferred to large metal pans and the fine aggregate added in recommended and approved proportions as specified in sub-section 10.2.5. The fine aggregate shall be added to the binder gradually and mixing continued until all particles are coated.

11.9.2 Temperature, Moisture and Protection for Epoxy Mortars and Concrete

Epoxy concrete and mortar shall be placed and repairs shall be made when the atmospheric and concrete temperature are above $5^{O}C$ and less than $38^{O}C$ and remain in this range for a period of at least 24 hours. If the work is required to be done at temperatures lower or higher than those specified; approved means as recommended by the manufacturer of the epoxy binder and approved by Engineer shall be provided to raise or lower the ambient and concrete temperatures as required for satisfactory work. Such means will include heating or cooling equipment and necessary shelters. If temperatures below $5^{O}C$ are anticipated during the cure-out or hardening period of the epoxy concrete or mortar, heated enclosures shall be maintained over the repair area with care taken to avoid localized heating or hot-spots. Circulating air shall be used to ensure that surface temperatures do not exceed $35^{O}C$ during curing. Epoxy resin concrete and mortar shall be placed only on sound, clean and dry surfaces. Suitable methods shall be used to dry and to maintain dry the contact surfaces of the concrete to which the epoxy concrete or mortar is to be applied. All repairs shall be protected from rain or seepage water for at least 24 hours and from all types of traffic for a period of 72 hours.

11.9.3 Preparation and Placing

EPOXY CONCRETE: All fines, dust, and other loose material on the contact surface shall be removed by scrubbing with a stiff bristle brush followed by washing. The dry, cleaned surfaces shall receive a prime coat of epoxy resin. The prime coat shall be applied in a thin coat and briskly scrubbed into the dry concrete surface with a stiff bristle brush. Placement of the epoxy resin concrete shall be delayed until the prime coat becomes tacky. The epoxy resin concrete shall be placed in layers not over 4 inch in thickness. The thickness of courses and time interval between courses, shall be such that the temperature of the epoxy concrete does not exceed $60^{O}C$ at any time during hardening. Mechanical plate, screed or float vibrators or hand tampers shall be used to consolidate the epoxy concrete. Excess epoxy concrete which becomes spread on the adjacent surfaces of hardened concrete shall be removed before it hardens.

EPOXY MORTAR: Defective concrete in areas as determined by the Engineer, shall be repaired with the aid of a saw cut at least 1 inch outside the faulty area. The concrete between the saw cut and the edge of the faulty area and the concrete throughout the area shall be chipped out to solid concrete. The cavity thus formed shall be thoroughly cleaned with compressed air, sand blasting or other method to remove all loose material. The dry, cleaned surfaces of the cavity shall receive a prime coat of epoxy resin binder of composition as recommended by the manufacturer of the epoxy. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff bristle brush. Placement of epoxy resin mortar shall be delayed until the prime coat becomes tacky. The epoxy mortar shall then be

placed in the cavity in layers not exceeding 1 inch in thickness. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin mortar does not exceed 60^{O}C at any time during hardening. Mechanical plate, screed or float vibrators or hand tampers shall be used to consolidate the epoxy resin mortar. Excess epoxy resin mortar, which becomes spread on the adjacent surfaces of the hardened concrete, shall be removed before it hardens.

11.10 Health and Safety Precautions

- Full face shields shall be used during all mixing and blending operations and for placing operations as required.
- Protective skin creams of a suitable nature for the operations shall be used.
- Portable eye washing facilities shall be maintained at mixing, batching and placing operations.
- Adequate fire protection shall be maintained at all mixing and placing operations.
- Smoking or the use of spark or flame producing devices is prohibited within 50 feet of mixing and placing operations.
- The mixing, placing, or storage of solvent is prohibited within 15 feet of any vehicle, equipment or machinery which could be damaged from fire or could ignite vapors from the material.
- Contaminated clothing which cannot be decontaminated shall be burned at an approved burning area at the end of each working day.
- Facilities shall be provided for decontamination of clothing and equipment at the job site.
- Care should be taken in handling solvent for cleaning equipment to avoid problems of toxicity, fires and possible explosions.
- Adequate ventilations shall be provided.

11.11 FINISHES AND FINISHING

11.11.1 General

Allowable deviations from plumb or level and from the alignment, profile grades and dimensions shown on the Drawings or specified in sub-section 5 “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.

The Contractor shall keep the Engineer informed as to when finishing of concrete will be performed. Unless inspection is waived in each specific case, finishing of concrete shall be performed only in the presence of the Engineer. Concrete surfaces will be tested by the Engineer where necessary to determine whether surface irregularities are within the limits hereinafter specified. Surface irregularities are classified as abrupt or gradual. Offsets caused by displaced or misplaced form sheathing or lining or form sections or otherwise defective form lumber will be considered as abrupt irregularities, and will be tested by direct measurements. All other irregularities will be considered as gradual irregularities and will be tested by the use of a

template, consisting of a straight edge or the equivalent thereof for curved surfaces. The length of the template will be 4 feet 6 inch.

The classes of finish for concrete surfaces shall be as shown on the Drawings or as directed by the Engineer. No grinding will be required on formed surfaces other than that necessary for repair of surface imperfections as specified herein.

11.11.2 Ordinary Finish (OF)

Ordinary finish (OF) applies to surfaces upon or against which fill material or concrete is to be placed. If unformed, the finishing operation shall consist of sufficient levelling and screeding to produce even uniform surfaces. When formed, the surfaces require no treatment after form removal except for repair of defective concrete and filling of holes left by the removal of fasteners from the end of the tie rods as required under sub-section 11.8 –"Repair of Concrete". Correction of surface irregularities shall be required for depressions only and only for those which exceed 1 inch when measured as described in sub-section 11.11.1.

11.11.3 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. After consolidation and levelling of the concrete to the specified tolerances, the surface shall be roughened with stiff brushes or rakes before final set. Where rough concrete finish is specified for wall surfaces, the same shall be obtained by use of formwork suitable to produce the required finish. Surface irregularities measured as described in sub-section 11.11.1 General, shall not exceed ¼ inch for floors and 1/8 inch for walls.

11.11.4 Ordinary Slab Finish (OS)

Ordinary slab finish (OS) applies to floor surfaces which are not intended to receive any floor coverings. After the concrete has been placed, consolidated, struck-off and levelled, and its surface has stiffened sufficiently, floating shall be performed by use of hand or power driven equipment, and shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Floating shall be continued until a small amount of mortar without excess water is brought to the surface so as to permit effective trowelling. Steel trowelling shall be started when the surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface. Steel trowelling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense uniform surface, free from blemishes and trowel marks. Surface irregularities measured as described in sub-section 11.11.1 General, shall not exceed ¼ inch for abrupt irregularities and ½ inch for gradual irregularities and ½ inch for gradual irregularities.

11.11.5 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. Surface irregularities shall not exceed 1/8 inch for abrupt irregularities and ¼ inch for gradual irregularities, when measured as described in sub-section 11.11.1 All abrupt irregularities and all gradual irregularities in excess of 6 mm shall be reduced by grinding to conform to the specified limit for gradual irregularities.

12. MEASUREMENT AND PAYMENT

12.1 General

12.1.1 Except as otherwise specified hereunder, measurement of concrete shall be made on the basis of the actual volume of concrete in place within the neat lines of the structure, as indicated on the Drawings. Measurement for payment shall not be made of concrete, nor any ingredients including cement in concrete, which is placed outside of the paylines shown on the Drawings. Measurement of concrete placed against the sides of any excavation without the use of intervening forms shall be made only within the pay lines of the structure. Unless otherwise specified, payment for concrete shall be made at the respective contract unit price per cubic feet for the various items of the Bill of Quantities, which price shall include the cost of all labour, materials and the use of all equipment and tools required to complete the batching, mixing, transporting, placing, protecting, curing and other concrete work; except the reinforcement, waterproofing and embedded parts which are specified to be paid for separately. The Contract unit prices per cubic metre for concrete will include the cost of formworks, form oils, aggregates, water, preparation of all type of joints, bond breaking and curing compounds, handling and incorporating the cement admixture into the work, mixing, cooling, specified cleaning and other preparation of surface to receive concrete, placing, finishing, curing and all other work required to complete the concrete structures. No measurement or payment shall be made for removal and replacement of rejected concrete with Portland cement mortar, epoxy concrete, epoxy mortar or by any other method.

12.1.2 No measurement and payment shall be made for testing of cement; sampling and testing of aggregates; providing and testing concrete for slump and compressive strengths on the basis of test cylinders as specified or cubes if approved by the Engineer; providing and designing the trial mixes and testing for each grade of concrete as required by the Engineer and other tests as specified to be made in the laboratory at Site and/or in a laboratory approved by the Engineer.

12.1.3 No measurement and payment shall be made for providing samples and testing precast concrete units manufactured outside the Site; admixtures; waterstops; embedded items; expansion/contraction joint filler materials, Aluminium strip cover etc. cost of which shall be deemed to be included in the cost of respective item.

12.2 Measurement

12.2.1 Concrete shall be measured as per approved execution, and no deduction shall be made for the following:

- Volume of any reinforcing steel embedded in the concrete.

- Volume occupied by water pipes and conduits etc, not exceeding 4 sq. inch each in cross-sectional area.
- Voids not exceeding 1.0 sq. ft. If any void exceeds 1.0 sq. ft total area of void shall be deducted.

12.2.2 Voids, which are not to be deducted as specified above, refer only to openings or vents which are wholly within the boundaries of measured areas. Openings or vents which are at the boundaries of measured areas shall always be subject to deduction irrespective of their size.

12.2.3 Concrete work shall be classified and measured separately as listed under the Items of BOQ.

12.2.4 Junction between straight and curved works shall in all cases be deemed to be included with the work in which they occur.

12.2.5 Measurement of walls shall be taken between attached columns, piers or pillar. The thickness of attached columns, piers or pillar shall be taken as the combined thickness of the wall and columns, pier or pillar. Attached or isolated columns, piers, pillar and the like (except where caused by openings) having a length on plan not exceeding four times the thickness shall be classified as columns. Those having a length over four times the thickness and caused by openings in wall shall be classified as walls.

12.2.6 Columns shall be measured from the top of footing/footing beams or floor surfaces to the underside of beams or slabs as the case may be. Where the width of beams is less than the width of columns, the extra width at the junction shall be included in the beams.

12.2.7 The depth of the beams shall be measured from bottom of the slab to the bottom of the beams except in case of inverted beams where it shall be measured from top of slab to the top of beam. The cross-section of the beam shall be the actual cross- section below or above the slab.

12.2.8 Measurement of acceptably completed works of plain and reinforced cement concrete shall be made on the basis of the number of cubic feet of concrete placed and compacted in position within the neat lines of the structure as shown on the Drawings or as directed by the Engineer.

12.2.9 Measurement of non-shrink cement grout shall be made on the basis of number of cubic feet of grout acceptably placed in positions as shown on the Drawings or as directed by the Engineer.

12.2.10 Measurement of acceptably completed works of expansion joint shall be made on the basis of the number of square feet of expansion joint for columns and beams and in the unit of running feet for roof slab as shown on the Drawings or as directed by the Engineer.

12.2.11 **Payment**

Payment will be made for the acceptable measured quantity of plain and reinforced cement concrete on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION 3000

STRUCTURAL STEEL WORKS

1 SCOPE

This Section covers general requirements of 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.

The applicable requirements of this section as determined by the Engineer shall apply to all structural steel works under this contract. The work covered by this section, consists of supply of 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. The scope of this section of specifications is covered with detailed specifications as laid down herein.

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 A307-80	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

3 SUBMITTALS

Prior to execution of work and sufficiently in advance, the Contractor shall submit the following to the Engineer for approval:

3.1 Shop Drawings

Shop Drawings, which shall show full construction details, quantities and locations, with metal gauges, reinforcing, cut- outs, holdfasts and attachment to adjacent construction and materials.

3.2 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.

3.3 Methodology

Methodology for fabrication, installation, erection and fixing.

4 QUALITY ASSURANCE

4.1 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.

4.2 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.

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.

4.3 Metal Window and Ventilators

- Window frame and ventilator sections shall be of mild steel.
- Hinges shall be subject to the approval of the Engineer.
- All operating hardware shall be of bronze lacquered iron.

4.4 Structural Steel

All structural steel shall conform to the requirements of ASTM A 36 or equivalent.

4.5 Welding

All welding shall be executed and inspected in accordance with the latest provision of the applicable code of the American Welding Society.

4.6 Bolts

All bolts, including anchor bolts shall conform to the requirements of ASTM A 307 or equivalent.

5 DELIVERY AND STORAGE

5.1 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.

5.2 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.

5.3 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.

6 PRODUCTS

6.1 GENERAL REQUIREMENTS

6.1.1 All contours and arises in metal door shall be true and sharp as can be produced in the thickness of metal required.

6.1.2 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.

6.1.3 Reinforcement and stiffeners shall be welded to the inside of the frame surfaces.

6.1.4 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.

6.1.5 Weather baffles shall be integrally rolled and shall provide contact on all the four sides of the operating ventilators.

6.1.6 Weep holes and drips shall be provided for drainage in accordance with Drawings or instructions of Engineer.

6.1.7 All windows shall be designed for exterior glazing to accommodate glass thickness specified.

6.1.8 Ventilators shall show in or out, as indicated on the Drawings and shall be mounted over heavy steel pivots with brass pins.

6.1.9 Push bars for out swinging windows shall be a notched device for fixed settings and designed to lock shutters in open/closed position.

6.1.10 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.

6.1.11 Windows shall be provided with all necessary clips and anchors required for securing the windows to the structure.

7 EXECUTION

7.1 FABRICATION OF DOORS AND WINDOWS

7.1.1 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.

7.1.2 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.

7.1.3 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.

7.1.4 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.

8 FABRICATION OF ROLLING SHUTTERS

8.1 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. (50mm) wide wire reinforced canvas belt shall be riveted (using aluminum rivets) to both shutter ends and aluminium rollers shall be installed at top.

8.2 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.

8.3 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.

8.4 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.

8.5 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.

8.6 Cover

The cover shall be fabricated from 22 gauge galvanized steel sheet of uniform shape and size without deformations.

9 INSTALLATION

9.1 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'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.

9.2 **Wire Gauze**

Unless otherwise specified or directed by the Engineer, the wire gauze to be fixed with doors, windows and ventilators shall be 22 gauges having 12 x 12 mesh.

9.3 **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.

10 PRIMARY COAT AND FINISHING

10.1 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.

10.2 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.

10.3 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.

11 MISCELLANEOUS STEEL WORK

11.1 **General**

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

11.1.1 Steel handrails.

11.1.2 Steel protection angles and Channels.

11.1.3 Steel doors, windows, and ventilators/louvers.

11.1.4 Steel fencing.

11.1.5 Steel Gate

11.1.6 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 for approval.

11.2 Steel Stairs

11.2.1 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.

11.2.2 Material

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

11.2.3 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.

11.3 Steel Protection Angles

Steel protection angles required for the protection of concrete work shall be erected true to line and level. Steel angles shall be grouted and fixed in position by using anchors as shown on the drawings or as directed by the Engineer.

11.4 Steel Door

Steel doors shall be fabricated inaccordance with the Drawings or as directed by the Engineer.

11.4.1 Sample

Sample of materials shall be submitted to the Engineer for approval prior to fabrication.

11.4.2 Frames

Frames shall be fabricated form locally available hot flush hollow pressed sections, 'Z' section angle, tee, channel or pipe sections as specified in the drawings. Material shall however conform to ASTM - A -36.

11.4.3 Shutters

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.

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.

The internal surfaces of frames and shutter including frame shall be painted with one coat of epoxy primer.

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.

11.5 Steel Grating on Drains

Steel grating shall conform to the requirement of Federal specification PR-G-661 b; (except for Naval Vessels) type T all panels shall be banded on the all edges.

11.6 Steel Hand Rail

Steel Handrail shall be fabricated in accordance with the drawing or as directed by the Engineer and shall conform to the applicable requirement of ASTM A53 for the type and class of pipe indicated.

12 MEASUREMENT & PAYMENT

12.1 General

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

- Nuts, bolts, screw, rivets, heads, fillets, welds and welding rods.
- Anti-corrosive prime coat.
- Glazing.
- All metal embedded parts, metal fittings and fixtures required for the operational process.
- Cleaning with sand blasting.
- Paint and Painting of Steel works
- Locks, handle, hinges, hold fast, Latches, L-drops stopper, etc.
- Fly screen with openable window panel
- Steel grill with windows
- Sealant, gaskets etc.

12.2 Steel Hand Rail

12.2.1 Measurement

Measurement of acceptably completed works of Steel Hand Rail will be made on the basis of net actual Running feet fabricated, provided and installed in position as shown on the Drawing or as directed by the Engineer.

12.2.2 **Payment**

Payment will be made for acceptable measured quantity of Steel Hand Railing on the basis of unit rate per Running feet quoted in the Bill of Quantities and shall constitute full compensation for all works related to the item.

12.3 **Steel Louver Door and Rolling Shutter**

12.3.1 **Measurement**

Measurement of acceptably completed works of Steel louver Door and Rolling Shutter will be made on the basis of net actual area in Square feet fabricated, provided and installed in position as shown on the Drawing or as directed by the Engineer.

12.3.2 **Payment**

Payment will be made for acceptable measured quantity of Steel louver Door and Rolling Shutter on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all works related to the item.

SECTION - 4200
BRICK MASONRY

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 connection with furnishing and installing plain Brick Masonry and fair face Brick cladding (Gutka) of specified size in position complete in strict accordance with this section of the specifications and applicable drawings and or as established by the Engineer.

2 CODES AND STANDARDS

The work shall conform to the requirements of the following Codes and Standards, unless otherwise specified.

ACI 530-88	Building code requirements for masonry structures
ACI 530.1-88	Specifications for masonry structures
PS 208	Classification, strength and properties of bricks.
ASTM C 67-81	Standard method for sampling and testing brick and structural clay tile.
ASTM C 144-81	Standard specifications of aggregates for masonry mortar.
ASTM C 150-81	Specifications for Portland cement
UBC 2405	Quality control
UBC 2406	Allowable stresses

3 SUBMITTALS

The Contractor shall submit the following to the Engineer for his approval:

3.1 Methodology and Sequence of work.

3.2 Specimen samples of bricks, aggregates for mortar or grout and Portland cement. Specimens of bricks shall be representative of a complete range of colours, textures and sizes.

3.3 Results of all the tests performed upon the materials and masonry units obtained from the site of work as per directions of the Engineer.

4 TOLERANCES

4.1.1 Brick

No overall dimension of brick (width, height and length) shall differ from the specified standard dimension by more than 1/8 inch (3 mm). Standard dimensions of brick are 9” x 4-1/2” x 3” (230 x 115 x 75mm) and fair face brick (gutka) is 9” x 2-1/4”” x 2-1/4” (230 x 62 x 62 mm).

4.1.2 Brick Work

All brick work shall be erected true to line, plumb and level and the variation:

4.1.2.1 from plumb in any length of wall shall not exceed 1/12" (2mm) in 3 feet (one meter) or 3/8" (10mm) in a storey height or 1 inch.(25mm) in the entire height.

5 INSPECTION AND TESTING

Regular inspections shall be carried out to control the quality of the works and to ensure that materials, construction and workmanship are in compliance with the plans and Specifications. Inspection and test records shall be maintained and made available to the Engineer as a routine, on each working day.

5.1 Inspection

Inspection for quality control shall include, but is not limited to the following:

5.1.1 the masonry units i.e. bricks, reinforcement if used, cement, lime, surkhi, aggregate, water and all the other materials meet the requirements of the applicable standards of quality

5.1.2 materials are properly stored and prepared for use

5.1.3 mortar and grout are properly mixed using specified proportions of ingredients,

5.1.4 the method of measuring materials for mortar and grout shall be such that the proportions of the constituents are entirely controlled.

5.1.5 the bricks pass a visual inspection for soundness, compact structure, reasonably uniform texture and shape; and that the bricks are free from cracks, warpage, large pebbles, balls of clay or particles of lime that would affect the serviceability or strength of the brick.

5.2 Testing

Burnt bricks shall be of uniform colour, finish and free from cracks, warpage, exposed stones, pebbles or particles of lime. The size of the bricks shall be in accordance with that shown on the Drawings. The testing of bricks shall comply with ASTM C 67. Physical requirements of the bricks shall be as given in Table 4A-1

TABLE 4A-1

□Bricks	□Minimum Compressive Strength (brick flat wise)	□Maximum water Absorption in 5 hour	□Maximum Saturation Co-efficient
□Individual	□(1,150 psi) □8 MPa	□25%	□0.90
□Average of 5 bricks	□(1,430 psi) □10 MPa	□22%	□0.88

The saturation coefficient is the ratio of absorption by 24 hours submersion in cold water and to that after 5 - hours submersion in boiling water.

In case the bricks do not have the compressive strength as specified then the Engineer shall use his best judgment in permitting incorporation of the best bricks available in the area, taking into consideration the nature and structural stability of the works.

If 10 bricks per thousand are defective or if the average weight of nominal 9" x 4-1/2" x 3" (230 mmx115x75mm) brick is less than 3.5 kg or the bricks are out of dimension the whole lot shall be rejected and the Contractor shall remove the rejected lots from the Site.

6 DELIVERY AND STORAGE

6.1.1 Delivery

The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the bricks nor delay the use of mixed mortar.

6.1.2 Storage

Masonry materials shall be so stored that at the time of use the materials are clean and structurally suitable for use.

7 MORTAR

7.1 Cement

All cement for mortar for brickwork shall conform to the applicable requirements set forth in Section Plain and Reinforced Concrete.

7.2 Sand

Sand for mortar used in brickwork shall be furnished by the Contractor, and shall meet the requirements set forth in ASTM C 144. The Fineness Modules of the sand shall range between 1.9 to 2.8 and the grading shall be within the limits given in Table

TABLE 4A-2

Sieve Sizes		**Percent Passing (by weight)**
4.76mm	No. 4	100
2.38mm	No. 8	95 to 100
1.18mm	No.16	70 to 100
600um	No.30	40 to 75
300um	No.50	10 to 35
149um	No.100	max. 25
74um	No.200	max. 10

Sand shall be stored at the Site in such a manner that it is not mixed with foreign matter. Methods employed by the Contractor for unloading, loading, handling and storage shall be subject to the approval of the Engineer.

Sufficient quantity shall be maintained at the Site at all times to assure continuous work.

7.3 Water

The water used in the manufacture of bricks and in the preparation of mortar shall be in complete conformity with the applicable requirements set forth for water in Section Plain and Reinforced Concrete.

7.4 Surkhi

Surkhi shall be prepared by grinding special bricks into powder form or may be obtained/purchased from approved manufacturers.

7.5 Mortar Composition

7.5.1 **Cement Sand Mortar**.

Mortar for all brickwork shall, except as otherwise specified or directed by the Engineer, shall consist of one part Portland Cement to four parts of sand by volume for 4-1/2" (115 mm) thick walls and one part of cement in six parts of sand for 9" (230mm) and over thick walls for building works and one part of cement to 5 parts of sand for other works, and sufficient water to produce the proper consistency for the intended use. Where directed by the Engineer for increased workability, hydrated lime putty, approved by the Engineer, shall be added to the mortar but shall not exceed 25 percent, by volume of the dry cement.

7.5.2 **Mortar for fair face Brick Cladding (gutka)**

The mortar for all fair face brick (gutka) masonry cladding shall consists of cement, surkhi and sufficient water to produce proper consistency in the following composition:

Cement	:	Surkhi
1	:	4

OR

Swan pozzolana in the ratio as recommended by the manufacturer.

7.5.3 **Mortar Batching**

Methods and equipment used for mixing mortar shall be such as will accurately determine and control the amount of each separate ingredient entering into the mortar and shall be subject to the approval of the Engineer. If a mixer is used, it shall be of approved design and the mixing time after all the ingredients are in the mixer, except for the full amount of water, shall not be less than two minutes. Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of the water to the mix shall be wasted. Re-tempering of mortar will not be allowed. Mixing troughs pans shall be thoroughly cleaned and washed at the end of each day's work.

8. BRICKS

8.1 Brick Materials

Bricks for plain brick masonry shall be first class bricks made from carefully selected earth which shall be good loam or clay. The earth shall be free from objectionable quantities of lime, gravel, coarse sand and roots and other organic matter. The salt contents shall not exceed 0.3 per cent and calcium carbonate content shall not exceed 2 per cent.

8.2 Brick Manufacture

All bricks shall be manufactured by the Trench Kiln Method or other standard method approved by the Engineer. The moulds to be used in the manufacture of bricks shall be thoroughly sanded before each use and shall be sufficiently larger than the size of the bricks being manufactured to allow for shrinkage in drying and burning. Each finished brick shall be a nominal 230x115x75 mm in size, shall weigh between 3.2 and 4.1 kilograms and shall have a "frog" 6 millimeter deep on the upper face. The bricks shall be thoroughly burnt but without being vitrified. The bricks used shall be well burnt, uniform in shape, size, texture, colour and should produce a ringing sound when struck. The bricks shall be free from flaws, cracks, chips, stone nodules of lime or kankar or other blemishes. Bricks over burnt, vitrified, irregular in shape or not having uniform colour or under burnt shall not be used. Bricks of uniform size shall be used throughout the work and the source of supply shall not be diversified.

8.3 Stacking And Sampling

The bricks shall be sorted and arranged in stacks of one or two thousands or as directed by the Engineer. Each stack shall be 10 courses high and two bricks thick so that at least 2 feet (0.6 meters) space between the stacks shall be left for the purpose of inspection. Each size or class of brick shall be stacked separately. For purposes of inspection and tests the sample bricks shall be selected by the Engineer or a person authorized by the Engineer for this purpose. These samples shall be furnished by the Contractor without charge. The sampling shall conform to ASTM C 67. For the modulus or rupture, compressive strength and absorption determinations at least 10 bricks shall be selected from each lot of 25,000 bricks or a fraction thereof. For larger lots five additional bricks shall be selected from each 50,000 bricks or a fraction thereof contained in the lot. In no case shall less than 5 bricks be taken.

Additional specimens may be taken at the discretion of the Engineer. Each specimen shall be marked so that it may be identified at any time. Markings shall not cover more than 5 per cent of the superficial area of the specimen.

9 SCAFFOLDING

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights. Scaffolding which in the opinion of the Engineer is unsafe, shall not be used until it has been strengthened and made safe for use of workmen to the satisfaction of the Engineer.

Damage to masonry from scaffolding or from any other causes shall be repaired by the Contractor.

10 EXECUTION

10.1 PLACING BRICK MASONRY

The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the brick nor delay the use of mixed mortar. Brick shall not be placed during rains sufficiently heavy or prolonged to wash the mortar from the brick. Mortar already spread which becomes diluted by rain shall be removed and replaced before continuing with the work. All brick to be used in brick masonry shall be moistened with water for three to four hours before they are used by a method which will ensure that each brick is thoroughly and uniformly wetted. All bricks shall be free from water adhering to their surface when they are placed in the brick masonry.

Bricks shall be laid "frog" upward with mortar joints and in English/Flemish bond as shown on the Drawings or as directed by the Engineer. Both bed and vertical joints shall be approximately 6mm and 10mm in thickness completely filled with cement mortar as specified herein, and each brick shall be bedded by firmly tapping with the handle of the trowel. All horizontal joints shall be parallel and all vertical joints in alternate courses shall be directly over one another. Excess mortar at the outer edges shall be removed and joints drawn straight with the edge of a trowel and a straight edge. All anchors and similar work required to be embedded in the brick masonry shall be installed as the work progresses. At the completion of the work all holes or defective mortar joints shall be cut out and re-pointed.

Where shown on the drawing the exterior faces of the walls shall be finished by striking the joints as the work proceeds. The joints shall be struck by raking the green mortar after the brick work has been laid and finishing the joint with a pointing tool. Horizontal joints shall be struck to form a weathered joint and vertical joints shall be struck with a V notch. Care shall be taken that the striking tools do not develop a cutting edge as the object of striking the joint is to compress the mortar into the joints.

The exposed faces of all brick masonry shall be thoroughly cleaned and left bare with struck joints as specified above.

The fair face Brick cladding (gutka) shall be laid in running bond unless otherwise as shown on the drawing or directed by the Engineer.

10.2 CURING

All brickwork requiring mortar shall be cured by water or other acceptable methods. All methods and operations of the Contractor in curing the different portions of the work shall be subject to the approval of the Engineer. When curing by water, the brickwork shall be kept wet for 7 days unless specified otherwise or covered with water-saturated material or by a system of perforated pipes, mechanical sprinklers, porous hose, ponding or by any other approved method which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements for water used in the manufacture of bricks.

10.3 Finishing

All bricks shall be skillfully laid frog face up with level courses, uniform joints, square corners, plumb verticals and true surfaces, except when otherwise

shown on Drawings or directed by the Engineer. Where the brickwork is required to be covered by mortar coating, the required finish shall be as indicated on the Drawings and shall meet with the requirements of the relevant specifications.

10.4 **Cement Mortar Coating**

Brickwork surfaces which are intended to receive paint coatings, shall have an over coating of cement mortar. The mortar shall consist of one part Portland cement to four parts of sand by volume and sufficient water to produce the proper consistency for the intended use. The surface on which mortar is to be applied shall be rough, clean and damp. The first layer of mortar, about 6 mm thick shall be forcibly dashed onto the surface so as to bond more tightly. The full thickness of the cement coating shall be ½" (12mm) except where otherwise shown on the Drawings or directed by the Engineer.

10.5 **Pointing**

Brickwork surfaces which are intended to receive pointing shall be given V-notch pointing by striking the joints. Tooling shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a tool which compacts the mortar. Raked joints shall be ½" (12mm) deep V-notch, 70 degree apex in order to give pressed and compacted surface. All joints shall be given finish with 1:3 cement sand mortar with a pointing tool.

REPAIRING BRICKWORK

10.6 If, after the completion of any brickwork, brick is out of alignment or not level, or does not conform to the lines and grades shown on the Drawings, or shows a defective surface, it shall be removed and replaced by the Contractor at his expense, unless the Engineer grants permission in writing to patch the defective area.

10.7 At the completion of the work, all holes and defective mortar joints shall be cut and re-pointed. Exposed masonry shall be protected against staining or other damages and excess mortar shall be cleared off the surfaces as the work progresses. All exposed masonry shall be clean, smooth, plumb and shall be of acceptable finish. In the event ordinary cleaning is not adequate, special methods such as sand blasting or otherwise as approved by the Engineer, shall be used to clean the surfaces.

11 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, mixed with 2.5 kg of pudlo/bag of cement or other approved quality water proofing compound as per manufacturer's specifications and shall be laid at required levels as per drawings and instructions of the Engineer. The D.P.C shall be tamped, consolidated, leveled and edges corners made to the requirements of the relevant drawings including finishing and curing complete. Including two float coat of hot bitumen 10/20 penetration grade shall be applied over the class "B" cement concrete @ 7 kg/100 sft.

12 VERTICAL DAMP PROOF COURSE

All vertical damp proof courses unless otherwise specified in the drawings shall consists of ½" thick cement sand plaster in 1:3, mixed with 2.5 kg of pudlo/bag of cement or other approved quality water proofing compound as per manufacturer's specifications and shall be applied at required elevation as per drawings and instructions by the Engineer, including two float of hot bitumen 10/20 penetration grade shall be applied over plaster @ 7kg/100sft.

13 MEASUREMENT AND PAYMENT

13.1 General

13.2 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 thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

13.2.1 Cutting & chiseling of masonry wherever required.

13.2.2 Cement sand mortar used in laying bricks including wastage.

13.2.3 Curing and repairing the masonry work.

13.2.4 All joint reinforcing bars, reinforcing anchor bars or hoop iron

13.2.5 Horizontal Damp proof course of class "B" concrete (3000 psi) including damp proof materials.

13.2.6 Vertical Damp proof course of 1:3 Plaster including damp proof materials

13.2.7 Scaffolding for Masonry Work.

13.2.8 2-1/2" long steel nails to be fixed in Brick masonry after every 5th courses at a distance 6" c/c for fair face Brick Cladding.

13.2.9 Cement sand mortar in 1:4 at the back of the fair face brick (Gutka) cladding to make it in plumb if required.

13.3 Brick Masonry

13.3.1 Measurement

In case of different thickness of slab in different areas or room or for any other reason whatsoever, if chiseling of masonry is required, the Contractor shall do so at his own cost where, for any reason whatsoever, the height, of the wall is short of ceiling height, of the actual height shall be made good with 3000 psi nominal mix concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under item of wall masonry. Similarly where the lintel heights are such that the Contractor has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiseling, but where such cast- in-place concrete is provided, payment for the same will be made at the unit rate for masonry. Measurement of acceptably completed works of brick masonry will be made on the basis of number of cubic feet for 9" (230mm) thick and above and for 4-1/2" (115mm) thick and below in Sq. feet as provided & installed in position

as shown on the Drawing or as directed by the Engineer. All opening more than 1 Sq. ft (0.1 Sq. meter) area left in the masonry wall shall be deducted.

13.3.2 **Payment**

Payment will be made for acceptable measured quantity of brick masonry on the basis of unit rate per cubic foot for 9" (230mm) thick and above and 4-1/2" (115mm) thick and below in square foot quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

13.4 **Fair Face Brick Cladding in Cement Surkhi**

13.4.1 **Measurement**

Measurement of acceptably completed works of fair face brick cladding will be made on the basis of actual area in Square feet of wall laid in position to the line, level as shown on the Drawing or as directed by the Engineer.

13.4.2 **Payment**

Payment will be made for acceptable measured quantity of fair face brick cladding on the basis of unit rate per Square foot quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 4600

CARPENTRY AND JOINERY

1 SCOPE

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

2 APPLICABLE STANDARDS

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

ISO (International Organisation for Standardisation)

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

1097 Plywood - Measurement of dimensions of panels.

1098 Veneer ply wood for general use-General requirements.

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

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

3804 Ply wood-Determination of dimension of test pieces.

3805 Ply wood-Determination of density.

3806 Ply wood-Determination of moisture content.

6442 Door leaves-Measurement of defects of general flatness.

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

6444 Door leaves-Test of behaviour under humidity variations.

BSI (British Standards Institution)

459 Wooden doors.

1186 Quality of timber and workmanship in joinery.

1127 Hinges

1331 Builder's hardware for housing.

1567 Wood door frames and linings nails.

1202 Nails

1203 Specifications for synthetic resin adhesive for ply wood.

1204 Synthetic resin adhesives for wood.

1282 Guide to choice, use and application of wood preservatives.

1494 Fixing accessories for building purposes.

1579 Connectors for timber.

3842 Treatment of ply wood with preservatives.

2 MATERIALS

2.1 Timber

2.1.1 Hard Wood

Hard wood shall comprise of Oak, beech, Walnut Mahogany, Teak, Iroko and Sheesham.

2.1.2 Soft Wood:

All soft wood shall consist of pines, spruce, hemlock and douglas fir or cedrous deader (referred in the document as deader) having density of 500-600 kg/square metre , wood locally known as 'Partial' to be used in framing where specified.

2.1.3 General Characteristics:

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

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

2.1.4 Preservation of Wood:

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

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

2.1.5 Adhesive:

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

2.1.6 Nails and Screws:

All nails and screws shall comply with requirements of BSI NO. 1202 and BSI NO. 1210 respectively.

2.2 **Ply Wood**

2.2.1 The ply wood shall comply in all respects with BSI No. 1455:1963. All the ply wood shall only be obtained from manufacturers approved by the Engineer.

Ply wood used for doors, panellings and other similar works shall be to the thickness and size as shown on the Drawings or as directed by the Engineer. The grade shall be first quality and the face and back shall be free from end joints, dead knots, overlaps, patches and other similar defects. The surfaces shall be free, smooth for painting or polishing.

2.2.2 The veneer shall be of the required thickness and quality including base veneer and shall be impregnated with an approved adhesive and machine compressed. Such machine pressed veneered wood shall be fixed on all sides of the inner core wood (soft wood of approved quality) after it has been treated with water resistant hot setting glue.

3 SAMPLES

3.1 **Samples of Materials**

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

3.2 **Shop Drawings**

The Contractor shall submit detailed shop Drawings on the basis of the drawings, specifications including fittings, fixtures and hardwares to the Engineer before fabrication.

3.3 **MOCK-UP SAMPLE**

After approval of shop drawings and tests etc., the contractor shall submit at his own cost one mock-up sample of each type of wood works complete with all fixing, fixtures accessories prior to the actual fabrication of the bulk.The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

4 FABRICATIONS

4.1 **General**

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

All framing shall be joined as shown on the Drawings or as directed by the Engineer. All joints shall be secured with sufficient number of nails. The Contractor shall perform all necessary mortising, tensioning, grooving, matching, tonguing, housing, rebating and all operations required for the correct jointing. The Contractor shall also provide all metal plates, screws,

nails and other fixing material that may be ordered by the Engineer for the proper execution of the joinery work. Fabrication that develop defects due to bad workmanship or unsound materials not conforming to these specifications and the directions of the Engineer, shall be cut out and replaced at Contractor's own expense before the expiry of the maintenance period.

4.2 **Doors**

4.2.1 Verify design and size of doors required for each opening. Door thicknesses shall be 40 mm unless otherwise indicated.

4.2.2 Fabricate flush wood doors in accordance with the following requirements.

Cores: Edging of doors and shutters shall be of hard wood and cores shall be soft wood (solid core) planed to a smooth uniform thickness. All doors and shutters shall have teak wood lipping on all edges.

4.2.3 **Face Panels**

4.2.3.1 Door facing on each side of shutter shall consist of three or more veneered plies of commercial ply/teak ply or Sheesham ply as shown on the Drawings

4.2.3.2 Veneer plies shall have total minimum thickness of 3mm before sanding.

4.2.3.3 Door veneers shall be bonded to each other, and to core unit with approved adhesive and machine compressed.

5 PROTECTION OF MATERIALS

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

6 WOODEN DOORS

6.1 **Materials**

6.1.1 First class Deader wood as approved by the Engineer shall be used for the door frames and full/half glazed and panelled shutters.

6.1.2 The ply wood and veneering shall be of selected best quality as approved by the Engineer.

6.1.3 Architrave shall be of Deader wood of specified sizes and fixed as per details shown on Drawings.

6.2 **Ground, Blocking & Nailing Strips**

Ground, blocking and nailing strips shall be provided as necessary to receive the work included herein and as required for the work of other trades.

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

6.2.1 **To steel**--- by means of 9.53mm diameter bolts spaced not over 900mm.

6.2.2 **To concrete block**----by the use of cut nails spaced not more than 400mm apart and driven directly into the block.

6.2.3 **To poured concrete**----by means of 6.35mm diamemter galvanized expansion bolts spaced not more than 400mm apart or by any approved method.

6.3 **Exterior and Interior Door Frames**

All exterior and interior door frames shall be constructed of given thickness nailed in place, jambs and beads shall be housed and nailed and glued together.

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

6.4 **Exterior and Interior Wooden Doors**

The exterior and interior wooden door shall, unless otherwise shown or specified, be of the flush, swing, and louvered type as shown on the Drawings or as directed by the Engineer.

Flush door shall comply with BSI 459 Part-2 and shall consist of solid core teak ply veneer 37mm thick shutters as shown on drawings.

6.5 **Door Shutters**

The shutters will be fixed to the frames with approved quality brass fittings as per hardware schedule.

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

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

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

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

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

6.6 **Fitting, Hanging and trimming**

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

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

6.7 **Hardware**

Hardware shall be of best quality local make extra heavy duty and first class finished material. The Contractor shall obtain prior approval from the Engineer for quality, shape, pattern, and brand of all the hardware materials by providing samples and catalogues, etc., and shall provide and fix only the approved hardware materials. The fittings shall included but not necessarily be limited to the following:-

Sr. No.	Items	Shutters		Remarks
		Single	Double	
1.	Brass push plate	one	two	nm x 200mm 18 gauge
2.	Brass Kick plate	two	four	
3.	Mortize lock (Japanese origin)	one	one	W C Doors
4.	Brass Tower/Sliding Bolt	one	Four	W.C Both Side
5.	Brass Hinges	Four	Eight	
6.	Room number Brass (65mm x 65mm)	one	one	Except Toilets.
7.	Door Closer	One	Two	Except Toilets.
8.	Door Stoper	One	Two	Except Toilets.

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

7.1 **Quality Assurance**

7.1.1 **Tolerances: Doors shall be fabricated to following tolerances**

7.1.1.1 **Size:** Plus or minus 1.6 mm overall dimensions

7.1.1.2 **Maximum Warp:** 3 mm

7.1.1.3 **Squareness:** Maximum diagonal difference 3mm (between length of diagonal measured on face of door from upper right corner to lower left corner and length of diagonal measured from upper left corner to lower right corner).

7.2 **Manufacturer's Qualifications:**

The manufacturer of doors herein specified shall have been in business of manufacturing doors of type specified for minimum period of five years.The manufacturer/Suppliers/Sub Controctor of Wood Work shall be subject to the approval of the Engineer.

7.3 **Submittals**

7.3.1 Provide manufacturer's literature completely describing products.

7.3.2 Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.

7.3.3 Provide certificates stating that doors were constructed with timber of the species specified having moisture content and meeting equilibrium and relative humidity requirements.

7.3.4 Submit samples of face veneers for selection of colour and pattern.

7.3.5 Procurement of materials shall be made only after the shop drawings and samples have been approved by the Engineer.

7.4 **Product Delivery, Storage and Handling**

7.4.1 Deliver and store products in waterproof, protective containers with seals unbroken and labels intact until time to use.

7.4.2 Keep products dry, stack products off ground on level platforms, fully protected from weather, including direct sunlight.

7.4.3 Identify type, size and location of each door before delivery in order to permit installation at correct location.

7.5 **Installation**

7.5.1 Install doors at correct openings and assure smooth swing and proper closer with frames.

7.5.2 Install finish hardware in accordance with manufacturer directions.

8 WOODEN RAILING

Material for wooden hand rail system shall be superior quality Teak/Sheesham / Deader Wood as shown on the drawings and specified in the BOQ. It shall be fabricated and installed in accordance with the design shown on the Drawings or as approved by the Engineer. Samples for decorative wood works of hand rail shall be submitted to the Engineer for approval prior to starting the work. Shop drawing for stair case hand rail system shall be submitted to the Engineer for his approval prior to start of work.Hand rail shall be installed to line, level and plumb.

9 KITCHEN CABINET, WOODEN BENCHES, PERGOLA AND JAFRI (TRELLIS)

All wooden kitchen cabinet, wooden benches, pergola and jafri (trellis) works shall be fabricated by approved sub contractor/manufacturer and shall be of best quality.

9.1 **Shop Drawings**

The details of these items shown on the drawing are tentative and shows basic configration 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 exeuction of kitchen cabinate, wooden benches, pergola and jafri for the approval of the Engineer before fabrication..

9.2 **Installation**

All the works, shall be installed in position by the manufacturer's skilled workmen specialised 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 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.

10 DEFECTIVE WORK

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

11 SURFACE PREPARATION

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

12 MEASUREMENT & PAYMENT

12.1 **General**

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

- Glass and glazing including other materials and accessories required for installation and finishing.
- Prime coat, painting and polish lacquer in carpentry and joinery works.
- Anti termite treatment to all wood works.
- Adhesives
- Timber batten, counter sunk screw for teak wood moulding, skirting, beading & wall panelling.
- Hardware/Iron mongery for wood works.

12.2 Wooden Doors (Flush and Panelled)

12.2.1 Measurement

Measurement of acceptably completed works of each type of wooden doors (Flush and Panelled) will be made on the basis of net actual area in square feet fabricated and installed in position as shown on the Drawings or as directed by the Engineer.

12.2.2 Payment

Payment will be made for acceptable measured quantity of each type of wooden door (Flush and Panelled) on the basis of unit rate per square foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

12.3 Kitchen Cabinets, Wooden Benches and Jafri (Terrlis)

12.3.1 Measurement

Measurement of acceptably completed works of Kitchen Cabinets, Wooden Benches and Jafri (Terrlis**)** will be made on the basis of net actual area in square feet fabricated and installed in position as shown on the Drawings or as directed by the Engineer.

12.3.2 Payment

Payment will be made for acceptable measured quantity of Kitchen Cabinets, Wooden Benches and Jafri (Terrlis) on the basis of unit rate per square foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

12.4 Wooden Pergola and Sheesham wood decorative bracket

12.4.1 Measurement

Measurement of acceptably completed works of Wooden Pergola and Sheesham wood decorative bracket will be made on the basis of Each number fabricated and installed in position as shown on the Drawings or as directed by the Engineer.

12.4.2 Payment

Payment will be made for acceptable measured quantity of Wooden Pergola and Sheesham wood decorative bracket will be made on the basis of Each number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 6220

ALUMINIUM WORKS

1 SCOPE

The work under this section of specification includes furnishing all labour, equipment, appliances and materials and performing all operations in carrying out the work of natural, anodized and powder coated aluminium windows, doors, ventilators and louver with fly proof shutters and aluminium false ceiling of polycarbonate sheet on project buildings. 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.

2 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 Aluminium alloy windows.

3 SUBMITTALS

3.1 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.

3.2 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.

3.3 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.

3.4 **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.

Such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturers and the Contractor may have law or by other provision of the Contract Documents.

4 INSPECTION & TESTING

4.1 Contractor shall arrange tests and analysis if directed by the Engineer of scaled models of each Door, window ventilator type at the maker's works or any laboratory specified by the Engineer for the material supplied by him to be tested in the presence of the Engineer's Inspector, to whom test certificates, proof sheets, etc. shall be furnished. The models shall be submitted to the Engineer for approval prior to testing. Nevertheless, neither the fact that the materials have been tested in the presence of the inspector nor that the Engineer may have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer to reject, after delivery of materials found not in accordance with these specifications.

4.2 After approval of shop drawings and tests etc., the Contractor shall submit at his own cost one mock-up sample of each type of aluminium 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.

5 PRODUCT DELIVERY AND STORAGE

5.1 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.

5.2 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.

6 MATERIAL

6.1 All the sections used for Doors, windows, ventilators & fly screens shall be of best quality aluminium products such as equal and unequal angles, channels, tubes, corrugated strips, mouldings etc.; in accordance with international standards conforming to ASTM B 308 & B221.

6.2 **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.

6.3 Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.

6.4 Gaskets shall be vinyl glazing channel gasket to commercial standard CS-230-60.

6.5 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.

6.6 Joint sealant shall be approved elastomer.

6.7 Fittings and fixtures shall be as per approved samples.

6.8 Joint sealant shall be approved elastomer.

6.9 **Finished Coating**

6.9.1 General

The finished coating shall be as stated on the Drawings and applied strictly in accordance with the manufacturer's instructions.

The colour 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.

6..9.2 **Anodized coating**

The aluminium anodizing shall comply with BS 3987 and be integral colour hard coat anodizing 550kp/mm^2 hardness, minimum 25 microns thick.

The colour of anodizing shall be as described on the drawings. Samples of colour including limits of colour 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 colour variation, the acceptable limit of variation being at the Engineer's discretion.

6.9.3 **Polyester Powder coating**

All aluminium 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. Iodization should be not les than 25 micron thickness.

All aluminium works shall be finished in colored electrostatic polyester powder coating as per DIN standard 53151, 53153, 53156 or equal and approved to Ral colour subject to the Consultant's approval.

6.9.4 **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 aluminium sections. Failure to provide such information shall result in the complete installation being rejected and replaced at the Contractor's expense.

6.9.5 **Dissimilar Materials**

All aluminium 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.

7 FABRICATION

7.1 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-Cation	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	
Heavy	2.50	12	3500	
Heavy	3.00	12	3500	With door

7.2 Sliding Windows and doors

Weather-stripping - high density acrilan wool weatherpile 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 finished as the aluminium 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.

7.3 **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 aluminium 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, colour 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).

7.4 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 aluminium 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 aluminium frame to the fly screen shall be finished to match the framing of the window or sliding door. Colour and type of mesh to Engineer's approval.

7.5 Glazing

The glass shall conform to specification laid down under chapter 'Glazing' and shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in window members. All the glass shall be best quality of approved manufacture or equivalent standard as approved by the Engineer.

8 ERECTION AND WORKMANSHIP

8.1 Erection

8.2 Rawlplugs and anchoring bolts shall be embedded into the concrete or masonry for holding the doors, windows, ventilators and louvers in their correct position.

8.3 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'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 manufacture's instructions.

8.4 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 un-obstructive 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 aluminium.

Temporary protection shall be achieved by applying water soluble protective coating capable of withstanding the action of lime mortar.

Protective coating shall be applied in the manufacturer's plant to the exposed surfaces of all components after removing all fabrication compounds, mixture and dirt accumulations.

8.5 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, colour and temper; clean, round, commercially straight and free from injurious defects.

9 PROTECTION AND CLEANING

- Temporary protection shall be achieved by applying water soluble protective coating capable of withstanding the action of lime mortar.
- Apply coating in the manufacturer's plant to the exposed surfaces of all components.
- Before application of coating, remove all fabrication compounds, moisture and dirt accumulations.

10 DEFECTIVE WORK

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

11 MEASUREMENT AND PAYMENT

11.1 General

Except otherwise specified herein or else where 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.

- Providing and fixing glazing.
- Rawlplugs, brackets, rubber gasket, sealants, rollers, vetting latches and any other embedded fixture required for fixing the doors, windows, ventilator and louvers.
- Providing and fixing locks, handles and door closers as approved by the Engineer.
- Providing and applying approved joint sealant according to the manufacturers instructions
- Providing and fixing fly proof shutters along with aluminium wire gauze to sliding/ openable windows and ventilators.
- Plant, tool and equipment required to fix aluminium at any height.
- Providing and applying approved joint sealant/ aluminium covering where window mullion touches with the wall poly carbonate sheet (lexan) for false ceiling.

11.2 Aluminium Doors, Windows and Ventilators

11.2.1 Measurement

Measurement of acceptably completed works of aluminium 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.

11.2.2 Payment

Payment will be made for acceptable measured quantity of all finished aluminium 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.

11.2.3 Aluminium frame with fixed Ploy carbonate sheet false ceiling

11.2.4 Measurement

Measurement of acceptably completed works of Aluminium frame with fixed Ploy carbonate sheet false ceiling 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.

11.2.5 Payment

Payment will be made for acceptable measured quantity of all finished Aluminium frame with fixed ploy carbonate sheet false ceiling 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.

SECTION - 6250
GLAZING & GLASS BLOCKS

1 SCOPE

The work under this section of the Specifications consists of furnishing all labour, equipment, tools, appliances, scaffoldings and providing glass gaskets, sealants, compound and other materials required for performing all operations in connection with the installation and setting of all types of glass, glazing and glass blocks complete in every respect in accordance with the Drawings or as directed by the Engineer. The scope of this section of Specifications is covered with detailed Specifications as laid down herein.

2 APPLICABLE STANDARDS

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

BSI (British Standards Institution)

952	Glass for glazing
5051	Security glazing Part I & II
CP.152	Glazing

3 GENERAL

3.1 Each type of glass shall have the manufacturer's label on each pane, and the labels shall remain on the glass until final cleaning.

3.2 Glazing sealant shall be as recommended by the manufacturer for the particular application.

3.3 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.

3.4 Contractor shall submit samples for each type of glass, minimum 100 mm x 100 mm 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.

3.5 Contractor shall submit 300 mm long sample of each type of glazing gasket.

3.6 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.

4 DELIVERY STORAGE AND HANDLING

4.1 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.

4.2 Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements which may damage glass.

4.3 Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces.

5 MATERIALS

5.1 General

Glass shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to fit the rebates so as to have a uniform clearance of 1.6 mm round the panes between the edges of glass and the rebates. All glass shall be best quality from reputable manufacturer as approved by the Engineer.

Unless otherwise indicated glass shall be of the following weight per square meter for various sizes mentioned below:

5.1.1 Not exceeding 300 x 350 mm -- 4.3 Kg/M

5.1.2 Exceeding 300 x 350 mm but not exceeding 600 x 600 mm - 8.0 Kg/M.

5.1.3 Exceeding 600 x 600 mm but not exceeding 750 x 750 mm - 9.0 Kg/M.

5.1.4 Exceeding 750 x 750 mm but not exceeding 900 x 900 mm - 9.8 Kg/M.

5.1.5 Plate glass 6 mm thick shall be used where size of glass exceeds 900 mm either in breadth or in length or in both.

5.2 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 and should be fixed with glazing bead securely screwed and finished off neatly.

5.3 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, if specified, sheet glass shall be made obscure by grinding off the polish from one side.

5.4 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.

5.5 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.

5.6 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. The tinted glass shall comply with the applicable specifications of B.S. 952.

5.7 Solar Control Film

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 aluminium vapor 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. The film shall transmit 18% of visible light and shall have reflectance of 18%.

5.8 Glass Blocks

The glass block shall be of specified size and shall be form a Manufacturers approved by the Engineer

5.9 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.

5.10 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.

5.11 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.

5.12 Glazing Sealants and Compounds

Contractor shall provide material colored to match frame in which glass is installed. Provide only compounds known to be fully compatible with surfaces which they will contact as follows.

5.12.1 Two component polysulfide glazing for sealant.

5.12.2 One component acrylic glazing for sealant.

5.12.3 Acrylic-latex glazing sealant consisting of modified latex rubber and acrylic emulsion, non-hardening, non- staining and non-bleeding.

5.12.4 Cleaners, Primers and sealer as recommended by the sealant manufacturer.

6 ACCESSORIES

6.1 Glazing Sealant

6.1.1 It shall be tape or ribbon of polymerized butyl or mixture of buty1 and polyisolbutylene compounded with inert fillers and pigments, solvent based, 95 percent solids thread or fabric reinforced, paintable, non-staining.

6.1.2 **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.

6.1.3 **Channels, Gaskets, and spacer's**

It shall be chloroprene (Neoprene), 40 to 50 durometer hardness compatible with sealant used.

7 INSTALLATION OF GLAZING

7.1 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.

7.2 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.

7.3 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.

7.4 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 600 mm apart around the perimeter.

7.5 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. 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.

7.6 **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 meter in area inside buildings or for external panes not exceeding 0.093 square meter, 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 9.5mm 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.

8 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. 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.

9 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.

10 PROTECTION AND CLEANING OF GLAZING

10.1 Remove all smears, labels and excess glazing sealant, Leave clean inside and outside free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with new glass at no additional expense to the Employer.

10.2 All glass surfaces shall be washed clean both inside and outside within two weeks prior to final acceptance by the Employer

11 MEASUREMENT AND PAYMENT

11.1 Glass Blocks

11.1.1 Measurement

Measurement of acceptably completed works of Glass Block wall will be made on the basis of net actual area in square feet of glass block wall laid in position to the line, level & grade as shown on the Drawing or as directed by the Engineer.

11.1.2 Payment

Payment will be made for acceptable measured of glass block wall 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.

Note:

No other measurement and 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 item of the Bill of Quantities.

SECTION - 6411

INSULATION, DAMP PROOFING/WATER PROOFING & BUILT-UP ROOFING

1 SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with installation of insulation, water-proofing and built-up roofing, including water proofing treatment to foundations, toilets floor and floor of water retaining structures and walls complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and Conditions of the Contract.

2 CODES AND STANDARDS

The work shall conform to the requirements of the following Codes and Standards, unless otherwise specified:

PS 208	Common building clay bricks.
ASTM C67-81	Standard method for sampling and testing brick and structural clay tile.
ASTM D41-78	Primer for use with asphalt in damp proofing and water proofing.
ASTM D2103-81	Polyethylene film and sheeting.
ASTM D 140-70	Standard methods of sampling bituminous (1981) materials.
ASTM D 449-79	Asphalt used in damp proofing and water proofing Type C
BS 747-77	Specifications for roofing felt.
BS 1521-72	Water proof building papers.
BS 2972-75	Methods of test for inorganic thermal insulating (1984) materials.
BS 4016-72	Building paper (breather type).

3 SUBMITTAL

3.1 **Shop Drawings**:

Shop drawings shall be submitted showing layout and all the details for construction.

3.2 **Samples**:

Samples of all materials proposed for use under this section, shall be submitted to the Engineer for approval.

4 MATERIALS

4.1 POLYSTYRENE

Expanded polystyrene (thermopore) shall be of the type as approved by the Engineer for insulating the roofs and shall conform to BS 7972. The adhesive for expanded polystyrene shall be as specified by the manufacturer or as approved by the Engineer.

4.2 ASPHALT/BITUMEN

Special industrial asphalt shall be of 10/20 penetration, or any other approved by the Engineer conforming to the following minimum and maximum limits:

Specific gravity	1.02/1.04 at 25oC
Penetration, 100 gm	10/20 at 25oC
Ductility (Cms)	417 at 25oC
Softening Point	77oC / 93oC
Working temperature	150oC /175oC

Asphalt primer shall be bitumen of 10/20 penetration grade 1420 from an approved manufacturer or any other approved by the Engineer conforming to ASTM D 41.

4.3 FELT

The felt shall be an asphalt impregnated type 1C fibber base as per BS 747. The number of ply shall be as specified in the Drawings. The felt shall be smooth and stout building paper having water proofing qualities conforming to BS 4016. Weight of 3 ply standard roll of 20 x 1 meter should not be less than 54 Kilograms.

4.4 THERMOFOAM/Jumbolon

Thermofoam/Insulite shall be as manufactured by Taunsa Gypsum (PVT) limited or as approved equivalent. Jumbolon if specified shall be manufactured by Crescent Industrial Enterprises (Pvt.) Ltd.

4.5 FEBTITE LIQUID

Febtite liquid (integral waterproofer for cement mortar) shall be as supplied by Silver streak corporation or approved equivalent.

4.6 FEB. HYSEAL/ BRUSH BOND REX WHITE

FEB. HYSEAL (Surface applied, capillary sealing waterproofer for concrete) shall be as supplied by Silver streak corporation, 103 1st floor, Latif Plaza, Ferozepur Road, Lahore; and shall confirm to ACI/SFB 1976 or approved equivalent.

4.7 VANDEX

Vandex waterproofer shall be best available as approved by the Engineer.

4.8 EARTH

Clay shall be plastic and obtained from sources approved by the Engineer and shall have fine sand in the range of 20% to 30%. It shall not contain more than 0.50% soluble salts, more than 0.2% sulphate, more than 4% organic contents and shall not contain any gravel, coarse sand, roots of grass and plants.

4.9 **BRICK TILES**

Brick tiles shall be either hard mould or machine molded having a nominal size of 230 x 115 x 37 mm, without frog on any side and weighing 1.6 Kg to 2.0 Kg. The tiles shall conform to PS 208 or ASTM C 67 and shall have same qualities as of bricks specified in Section **"Brick Masonry"**.

4.10 **CLASS "B" CONCRETE**

Class "B" cement concrete shall be in accordance with specification for "Plain & Reinforced Concrete".

4.11 **ISOLATION MEMBRANE/POLYETHYLENE SHEET**

Isolation membrane shall be polyethylene sheet 500 gauge thick conforming to ASTM D 2103.

4.12 **TERRA COTTA TILES (Kaphrail) FOR SLOPING ROOF.**

The terra cotta tiles for sloping roof shall be as shown on the drawing or as approved by the Engineer.

4.13 **CEMENT PLASTER**

Cement Plaster shall be in accordance with specification for cement plaster.

5 **PREPARATORY WORK**

All scuppers and roof drains shall be placed and metal flashing flanges etc. shall be provided in time to be installed alongwith the roofing assembly.

All surfaces, to be treated shall be dust free and dry. Application of roof finishes shall not start unless the preparatory work has been inspected and approved by the Engineer.

6 INSTALLATION

6.1 **GENERAL**

The selection and combination of various water proofing and damp- proofing materials for different locations shall be as shown on the Drawings or as directed by the Engineer. Unless otherwise directed or approved by the Engineer, the procedures given in this sub-section shell be adopted.

A priming coat of asphalt primer shall be applied to all parts of surfaces to be damp/water proofed before the application of asphalt coating.

6.1.1 Asphalt for built-up roofing shall not be applied when it is above 205oC, (400oF) nor shall it be heated above 245oC (475oF).

6.1.2 Felt shall be stacked in properly protected piles and maintained at temperature of at least 10oC (50oF) for a period of not less than 24 hours prior to laying. Felt surfacing material shall always be dry and the several layers of felt shall be laid free from wrinkles.

6.1.3 Roofing shall not be applied during rain or while surfaces are damp; it shall be applied only to surfaces that are clean and dry.

6.1.4 Method of laying the different layers of built-up roofing shall be strictly in accordance with the instructions of the Engineer.

6.1.5 Built-up roofing shall not be laid when the temperature at the location of the work is below 5oC (40oF).

6.1.6 Heating of asphalt shall be strictly regulated by means of an accurate thermometer of approved type, kept constantly suspended in the heating kettle while the work is in progress.

6.1.7 Entire deck surface and parapet walls shall be painted with asphalt primer and allowed to dry thoroughly. Primer shall be kept several centimeters back from joints of pre-cast panels.

6.1.8 Mopping of surface with asphalt shall be performed so that the surface shall be completely covered. Bond coats of asphalt shall be at the rate of 2 Kg per 10 Sft. (square meter) each coat. At no point shall felt touch the underlying concrete and the rate of application shall be such that the asphalt mopping shall not be more than one meter ahead of the roll of felt. All asphalt shall be applied with mops except that the hot surfacing application shall be poured from a dipper.

6.1.9 Felt shall be laid with each sheet lapping the preceding one. Each sheet shall be lapped with an exposed lap of 12 inch. (300mm). All end laps shall be 4 inch (100mm) minimum. The laying of felt shall, in general, be started at low points working upwards to high points of the surface. The roofing felt shall be rolled while mopping, rubbing and pressing the felt sheets as it spreads on to the surface, so as to ensure thorough sticking and a smooth firm surface, free from wrinkles or bubbles. Roofing felt shall be extended to points and position as shown on the Drawings.

6.2 EARTH AND TILE ROOFING (FLAT ROOF)

- Roof surface shall be painted with asphalt primer at the rate of 0.5 liters per 10 sft.
- Two uniform mopping coats of hot asphalt at the rate of 34Lb per 100 sft shall be applied.
- Polyethylene sheet shall be laid with 6” side laps and 8” end laps staggered with layers bonded together with asphalt. The surface shall be broomed to ensure that it is free of wrinkles.
- Earth shall be laid in desired slopes and thickness.
- One inch thick mud plaster mixed with bhoosa
- Brick tiles shall be laid wet, grouted and pointed flush in cement sand mortar 1:3. The top surface shall be smooth and accurately level. No cracked tiles shall be used.
- Tiles, after laying, grouting and flush pointing, shall be kept wet throughout for 7 days.
- The Contractor shall take care to maintain the slopes, levels and protect the work from any damage during the construction and maintenance period. The Contractor shall have to remove, replace and rectify such damaged work.

6.3 **R.C.C RETAINING WALL**

- ½" thick 1:3 cement sand plaster shall be provided on R.C.C wall
- Wall surface shall be painted with asphalt primer at the rate of 5 liters per 100 sft.
- Two uniform mopping coat of hot asphalt at the rate of 20Lb/100 Sft shall be given.
- One layer of Polyethylene sheet 500 gauge thick in shall be applied with 6" (150 mm) side laps and 8" (200 mm) end laps staggered with layers bonded together with asphalt. The surface shall be broomed to ensure that it is free of wrinkles.

6.4 **WATER PROOFING TREATMENT IN FOUNDATION RAFT & TOILET FLOOR SUB- STRUCTURES**

Two uniform mopping coat of Hot bitumen shall be applied @ 20 Lb/100 Sft. over blinding concrete of foundation including a layer of Polyethylene sheet 500 gauge thick in shall be laid with 6" (150 mm) side laps and 8" (200 mm) end laps staggered with layers bonded together with asphalt. The surface shall be broomed to ensure that it is free of wrinkles

7 MEASUREMENT AND PAYMENT

7.1 General

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

7.1.1 All preparatory work, scrapping, cleaning and primer coat.

7.1.2 Formwork.

7.1.3 Brick tiles in roof treatment.

7.1.4 Coats of bitumen.

7.1.5 Cement sand mortar for sloping roof.

7.1.6 Polyethylene sheet.

7.1.7 Cement sand plaster 1:3 on R.C.C wall.

7.2 Water Proofing/Damp proofing of Foundation Raft, Retaining walls, Toilets floor

7.2.1 Measurement

Measurement of acceptably completed works of Water Proofing/Damp proofing of Foundation Raft, Retaining walls, Toilets floors will be made on the basis of net actual area in square feet as shown on the Drawings or as directed by the Engineer.

7.2.2 Payment

Payment will be made for acceptable measured quantity of Water Proofing/Damp proofing of Foundation Raft, Retaining walls, Toilets floor on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 6521
CEMENT PLASTER AND POINTING

1 SCOPE

The work done under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in connection with providing and installation of cement plaster and cement pointing specified external rendering complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the Contract. The scope of this section of Specification is covered with detailed Specifications as laid down herein.

2 APPLICABLE STANDARDS

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

Pakistan Standard

P.S 232 Ordinary Portland Cement

ISO (International Organization for Standardization)

R.597 Definitions and terminology of cement.

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

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

R.681 Chemical analysis of cements-mixer Constituents of Portland cement.

R.682 Chemical analysis of cements - determination of sulphur as sulphide.

ASTM (American Society for Testing and Material)

C. 144 Aggregate for Masonry mortar.

C. 150 Specification for Portland Cement.

C. 631 Bonding compounds for interior plastering.

BSI (British Standards Institution)

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

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

1369 Metal lathing (steel) for plastering.

4027 Specification for sulphate resisting Portland cement.

5262 External rendered finishes.

5492 Internal plastering.

3 GENERAL

3.1 Except as may be otherwise shown on drawing specified, all plaster work, both internal and external shall be ordinary Portland Cement plaster of the required thickness as shown on the drawings.

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

3.3 Sample of materials shall be submitted to the Engineer for his approval prior to use in the works.

4 MATERIALS

4.1 Cement for plaster shall be Ordinary Portland Cement (ASTM C 150 B.S 12 or P.S 232). Sulphate resisting cement (B.S 4027 or P.S. 612) as specified and shall conform to requirements specified in the section "Plain and Reinforced Concrete".

4.2 Sand for plaster shall comply with the requirements of BS 1199, BS 1200 or the draft Pakistan Standard "Sand for Plaster" as directed by the Engineer.

4.3 Water for plaster shall conform to requirements specified in the section for "plain and reinforced concrete".

4.4 Lime putty shall pass 100% through a sieve of 1.4 mm and shall not be retained more than 2% on a sieve of 300 um.

4.5 Corner beads shall be fabricated from less than 26 US Standard gauge galvanized steel sheets, shall have 3mm radius corner and shall have expanded wings not less than 65mm width.

Angle beads, stop beads, depth gauge beads, edging profiles, plaster dividing profiles, interior angle profiles, plaster borders and the like shall all be manufactured from sheet steel and galvanized after fabrication, all beads shall be perforated at edges to ensure good adhesion of the plaster work. Thickness and dimensions shall suit particular locations and plaster thickness.

4.6 All materials and workmanship for plaster, not explained in these Specifications or, shall comply with the requirements of relevant BS CP 5262 and BS 5492 as directed by the Engineer.

5 PROPORTIONING AND MIXING

5.1 Measurement of materials by volume shall be by containers of known capacity to maintain consistent proportions. No lumpy or caked material shall be used. Mixing equipment boxes and tools shall be clean. Materials shall be proportioned as specified on the Drawings, in the Bill of Quantities or as directed by the Engineer. Plaster ingredients shall be thoroughly mixed either by hand on a clean cement concrete platform or by a mechanical mixer.

5.2 Quick lime shall be slaked by stirring it into excess of water in a tank where it will hydrate and generate heat. Slaking shall be complete in about 12 hours when temperature shall cease to rise. Lime shall then be sieved through 1.4 mm mesh and stored under water and left to mature. Maturing period shall be from one to three weeks as directed by the Engineer. Matured material known as lime putty, shall then be ready for use in plastering.

5.3 Only limited water shall be added for proper workability and such quantity of mortar shall be prepared which can be consumed in thirty minutes after preparation. Preparation of mortar in bulk quantity for use during the entire day or for any other time more than that stipulated above is expressly prohibited. Re-tempering shall not be permitted and all mortar which has begun to stiffen shall be discarded.

5.4 For cement, lime and sand plaster, normal procedure shall be to prepare a day's supply of coarse materials by mixing one part of lime putty with six parts of sand. Plaster mortar shall be prepared by mixing one part of Portland cement with six parts of coarse material and adjusting the water content to give adequate workability. After adding the Portland cement the plaster shall be used within two hours.

6 PREPARATION OF SURFACE TO BE PLASTERED

6.1 Concrete surface to be plastered shall be cleaned to remove all grease, form oil and other surface impurities which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface of all concrete ceilings, beams and columns shall be lightly hacked by approved means to give the required key for plastering.

6.2 All masonry surface to be plastered shall be cleaned to remove all matter which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface shall be washed with clean water and kept damp for 24 hours before further treatment. The surface thus prepared shall be treated uniformly with cement and sand slurry. The slurry to be used shall be one part cement to one part sand by volume with water added to make a stiff creamy mix. The slurry shall be applied with a stiff brush on surface which has previously been well wetted. The surface so treated shall be left to cure for three(3) days.

6.3 For pointing all joints shall be racked to make a groove of 20mm deepened surface cleaned with a wire brush.

7 APPLICATION OF PLASTER

The plaster of thickness less than the specified thickness shall be rejected. If the plaster is to be more than 15mm 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. No extra payment shall be allowed for jambs, junctions, corners, edges, round surfaces or for more than one layer of plaster required due to any unevenness in the work done by the Contractor. The 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 a three (3) meter straight edge and plumb bob.

Plaster containing cracks, blisters, pits, discoloration or any defects shall not be acceptable. Any such plaster or loose plaster shall be removed and replaced with plaster in conformity with these specifications and as additionally directed by the Engineer.

The Contractor shall cut out and patch all defective work at his own cost. All damaged plaster shall be patched as directed by the Engineer. Patching plaster shall match appearance of and shall be finished level with adjoining plaster.

8 METAL LATH OVER REINFORCED CONCRETE AND MASONRY JOINT

Metal lath shall be fabricated from sheet steel and shall be of uniform quality and free from flaws broken strands, cracks and corrosive pitting, shall be rectangular and true to shape and shall comply with BS-1369.

All lathing shall be galvanized. Where plastering material depends entirely on the lathing for its key, these shall be not less than two complete mesh openings per 28 mm in one direction and the width of the aperture shall not be less than 5mm.

Sheets shall not be less than 1.6 kg/sq.m when fabricated, using 0.7mm thick steel sheet. Where used on smooth surfaces to form a key it shall be not less than 0.12 kg/sq.m. when fabricated, using 0.5mm thick steel sheet. Tying wire shall be 1.2mm diameter galvanized annealed iron wire.

Before plastering, wherever brick masonry meets with reinforced concrete members a 230mm wide continuous strip of expanded metal lath shall be nailed to the masonry and the reinforced concrete member covering the joint completely to prevent cracking of the joint.

9 BEADS

Angle beads, stop beads, depth gauge beads and the like shall are to be fixed in accordance with the manufacturer's instructions, where shown on the drawings or as directed by the Engineer.

10 INTERNAL/EXTERNAL PLASTER OVER CONC./BRICK SURFACES.

10.1 All internal/External plaster on concrete surfaces shall have an average ½" (12mm) thick consisting of 1:3 cement sand mortar in gray cement finished smooth plaster unless otherwise specified on the Drawings and or as directed by the Engineer.

10.2 All internal/ external surface on brick/block masonry shall have an average ¾" (20mm) thick plaster consisting of base coat of 1:5 cement sand mortar in gray cement and finished smooth unless otherwise specified on the Drawings and/or as directed by the Engineer.

11 POINTING

11.1 General

Brick masonry and stone masonry which are intended to be pointed shall be given flush pointing or struck pointing as required in 1:3 cement sand mortar unless otherwise specified on the Drawings.

11.2 Flush Pointing

After preparing the surface of brick or stone masonry all horizontal and vertical joints shall be raked in upto a depth of ½" (12mm) in brick and ashlar (stone) masonry and upto a depth of ¾" (20mm) in rubble (stone) masonry. The joints should be cleaned with a wire brush and the cement sand mortar shall be pressed in all joints. The mortar shall be made flush with the surface with a steel trowel.

11.3 **Struck Pointing**

For struck pointing, all the vertical and horizontal joints after raking upto a depth of ½" (12mm) in brick and ashlar masonry and ¾" (20mm) in rubble masonry and cleaning with a wire brush shall be filled with 1:3 cement sand mortar. All the joints shall be pressed and given a V-notch by striking with a tool. Striking shall be done when the mortar is partially set but still sufficiently plastic to bond. All striking shall be done with a tool which compacts the mortar, gives 6mm deep V-notch with a 70 degree apex. in order to give a well defined network of lines on the surface.

12 GYPSUM PLASTER

Gypsum Plaster shall be provided wherever shown on the Drawings or as directed by the Engineer. The Work shall be carried out strictly in accordance with the manufacturer's instructions.

13 CLEANING AND PROTECTION

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

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

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

14 TOLERANCES

14.1 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 walls and reveals plumb and square.

14.2 Maximum permitted tolerances shall not exceed 1/8" in 6 ft. (3mm in 2M) variation from plumb or level in any exposed line or surface and 1/16 inch (1.5 mm) variation between planes of abutting edges or ends.

15 MEASUREMENT AND PAYMENT

15.1 **General**

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities.

The cost thereof shall be deemed to have been included in the quoted unit rate of the respective item of the Bill of Quantities.

15.1.1 Metal lath over reinforced concrete and masonry joint.

15.1.2 Joints, junctions, corners, drip course edge, and roundings.

15.1.3 More than one layer due to any unevenness in the finished works.

15.1.4 Cutting & patching of all defective works.

15.1.5 Surface preparation, cleaning and protection as specified.

15.1.6 Curing of plastered/Pointed surfaces.

15.1.7 Water proofing Admixture in plaster if specified on the Drawings.

15.2 **Cement Sand Plaster,**

15.2.1 **Measurement**

Deductions shall not be made for ends of joints, beam posts, etc., and openings not exceeding 2 square feet each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings non for finishing the plaster around ends of joints, beams posts, etc.

In case of opening of area exceeding 2 square feet each, deduction shall be made for the openings and also no addition shall be made for reveals jambs, soffits, sills, etc., of these openings.

Measurement of acceptably completed works of plaster on R.C.C work or Brick masonry walls on internal or external surfaces of specified thickness will be made on the basis of number of square feet of the surface area plastered as shown on the Drawings or as directed by the Engineer.

15.2.2 **Payment**

Payment will be made for acceptable measured quantity of plaster on R.C.C or Brick masonry work on internal or external surfaces of specified thickness on the basis of unit rate per square foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 6531
MARBLE

1 SCOPE

The work done under this section of specifications, consists of providing all material, labour, plant, equipment, appliances and performing all operations required for providing and installing marble natural stone slab and tile finishes in floor, skirting, stair case portion of exterior walls, kitchen and toilet counters, flower beds, and verandahs etc. as shown on the drawings, complete in accordance with this section of the specification and the applicable Drawings.

2 SUBMITTALS

2.2 Manufacturer's/Supplier's Product Data

The Contractor shall submit manufacturer's specifications and other product data for each type of marble stone and fixtures required, including instructions for handling, storage, installation and protection.

2.3 Shop Drawings

Shop Drawings shall be submitted showing sizes, dimensions, sections and profiles of slab and tile units, arrangement and provisions for jointing, anchoring, fastening and supports and other necessary fixing details. Indicate locations, layouts and pattern arrangements for each stone type and colour.

2.4 Samples

Submit three sets of range samples not less than 300mmx300mm in size of each type for different colour, grade and finish required include in each set the full range of exposed colour and texture, including material blemishes which may be characteristic of marble selected and to be expected in the complete work.

3 DELIVERY, STORAGE AND HANDLING

Materials shall be protected from damage during loading, shipment, delivery and storage. Non-staining materials for blocking and packing shall be used. Stack marble units at site in accordance with manufacturer's recommendations and as required to prevent staining, scratching, etching or breakage. Marble slabs/tiles shall be delivered finished unless otherwise approved. Damaged slabs/tiles with chipped edges or cracking will not be accepted if such defects are noticeable at a distance of one meter under normal light conditions. Decision of rejection shall be final.

4 TOLERANCES & TESTING

4.1 Tolerances

Fabricate marble Slab/Tiles in accordance with the followings unless otherwise shown.

• Length and Width	1mm (1/16")
• Thickness (depth)	1mm (1/16") where visible6mm (1/4") (where not visible)
• Horizontal and vertical alignment (deviation from straight lines parallel to centre line)	1mm (1/16") 3 M (10ft.) of length
• Out of Square (differences in Length of two diagonal measurements)	1mm (1/16) 3 M (10ft.)

1.1 Testing

The tests for marble shall be made as per B.S. Standards for the determination of:

→ Weight %age Absorption

→ Modulus of Rupture

→ Compressive Strength

→ Resistance to Abrasion

→ Flexural Strength

5 MATERIALS

5.1 General

5.1.1 Obtain each marble stone type from a single quarries from Pakistan and ensure consistent colour range and texture through out the work. It shall have a specific gravity of about 2.7 and of hardness number on Moh's scale shall range 3 to 4.

5.1.2 Provide marble slabs or tiles of specified sizes in floor, wall areas and countertops as shown on drawings.

5.1.3 Provide marble slabs of type, colour and finish for each area as per approved samples by the Architect/Engineer.

5.1.4 Provide marble of specified thickness. Saw-cut the back surfaces that are meant to be concealed in finished work.

5.1.5 Provide irregular shaped units, staircase units and skirting base units and counter tops to the profiles of required shape, with arises sharp, true and matched at joints, polished exposed edges.

5.2 Beds and Backings

Where applicable, standard cementitious screed and mortar beds and backings, mixed and proportioned by volume shall be as follows:

ordinary Portland Cement	1 part
Sand:	3 parts
Water:	Clean, fresh and free from deleterious substances

5.3 Adhesives, Grouts and Sealants

Proprietary adhesives, joint grouts and sealants of approved type as required and recommended by the manufacturer for specific application shall be used. The colour of the joint grout and the sealants shall match with the colour of stone.

5.4 Setting Shims or Buttons

Lead buttons of the thickness required for the joint size shown or specified, and of the size required to maintain uniform joint width.

5.5 Connection Materials

Provide necessary anchorages loose steel plates, clip angles, seat angles, anchors, dowels, clamps, hangers, and other miscellaneous steel shapes for securing marble units to other supporting and adjacent members. Provide at least two anchors for each piece.

6 FABRICATION

6.1 Fabrication Qualification

Fabrication of Marble shall be by a firm which has successfully fabricated marble similar to the quality specified for a period of not less than five years.

6.2 General

Fabricate as shown and as detailed as finial shop drawings. Provide holes and sinkages cut or drilled for anchors, fasteners and supports as shown and as necessary to secure marble in place. Cut and back check as required for proper fit and clearance. Shape beds to fit supports. Provide reinforcing backing as required for adequate strength firmly adhered in place.

6.3 Contiguous Work

Provide chars, reveals, openings and similar spaces and features as required for conuguow works.

Co-Ordinate with drawings and final shop drawings showing contiguous work.

6.3.1 Cut openings for lavatories, plumbing fittings and similar items indicated on the drawings, as specified in other drawings and as required.

7 EXECUTION

7.1 General

The Contractor shall employ skilled and trained marble workers for doing this job. He may be allowed to employ a specialist Sub-Contractor for this item of work with the approval of the Engineer. The surface over which marble slab/title are required to be fixed shall be clean of all dirt and dust and shall be properly hocked so that the mortar sticks well to the surface.

Do not use marble Slab/Tile with chips, cracks, stains or other defects which might be visible in the finished work. Clean stone before setting by thoroughly scrubbing with fiber brush followed by a through drenching with clear water.

7.2 **Paving, Flooring, Skirting and Stair**

Apply cement slurry coat over surfaces of concrete substrate immediately prior to placing setting bed. Limit area of application to avoid premature drying out. Install setting bed of required thickness and set stone units before initial set occurs. Apply a thin layer of cement paste to bottom of each unit. Set, tamp and level units immediately. Set units in required pattern with uniform joint widths.

Point joints as soon as possible after initial set. Force grout into joints, strike flush and tool slightly concave.

Remove mortar and grout from surfaces while still moist and as the work progresses.

Do not permit traffic on finished surface during setting and for a minimum of 24 hours after final pointing of joints.

7.2.1 **BASE**

The base in cement concrete if required, the sub base in brick ballast plus sand or lean concrete shall be prepared as provided in "Section Floor and Wall Finishes" cement concrete flooring. The thickness of sub-base if any and base shall be as shown on the drawings or directed by the Engineer. The surface of the concrete base shall be rough finished. The curing period of the base shall be at least 72 hours before laying the marble work.

7.3 **Repair and Cleaning**

Remove and replace marble units which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units which do not match adjoining stonework or are not in line and level as shown on Drawings. Provide new matching units, install and point joints to eliminate evidence of replacement. Repoint defective and unsatisfactory joints to provide neat, uniform appearance.

Clean stonework not less than 6 days after completion of work, using clean water and bristle brushes. Do not use wire brushes, acid or caustic type cleaning agents or other cleaning compounds which may be detrimental to the stone finish or joint grout.

7.4 **FINISHING AND POLISHING**

The Contractor shall make suitable arrangements for giving final finish to the marble tile work such as cleaning, washing and chemical polishing as specified or as directed by the Engineer.

The marble shall be polish finished to a glossy surface that will reflect light to emphasize the colour and marking, produced by a chemical polish applied to a honed surface. All finished surfaces shall be of uniform texture, colour and appearance and shall be in conformity with the sample approved by the Engineer.

7.5 **Protection**

Provide covers, boards, supports and all other necessary materials to protect finished work from collapse, deterioration, discoloration or damage during installation and until contract completion.

8 MEASUREMENT AND PAYMENT

8.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included "Instructions to Tenderers" are attached.

- Finishing, washing, polishing, repair cleaning and protection of marble slab, tiles, in position.
- Appropriate adhesives, joint grouts and sealants for fixing marble tiles, where specified on the Drawings or directed by the Engineer.
- 3:4 thick 1:3 cement sand setting mortar for marble stone/tiles.
- Preparation of concrete substrate for laying marble tiles on floor.
- M.S. angle framing and fixing accessories for marble slab on vanity counter if required
- Cost of factory chemical polish for pre polished marble tile/ slab.

8.2 Marble Slab on Vanity, Kitchen, and Reception Counter

8.2.1 Measurement

Measurement of acceptably completed works of marble slab on Vanity, Kitchen and Reception Counter, will be made on the basis of net actual area in square feet of marble slab provided and laid in position as shown on the Drawings or as directed by the Engineer.

8.2.2 Payment

Payment will be made for acceptably measured quantity of marble slab on Vanity, Kitchen and Reception Counter, will be made 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.

SECTION - 6560
FALSE CEILING

1 SCOPE

The work under this section of the specifications, consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with providing and installing different types of false ceiling including suspension system complete as shown on the drawing, specified herein and/or as directed by the Engineer.

2 CODES AND STANDARDS

The following Codes and Standards shall be followed wherever relevant and applicable and/or as directed by the Engineer.

CP 290-73	Suspended Ceilings and linings of dry construction using metal fixing systems.
BS 443-82	Specifications for testing zinc coatings on steel wire and for quality requirements.
BS 729-71	Hot dip galvanized coatings on iron and steel articles.
BS 1369-47	Metal lathing (steel) for plastering
ASTM C841-81	Installation of interior lathing and furring
ASTM C847-77	Specifications for Metal lath
BS 1191	Gypsum plaster for building Part I & II
ASTM C-28	Gypsum Plaster
ISO 3048	Gypsum plaster general best conditions
ISO 3049	Gypsum plaster-Determination of physical properties of powder.
ISO 3051	Gypsum plaster-Determination of mechanical properties.
ISO 3052	Gypsum plaster-Determination of water and crystallization.

3 SUBMITTALS

3.1 Shop drawings shall be submitted showing reflected ceiling plan, locations of built-in products and access facilities, dimensions, layout arrangements, hanger locations, structural connection, details of level changes, direction of pattern and panel joint details. The shop drawings shall be got approved by the Contractor from the Engineer in advance of under taking this item of works.

3.2 Catalogue, data of standard products and printed installation instructions of the ceiling manufacturer shall be submitted for approval of the Engineer well before commencing of works.

3.3 No materials shall be procured prior to approval of shop drawings and details.

3.4 The Contractor shall incorporate the required access panels of all types of false ceiling in shop drawings.

4 PRODUCT DELIVERY, STORAGE AND HANDLING

4.1 Material shall be delivered in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating.

4.2 Material shall be stored in original protective packaging to prevent soiling, physical damage or wetting.

4.3 Cartons shall be stored in the installation area, opened at each end to stabilize moisture content and temperature, for 48 hours prior to installation.

5 QUALITY ASSURANCE

5.1 Installer Qualifications

Workmen shall be skilled , well trained and experienced in their respective crafts and familiar with specified requirements and methods.

5.2 Manufacturer to be Approved

For hangers, aluminium metal suspension system, panels, air distribution boxes and other accessories the manufacturer shall be the one approved by the Engineer.

5.3 Tolerances

Suspension system components, hangers, fastening devices, supporting light fixtures, metal pan tiles and others shall be so installed that maximum deflection is not more than 1/360th of the span. Allowable tolerance of furnished ceiling system shall be level to within 3 mm in 4m.

5.4 Warranty

Ceiling system materials shall be guaranteed by the manufacturer for 5 years.

6 JOBSITE CONDITIONS

6.1 Work which will be concealed by false ceilings shall be completed, tested, inspected and accepted before ceiling work is started.

6.2 False ceiling installation shall not begin until the area has been closed in, and temperature and humidity approximate occupancy conditions. Wet work shall be cured and dry before ceiling work is started.

6.3 Surface which will support the ceilings, and those to which the ceiling abut, shall be inspected and accepted for completeness and adequacy to receive the ceilings before the work begins.

7 MATERIALS

7.1 SUSPENSION SYSTEM

a) **Suspension System for Acoustic Tiles**

It shall be the Reveal T-Bar system comprising of main T- Bars and Cross T-Bars including the hold down clips for the tiles.

b) **Hangers**

This shall be 8 SWG steel wire or 10 SWG steel bars galvanized to B.S. 443. Attachments and metal accessories shall be provided in accordance with manufacturer's recommendations.

c) **Suspension System for Solid Wood Boards And Sheets False Ceiling**

The partal wood frame of 2"x1½ @ 1/2x2 both ways shall be screwed to the side walls and suspended with appropriate hanging suspension system to the ceiling as directed by the Engineer.

d) **Metal Lath**

It shall be M.S. expanded diamond mesh type conforming to BS 1369 weighing 1.3 Kg/sq. meter. It shall be galvanized to BS 729.

7.2 ACOUSTIC CEILING(Dampa Type)

a) **Acoustic Tiles**

These shall be non-combustible mineral fiber (Select-Tone) reveal tiles. The surface pattern shall be Travertine- Delica or as approved by the Engineer with a dimension of 600 x 600 mm 16 mm thick, all four edges shall be revealed to be installed by an approved recessed suspension system. The tile shall have a factory applied washable white paint finish having a light reflectance of 75 degrees or more.

b) **Acoustic Ceiling**

These shall be 200 mm wide profiled units, manufactured from 0.55 mm aluminium strips. The units shall be perforated and shall have an inlay of pattern glued foil and a pad of mineral wool 12 mm thick. The units shall be chromated and stone enameled in white and manufactured by Dampa UK or Laxalon Sadi or approved equivalent.

7.3 WOODEN CEILING

a) **Wood**

It shall be best quality available wood as specified on the drawing.

b) **Chip Board and Lasani MDF Board**

It shall be of best quality available having uniform texture and thickness. The density of the chip board and Lasani Board shall be in the range of 800 Kg per cu. meter.

c) **Fiber Insulation Board**

It shall be 2 inch (50 mm) thick high density rigid panel and shall have high sound absorption efficiency as manufactured by Ownens Corning. Fiber glass Corporation U.S.A. or any other approved manufacturer.

7.4 **PLASTER OF PARIS**

Plaster of Paris tiles/panels shall be made of calcium sulphate hemihydrate and it shall conform to BS 1191. Most of the panels shall be reinforced with hesssian cloth. The special panels which have long span shall be reinforced with BRC Wire mesh D-83.

The Contractor shall use rubber/rubber lined mold for casting the specified size of Plaster of Paris tiles/panels.

Materials shall conform to the applicable provisions of BS-CP 29.

7.5 **SHEET FALSE CEILING**

The asbestos cement sheet hard board or other sheets for false ceiling shall be of the approved pattern, size and thickness.

8 EXECUTION

8.1 GENERAL REQUIREMENTS

a) False ceiling shall be installed wherever indicated on the Drawings.

b) Temperature shall be maintained at 10 degrees centigrade or above while system is being installed.

c) Application of ceiling units shall be done in strict accordance with the manufacturer's specifications unless otherwise modified.

d) Ceiling units shall be Installed in a true and even plane, in straight line, courses laid out symmetrically about centre lines of ceiling or panels.

e) Reinforcement shall be provided around openings of electrical lighting, air diffusers and access panels as indicated and shown on the Drawings.

f) Reinforced bracing for hanger bolts shall be provided where the height of space in ceiling is more than 1.5 meters.

g) Anti-corrosive paint shall be provided at welding points.

h) Access panels shall be furnished and installed as shown on the Drawings in strict accordance with the manufacturer's specifications.

8.2 INSTALLATION OF ACOUSTIC TILES AND CEILING

False ceiling suspension system and panels shall be installed in accordance with the requirements of BS-CP.290 and with the manufacturer's recommendations as approved by the Engineer. Engineer shall be notified of any discrepancies which preclude installation in patterns shown prior to execution of Work.

a) The hangers as specified shall be evenly disposed as per Shop Drawings and placed in position as indicated at the time of concrete pour of R.C.C. roofing structure. Their lengths clear of roofing slab shall be as per Shop Drawing.

b) The framing shall be of the specified section and run at spacing as per Shop Drawings. The jointing of battens to hangers and the extra framing if required shall be provided for light receptacles/air- conditioning as per approved Shop Drawings.

c) Wall angles shall be positively and rigidly connected to the structure and to cross runners.

d) Tiles shall be installed in the grid system after completion of installation of the suspension, lighting fixtures and ventilating unit.

e) Forming ceiling panels shall be laid out in pattern including border of uniform width around all sides of each ceiling area. The pattern shall be as per approved Shop Drawings.

8.3 INSTALLATION OF WOODEN & FIBER BOARDS FALSE CEILING

a) **Wooden**

The Partal wood frame of 2”x1 ½ @ 2’ x 2’ both ways shall be screwed to the side walls and suspended with appropriate hanging suspension system to the ceiling. The lasani MDF Board of specified thickness as shown on the Drawings shall be screwed to the wooden frame. The deodar wood strips 2” x ½ “ thick of specified length shall be then glued to Lasani MDF board by approved adhesive and nailed with headless nails and polished/painted as directed by the Engineer.

b) **Fiber Boards**

Chip Board panels of size shown on the Drawings shall be first screwed to the wooden structure provided for the ceiling. Fiber glass insulation board shall then be glued to the chip board by an approved adhesive. Adhesive shall be applied around the panel perimeter using a minimum of 10 mm dia bead of adhesive and a maximum of 300 mm length wise.

8.4 **PLASTER OF PARIS**

600x600x25mm plain or patterned plaster of Paris tiles equally and proportionally divided with joint and groves as per approved drawing shall be screwed with wooden frame. The plaster of Paris cornice tiles with approved pattern design and groves shall also screwed to wood framing and walls. The groves in panel and cornice shall be painted with two coats of golden lacquered or as approved by the Engineer.

8.5 **METAL LATH PLASTER CEILING**

Metal lath plaster ceiling shall consist of expanded galvanized metal lath suspended to an approved framing system consisting of main runners and cross runners of steel channels, bars, clips or other devices as approved by the Engineer.

15mm thick cement sand plaster in the mortar ratio of 1:4 shall be applied smooth over metal lath to completely cover both internal and external surfaces of the metal lath. Ceiling shall be applied with two coats of approved paint and finished fine, smooth to the acceptance of the Engineer.

9 INSTRUCTIONS

a) Light fixtures and ventilating units shall be installed in grid pattern shown and supported in accordance with the manufacturer's recommendations.

b) After installation, dirty, soiled or discolored surfaces shall be cleaned and left free from defects and ready to receive any painted finish if required.

c) The panels which are damaged or improperly installed shall be removed and replaced by the Contractor at his own cost.

10 MEASUREMENT AND PAYMENT

10.1 General

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

- G.I. hanging system, M.S. strip hangers and anchor bolts, steel channels, bars, clips etc.
- Partal wood framing.
- Lasni MDF Board
- Polishing/Painting to false ceiling.
- Deodar wooden strips.
- Provision of extra framing for light points, columns etc.
- Headless nails and adhesive

10.2 **False Ceiling**

10.2.1 **Measurement**

Measurement of acceptably completed works of false ceiling will be made on the basis of net actual area in square feet of false ceiling provided and installed in position as shown on the Drawings or as directed by the Engineer.

10.2.2 **Payment**

Payment will be made for acceptable measured quantity of false ceiling on the basis of unit rate per square foot quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 6600
FLOOR AND WALL FINISHES

1 SCOPE

The work done under this section of the Specification consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in connection with the installation of cement concrete floors and floor finishes including bases, skirting wainscots and exterior wall finishes complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract. The scope of this section of specifications is covered with detailed specifications as laid down herein.

2 APPLICABLE STANDARDS

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

Pakistan Standard

232 Ordinary Portland Cement

511 Terrazzo tiles

531 Cement Concrete Floor Tiles

ISO (International Organization for Standardization

R 680 Chemical analysis of cements Main constituents of Portland Cement.

R 681 Chemical analysis of cements Minor constituents of Portland cement.

ASTM (American Society for Testing and Materials)

C 482 Bond strength of ceramic tile to Portland cement.

C 648 Breaking strength of ceramic tile.

C 650 Resistance of ceramic tile to chemical substances.

C 798 Colour permanency of glazed ceramic tile.

D 2859 Flammability of finished materials vinyl-asbestos tile or flooring.

D 3564 Application of floor polishes to maintain vinyl- asbestos tile or flooring.

E 84 Surface burning characteristics of building materials

F 141 Resilient floor coverings, definitions of terms.

F 510 Resistance to abrasion of resilient floor coverings.

BSI (British Standards Institutions)

882 Pt.2 Course and fine aggregates from natural sources.

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

1201Pt.2 Aggregates for granulithic concrete floor finishes.

1281 Glazed ceramic tiles and tile fittings for internal walls.

1286 Clay tiles for flooring

3260 PVC (vinyl) asbestos floor tiles.

3261 Unpacked flexible PVC flooring.

5385	Internal Ceramic wall tilling and mosaics in normal conditions.
5442	Classification of adhesives for use in Construction pt-1 Adhesives for use.
203	Sheet and Tile flooring
204	In-situ Floor Finishes.
209 Pt.1	Care and Maintenance of floor surface, wooden flooring.

3 SUBMITTALS

Prior to the execution of work and sufficiently in advance, the Contractor shall submit to the Engineer:

3.1 Methodology

Method statements detailing his proposed plans and programs in respect of all the important and critical items of work or parts thereof for technical scrutiny. He should obtain approval from the Engineer in time so that the Work schedule is not affected adversely.

3.2 Specimen Samples

Specimen samples of all the materials, elements, components and embedded parts (if any) for prior approval by the Engineer. The Contractor shall retain and store the approved samples throughout the entire period of Works. Three samples shall be submitted of each type of all available colour and pattern for approval.

3.3 Technical Literature

Technical literature, brochures and documents relevant to the items of Works and the materials or components that he intends to use in the Works. The literature shall include manufacturer's/supplier's specifications/ recommendations.

3.4 Test Certificates

Test Certificates in respect of the materials/products from the manufacturers/suppliers. In case of supplies, the Contractor shall ensure that the materials supplied are from genuine source and from the original manufacturers.

4 TOLERANCES

The tolerance in surface level of terrazzo and ceramic tiles shall be 1/8” (3mm) over a length of 10 feet (2 meters).

5 TESTING

5.1 Tiles

The Contractor shall provide samples of tiles for selection, testing and approval of the Engineer. The samples shall be in finished sizes and shapes and adequate in number for testing in the laboratory as and when ordered by the Engineer.

The Contractor may also be required to lay samples of finished items of tile work fixed in position before he is allowed to proceed with the work on a particular item.

5.2 **Adhesion to Base**

The adhesion between the screed or topping and base of tile shall be tested by tapping the surface with a rod or a hammer. A hollow sound shall be considered to indicate poor adhesion. When poor adhesion is accompanied by visible or measurable lifting of tiles at the edges of bays or the tile cracks then the adhesion shall be considered to be unsatisfactory and it shall be necessary to renew the whole of the affected bay or bays.

6 DELIVERY AND STORAGE

6.1 Materials shall be delivered in manufacturer's original sealed containers with labels intact and legible, identifying brand name and contents.

6.2 Manufactured materials shall be protected from moisture and extreme of heat and cold.

6.3 The aggregate shall be stored on properly constructed paving as directed by the Engineer.

6.4 There shall be a physical partition between the stockpiles of coarse and fine aggregate.

7 MATERIAL

7.1 **Gray/ White Cement**

Cement shall be ordinary Portland cement conforming to B.S. 12 or PS 232.

7.2 **Sand**

All fine sand shall be obtained from sources approved by the Engineer. The grading shall conform to B.S 882 Grading Zone 1 and 2 of which the gradation limits are as follows:

Percentage (by weight) passing

Sieve	Grading Zone 1	Grading Zone 2
3/8" (9.53mm)	100	100
3/16” (4.76mm)	90-100	90-100
No. 7	60- 95	75-100
No. 14	30- 70	55- 90
No. 25	15- 34	35- 59
No. 52	5- 20	8- 30
No. 100	0- 10	0- 10

7.3 **Coarse Aggregate** :

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone, angular or rounded in shape and shall have granular, crystalline or smooth surface free from friable, flaky and laminated pieces, mica and shale. It shall not contain matters injurious to concrete. All coarse aggregate shall conform to BSS NO.882 and shall be graded as follows:

Sieve	% Passing by weight
25.40mm (1")	100
19mm (3/4")	90-100
9mm (3/8")	20- 55
4.67mm (3/16")	0- 10

The aggregate shall be stored on properly constructed paving or as directed by the Engineer.

There shall be a physical partition between the stockpiles of coarse and fine aggregate. If required aggregates shall be washed and screened to the satisfaction of the Engineer. Sieve analysis of all the aggregates to be used in the works and shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer.

Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall be removed from site with-out delay.

Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuilt at the expense of the Contractor.

7.4 **Brick Ballast** :

Brick Ballast as Sub base of floors shall be obtained from well burnt or over burnt bricks which are hard, durable and strong. Brick ballast shall be free from impurities, quarry sap , dust, dirt and solubility characteristics

7.5 **Water**

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solutions or in suspension. Only water of the approved quality shall be used for all constructional purposes.

7.6 **Terrazzo Tiles**

Terrazzo tiles shall be first grade mechanically compressed type conforming to PS-531. Tiles shall be of sizes specified on the drawings with a topping of ½" (10mm) thickness composed of 1:2 cement marble chips, the base being 1:2 cement mortar. The colour quality and size of chips and colour of cement shall be as per approved sample.

7.7 **Ceramic Tiles (Glazed , Matt tiles)**

Ceramic tiles shall be export quality white or colored. The size, colour pattern and shade of Ceramic tiles shall be selected and approved by the Engineer, and shall conform to BS 1281 as per samples.

7.8 **Cleaning Compound**

The compound used for cleaning of terrazzo shall be an approved neutral chemical cleaner free from acid and alkali or any other material that will affect the colour or otherwise damage the terrazzo and shall not affect the conductivity of terrazzo floors.

7.9 **Division Floor Strips**

7.9.1 **Glass Floor Division Strips**

Division strips of glass shall be cut from 5mm thick plate glass in widths as specified in the drawings or as directed by the Engineer.

7.9.2 **Brass or Aluminium Floor Division Strips**

Floor dividing strips of brass and aluminium shall be at least 1/8 inch (3 mm) thick and 1½ inch (38 mm) wide or as required in the drawings.

7.9.3 **Marble Floor Division Strips**

The marble dividing strips shall be ½ inch (12mm) thick and 1½ inch (38 mm) wide or as directed by the Engineer.

7.9.4 **Pigment and Joint Filler**

The mineral pigment for closuring the matrix of terrazzo shall be of the best quality, purity and shall be alkali resistant, sun proof and lime proof with a specific gravity similar to that of Portland cement.

Joint filler shall be white Portland cement grout which shall bond to dry tile, shall be non- shrinking, stain resistant, permanent in colour and shall not in habit fungus and bacterial growth. It shall be odorless and non-toxic, of smooth consistency for early preparation and neat rapid installation and shall contain non-metallic material. Grout shall be water resistant and shall not wash out under water.

Commercial product for polish shall be of the best quality as approved by the Engineer.

7.10 **Marble Chips**

Marble chips shall be crushed marble of specified grade and colour shall be of approved quality from quarries in Pakistan. It shall have an abrasive hardness of not less than 16. Before any material is purchased, the contractor shall submit to the Engineer for approval samples in duplicate. The material used in the work shall correspond with the approved samples in quality, colour texture and finishes etc.

7.11 **Pre-cast concrete interlock Pavers**

The type, colour, pattern and shade of Pavers shall be selected and approved by the Engineer The minimum compressive strength of interlock pavers shall be 7000psi.as approved by the Engineer.

7.12 The pre casts cement concrete tiles (clad stone) for the floors and walls shall be from the approved manufacturers.

The size, colour, shade and patterns shall be as shown on the drawings and as approved by the Engineer.

8 EXECUTION

8.1 **CEMENT CONCRETE FLOORING**

The materials for P.C.C flooring shall be same as already specified under clause 7, **"Materials"**.

8.1.1 **Preparation**

The ground surface shall be cleared and grubbed of top soil and all grass, roots and loose material removed in any. Surface shall be dry, leveled and any fill or backfill under the floors done as per section Earth work Sub-Section 6 of these Specifications.

8.1.2 **Sub-Base**

The floor sub base shall be either brick ballast or lean concrete or R.C.C Slab as shown in the drawings.

8.1.2.1 **Brick Ballast**

The brick ballast shall be of 1:6:12 using coarse aggregate as brick ballast and laid in position. It shall be properly watered and rammed to get the required thickness.

8.1.2.2 **Lean Concrete**

Lean concrete shall have a strength of 1000psi., and shall conform to Section Plain and Reinforced Concrete of these

Specifications. It will be screeded in position to required depth and or surface elevations.

The surface of the sub base concrete shall be brushed with a stiff broom just before it hardened to remove all litanies and loose aggregate and at the same time to roughen the surface to improve the bond. The hardened base shall be thoroughly cleaned, wetted preferably overnight, the surplus water removed and a grout of cement and water brushed into the surface just ahead of the application of the topping.

8.1.3 **Panels**

Before laying the cement concrete flooring, the surface of the sub-base shall be divided into panels of required size as shown on the Drawings. Panels shall be made of plate glass, division strips or as specified. The top of the division strips shall conform to the specified level of the finished floor surface.

8.1.4 **Floor**

Mixing and placing of first bottom layer of 3000psi. concrete shall be in accordance with **Section 2300**-**"Plain and Reinforced concrete".** Concrete may be conveyed in any suitable manner from the place of mixing provided there is no segregation or loss of any ingredients and provided it is placed in its final position before initial setting takes place, that is within 30 minutes of addition of water to the mix. The concrete will be laid in a manner so as not to cause the aggregate to separate from the mortar and laid in alternate panels, each panel shall not exceed the area as directed by the Engineer. Dividing strips shall be provided unless otherwise specified on the Drawings and BOQ. The floor concrete panels shall have the thickness as shown on the Drawings. The concrete shall be rammed and thoroughly consolidated and finished rough.

8.1.5 **Finishing**

Immediately after consolidation, the surface, shall be leveled with a wooden trowel. Excessive trowelling in the early stage shall be avoided. The surface shall be tested with a straight edge to detect undulations, which, if found, shall be eliminated. The finer components in the concrete which come to the surface with the stroking shall be quickly but carefully smoothed with the steel trowel. When the concrete has hardened sufficiently, trowelling shall be done with steel trowels. No dry cement or a mixture of dry cement with sand shall be sprinkled on the surface for hardening the surface.

8.1.6 **Dado/Skirting**

The plaster on the portion of the wall to be provided with skirting or dado shall be left in a rough state by brooming or by using wire brushes of approved type so as to provide a bond between this base plaster and the dado or skirting. The surface of the wall shall be cleaned of all foreign matter and shall be thoroughly wetted to control the suction. Only so much mix shall be mixed with water that could be utilized within 30 minutes. This mix of cement and coarse sand in the ratio of 1:2 shall be applied to the wall in a thickness as specified and trowelled hard to a smooth surface, proper in line both vertical and horizontal.

8.1.7 **Curing**

Curing shall be carried out in accordance with the Specifications given under Section - Plain and Reinforced Concrete.

INSTALLATION OF TILE FLOORING

The base in cement concrete and if required the sub-base in lean concrete shall be prepared as provided in Sub-Section 8.1 "Cement Concrete flooring". The thickness of sub-base if any and base shall be as shown in the Drawings, BOQ or directed by the Engineer. The surface of concrete base shall be rough finished. The curing period of base shall be at least 72 hours before laying the tile work.

8.1.8 **General**

The sub-base and base shall be prepared by laying cement concrete of specified grade and thickness as shown on the drawings, or as specified in the Bill of Quantities.

The Tiles shall be laid to the required levels and grades over a setting bed of ¾" thick cement sand screed comprising of one part cement to three part of sand of volume unless otherwise shown in the Drawings or specified in the BOQ. 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. The thickness of setting bed in any space shall not be less than ½" or as shown on the drawings.

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 an outward direction and the pattern should be made symmetrical with a minimum number of cut tiles and shall be laid to straight edges. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth.

After each piece is laid, it shall be firmly pressed into place so as to embed it and to even the surface before the mortar takes its initial sating.

Joints between the tiles shall be of uniform width and shall be grouted full with a plastic mix of grey or white cement (as directed by the Engineer) immediately after a suitable area of tiles has been set.

8.1.9 **Terrazzo Tiles**

The terrazzo tiles will be laid to the required lines, levels and grades over a setting bed of ¾ inch thick cement sand mortar. The thickness of cement concrete sub-base and base shall be as per Bill of Quantities.

After seven days of tile laying, the terrazzo tile floors shall be machine grinded 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 cement mortar of the same colour 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 grinded and rubbed by hand. After the floor has been machine finished, it should be covered with white, non-staining sand or rags to protect it while other work is being done. After removal, the floor shall be thoroughly scrubbed. The final gloss shall be given by chemical polishing the surface to the satisfaction of the Engineer. Preservative treatment for terrazzo floor shall produce a water-proof finish which will not be impaired by immersion in water at room temperature for a period of 2.5 hours, approximately 18 hours after the floor is finished by buffing, as specified. The preservative material shall not discolor

the buffing, as specified the terrazzo nor leave a tacky or sticky finished film on the surface after buffing.

8.1.10 **Ceramic Tiles**

The glazed and matt finished ceramic tiles shall be laid to the required lines, levels and grades over a setting bed of cement sand mortar comprising of one part of cement and 3 parts of sand by volume and the joints filled with neat white cement mixing with matching colour pigment including vertical and horizontal covers. The tile floor/wall shall be kept wet for at least 72 hours and no traffic should be allowed on the tiles during curing period.

8.2 TERRAZZO CAST IN-SITU

8.2.1 FLOORING

8.2.1.1 Mix

The terrazzo mixes shall be composed by volume as follows:

8.2.1.1.1 Plain terrazzo for all floors and basis indicated as terrazzo and not otherwise specified, shall be composed of one part cement (white or gray) and 2 parts of marble chips of the sizes colours and pigment as shown on the Drawings specified in BOQ specified and/or as directed by the Engineer.

8.2.1.2 Preparation for Terrazzo

The grade and thickness of sub-base and base concrete as shown on the drawings shall be laid to receive terrazzo. The surface of the bed shall be roughened for bounding with the terrazzo finish. If the surface is too smooth it shall be roughened with a toothed chisel and, prior to laying the terrazzo the bed shall be cleared of all dirt, oil grease and extra loose material.

8.2.1.3 Division Strips

The under bed consisting of 3000 psi. concrete screed shall be spread and brought to a level not less than ½ inch (15mm) below the finished floor level, the dividing strips shall be installed in the green under bed.

Terrazzo floors under bed shall be divided by marble/glass, aluminium/brass strips as specified and approved by the Engineer. The division strips between field work and borders shall have exposed tops in full width of the strips. The strips being partially embedded therein, securely anchored to the under bed and grouted solid.

All division strips shall be set, straight to lines and to the proper level to ensure that the tops of the strips will show uniformly after grinding and smoothening operations are completed and joints and intersections shall be fitted tight. Strips shall be braced to prevent bulging during the placing of terrazzo.

Unless otherwise shown on the drawings, the divisions in field work of large areas shall not exceed 3ft x 3ft and in small areas shall not exceed 2ft x 2 ft

Edging strips shall be placed at door ways between terrazzo and types of flooring and along the edges of all terrazzo bases or borders and adjoining other types of floor finishes or floor

covering. The edging strips at door ways shall be placed in line with the step face of doors. All edging strips shall be anchored and grouted solid in the under bed or to the concrete sub- floor and braced to prevent bulging as specified for divisions strip.

8.2.1.4 **Laying Terrazzo**

The sub-surface shall be swept clean, thoroughly moistened, but not saturated, and slushed with a coating of neat cement grout approximately 1/8 inch (3 mm) in thickness. The under bed consisting of 3000 psi. concrete screed shall be spread and brought to a level not less than ½ Inch (15mm) below the finished floor level, the dividing strips shall be installed in the green underbid. The cement and marble must be mixed dry in such quantities as are sufficient for a unit of specified shade. Water shall be added to only such quantities as can be mixed thoroughly and consumed in less than 30 minutes, the quantity of water being the minimum for workability. Mixing must be done on water tight platform and any mix not used within 30 minutes shall be discarded and removed from the Site. A layer of cement and marble chipping mixture should be well trowelled into the surface of the base concrete before filling to the top level of the screeds. The layer should be well compacted and all voids shall be filled in. A layer of neat cement, of the specified colour shall then be well trowelled into the surface leaving a plain smooth surface.

8.2.1.5 **Seasoning**

The completed terrazzo shall be allowed to season for 6 days during which time it shall be kept moist and free of traffic. The curing shall be accompanied by **(1)** covering with approximately one inch thickness of sand: or **(2)** covering with building paper or mats; or **(3)** springing with water at every 10 hour interval.

8.2.1.6 **Surface**

Following the curing period, the terrazzo shall be machine ground to a true, even surface using a No.24 grit followed by a No. 80 grit or finer abrasive stone. After the first grinding, the floors shall be thoroughly grouted with the same cement and colour composition as specified for the matrix of the terrazzo mix. The grout shall be of the consistency of thick cream, and shall be brushed over the floor to eliminate all pits and thoroughly fill the surface for final grinding.

8.2.1.7 **Finishing**

Not less than 72 hours after application, the grouting coat shall be removed by grinding. In the later stages of grinding, the grit stones or other abrasive used in the grinding machine shall be of a grain of fineness that will give the surface smooth finish. Small areas, inaccessible portions and corners which cannot be reached by the grinding machine shall be grinned and rubbed by hand.

8.2.2 **Terrazzo Dado and Skirting**

The plastered surface over which the dado/skirting is to be applied shall be well roughened and watered, cement mortar of specified ratio shall then be plastered over this well roughened surface to the indicated thickness. Before the base course has set the layer of

terrazzo mixture shall be well trowelled into the surface of the base to a thickness which after grinding shall result in the finished thickness. A layer of neat cement of the specified colour shall then be well trowelled into the surface leaving a plain smooth surface. After the period specified for floors above, the Contractor shall start finishing as for floors specified above. Terrazzo skirting shall be provided around all terrazzo floors unless shown otherwise. Skirting and dado shall be straight, level and in plumb. Intersections at floors shall be straight and flush.

8.2.3 **Terrazzo 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, and shall be protected by aluminium angles as specified or shown on the Drawings. The angles shall be firmly secured, by means of counter-sunk brass screws, and cast together with the step.

8.2.4 **Washed Terrazzo On Walls**

The work to be done by the contractor consists of providing ¾" thick washed terrazzo in white cement with approved pigment, laid on ½" rough plaster in 1:3 cement sand mortar in panels with ¾"x ¾" thick Aluminium "U" channel on walls, and other surface as shown on the Drawings.

8.2.4.1 **Sub Grade**

The sub grade under terrazzo top shall be ½ thick cement sand rough plaster in 1:3. The sub grade shall be constructed in accordance with the applicable stipulations and requirements of section Cement Plaster of these specifications. The sub grade surface shall be kept wet for proper adhesion of terrazzo topping, which shall be laid when the sub grade is still green.

8.2.4.2 **Topping**

The terrazzo topping shall consist of one part of white cement and one and half parts of marble chips mixed by volume with approved water cement ratio. The dividing panels of Aluminium "U" section shall be fixed with stainless steel or brass screw in the size as directed by the Engineer. Before laying terrazzo topping the surface shall be thoroughly cleaned so as to be free from dust or foreign matter. The topping shall be laid while the bottom sub grade surface is still plastic preferably the next day, after the sub grade is laid if the surface is not plastic a slurry of neat cement shall be brushed on to it immediately before the topping is laid.

8.2.4.3 Rough Finish

Before the terrazzo is hardened the top surface shall be brushed down, plenty of water being used in this process. The brushing shall continue till the matrix is removed and each piece of marble chips is clearly exposed. If brushing of surface does not produce desired results tooling process shall be carried out by Kango Hammer. After whole of the area is evenly exposed the surface shall be sprayed with water and lightly brushed down cleaning all the adhering mortar and revealing the true colour on the marble chips.

8.3 Protection

All surfaces of the finished work of other trades shall be properly protected from damage and spoiling during the process of grinding and washing of the terrazzo.

After the final grinding has been completed and the surface treatment and polish applied, the terrazzo work shall be covered and protected with material approved by the Engineer until completion of the work of all other trades.

8.4 Cleaning and Coating

Prior to placing the protective covering, the terrazzo floor shall be approved by the Engineer. After the work of all other trades has been completed and the protective covering removed, all terrazzo work shall be washed with cleaning compound, mixed with water and using a fine abrasive where necessary to remove any stains or cement smears. The terrazzo shall be allowed to dry thoroughly and shall be given a sealing application of preservative material. The sealing material shall be applied in accordance with the manufacturer's directions, leaving all terrazzo work in clean condition as approved by the Engineer. The final glass shall be given by polishing with chemical polish the surface, with was polish of approved manufacturer, to the satisfaction of the Engineer.

8.5 **PRE CAST CONCRETE INTERLOCK PAVERS**

The pre cast interlock concrete pavers of specified size, shape and colour 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 pavers shall be filled with neat sand.

The laid pavers 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.

8.6 **PRE CAST CEMENT CONCRETE TILES ON FLOOR AND WALLS**

The sub-base and base shall be prepared by laying cement concrete of specified grade and thickness as shown on the drawings, or specified in the Bill of Quantities.

The Tiles shall be laid to the required levels and grades over a setting bed of ¾" thick cement sand screed comprising of one part cement to three part of sand of volume unless otherwise shown in the Drawings or specified in the Bill of Quantities. 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. The thickness of setting bed in any space shall not be less than ½" or as shown on the drawings.

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 an outward direction and the pattern should be made symmetrical with a minimum number of cut tiles and shall be laid to straight edges. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth.

After each piece is laid, it shall be firmly pressed into place so as to embed it and to even the surface before the mortar takes its initial sating.

Joints between the tiles shall be of uniform width and shall be grouted full with a plastic mix of neat grey or white cement (as directed by the Engineer) immediately after a suitable area of tiles has been set.

9 MEASUREMENT AND PAYMENT

9.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities.

he cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

9.1.1 Loss and wastage of material due to consolidation, erosion, settlement and during transportation.

9.1.2 All type of joints (expansion, contraction and construction joint etc.).

9.1.3 1:3 cement sand setting mortar.

9.1.4 Finishing, washing and polishing works of ceramic tiles and washed terrazzo on wall..

9.1.5 Rough plaster and Cement sand mortar as Adhesive for fixing of tiles.

9.1.6 Any steel sec. for fixing of tiles on wall.

9.1.7 6 Inch (100 mm) thick Setting bed of crushed stone and 2 inch (50 mm) thick sand for interlock pavers.

9.1.8 Providing & fixing of specified dividing strips for cast in situ terrazzo.

9.1.9 3000 psi. cement concrete as base for terrazzo or any type of floor. .

9.1.10 Colour Pigment.

9.1.11 Aluminium “U” channel and ½ inch (12mm) thick rough plaster for Washed terrazzo on wall.

9.2 Tiles on floor

9.2.1 Measurement

Measurement of acceptably completed works of respective type of tile 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.

9.2.2 Payment

Payment will be made for acceptable measured quantity of respective type of tile on floor the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.3 Tiles on walls

9.3.1 Measurement

Measurement of acceptably completed works of respective type of tiles in dado and on wall will be made on the basis of net actual area in square feet laid in position to the line, level & grade as shown on the Drawing and as directed by the Engineer.

9.3.2 Payment

Payment will be made for acceptable measured quantity of respective type of tile in dado and on walls on the basis of unit rate per square feet

quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the items.

9.4 **Terrazzo Skirting/Dado**

9.4.1 **Measurement**

Measurement of acceptably completed works of Terrazzo skirting/ dado will be made on the basis of net actual area in square feet laid in position to the line, level & grade as shown on the Drawing and as directed by the Engineer.

9.4.2 **Payment**

Payment will be made for acceptable measured quantity of Terrazzo skirting/dado on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the items.

9.5 **Terrazzo Cast-in-situ Floor**

9.5.1 **Measurement**

Measurement of acceptably completed works of Terrazzo Cast-in-situ 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.

9.5.2 **Payment**

Payment will be made for acceptable measured of Terrazzo Cast-in-situ floor on the basis of unit rate per feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.6 **Terrazzo Tiles.**

9.6.1 **Measurement**

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.

9.6.2 **Payment**

Payment will be made for acceptable measured of Terrazzo Tiles floor on the basis of unit rate per feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.7 **P.C.C Floor**

9.7.1 **Measurement**

Measurement of acceptably completed works of P.C.C 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.

9.7.2 **Payment**

Payment will be made for acceptably measured quantities of P.C.C floor will be made 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.

9.8 **Washed Terrazzo on walls**

9.8.1 **Measurement**

Measurement of acceptably completed works of washed terrazzo on walls will be made on the basis of net actual area in square feet, laid in position to the line & level as shown on the Drawing or as directed by the Engineer.

9.8.2 **Payment**

Payment will be made for acceptably measured quantities of washed terrazzo will be made 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.

9.9 **Ceramic Tile Decorative Border**

9.9.1 **Measurement**

Measurement of acceptably completed works of Ceramic Tile Decorative Border on walls will be made on the basis of net actual Length in running feet, laid in position to the line & level as shown on the Drawing or as directed by the Engineer.

9.9.2 **Payment**

Payment will be made for acceptably measured quantities of Ceramic Tile Decorative Border will be made on the basis of unit rate per running feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 6700
PAINTING

1 SCOPE

The work under this section of the Specifications consists of furnishing all materials, plant, labour, equipment, appliances and performing all operations in connection with surface preparation, mixing, painting concrete works, Metalwork, wood works, Structural steel, walls, ceilings, pipes ,valves and all such surfaces as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

2 APPLICABLE STANDARDS

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

BSI (British Standards Institution)

245	Specification for mineral solvents (white spirits and related hydrocarbon solvents) for paints and other purposes.
2521	Lead-based priming paint for wood work.
2523	Lead based priming paint for iron and steel.
2569	Sprayed metal coatings.
4800	Paint colours for building purposes.
CP. 231	Painting of building.
CP.3012	Cleaning and preparation of metal surfaces.

3 GENERAL

3.1 Except as otherwise specified, all painting shall be applied in conformity with BS CP 231 "Painting of Building" as applicable to the work.

3.2 The Contractor shall repair at his own expense all damaged or defective areas of shop-painted metal work and structural steelwork. Metal surfaces against which concrete is to be placed will be furnished shop-painted and shall be cleaned prior to being embedded in concrete.

3.3 Except as otherwise specified, all concrete and plastered surfaces are to be painted.

3.4 The Engineer will furnish a schedule of colours for each area and surface. All colours shall be mixed in accordance with the manufacturer's instructions.

3.5 Colours of priming coat (and body coat where specified, shall be lighter than those of finish coat. The Engineer shall have unlimited choice of colours.

3.6 Samples of all colours, and finishes shall be prepared in advance of requirement so as not to delay work and shall be submitted to the Engineer for approval before any work is commenced. Any work done without such approval shall be redone to the Engineer's satisfaction, without additional expense to the Employer. Samples of each type of paint shall be on separate 300 x 300 x 3 mm tempered hard board panels. Manufacturer's colour chart shall be submitted for colour specifications and selection.

4 MATERIALS

4.1 All materials shall be acceptable, proven, first grade products and shall meet or exceed the minimum standards of reputable manufacturers as approved by the Engineer.

4.2 Colours shall be pure, non-fading pigments, mildew-proof sun- proof, finely ground in approved medium. Colours used on- plaster and concrete surfaces shall be lime-proof. All materials shall be subject to the Engineer's approval.

4.3 All synthetic enamel paints and primers for structural steel works, metal work, will be the best available of its type and shall be approved by the Engineer prior to its procurement.

4.4 Unless otherwise specified on Drawings approved quality Durocem/snowcem paint or approved equivalent shall be used for painting the exteriors of the structures or other surfaces and/or as directed by the Engineer.

4.5 The plastic emulsion/weather shield/ vinyl emulsion paint or similar as approved by the Engineer shall be used for interior surfaces.

4.6 Approved quality plasticized Duco Hi Build paint or approved equivalent shall be used for painting the wooden doors or other wood surfaces as shown on the drawings or as directed by the Engineer.

4.7 Fire resistant painting shall be proprietary painting material to be applied in conformity with the recommendations and instructions of the manufacturers.

4.8 Where ever Multi-colour paint coating for interior is specified ZOLA COAT or equivalent as approved by the engineer is to be used. Painting shall be proprietary painting material to be applied in conformity with the recommendations and instructions of the manufacturers.

4.9 Where ever Textured roll on paint for interior is specified, ICI, Dulux or equivalent as approved by the Engineer to be used . Painting shall be proprietary painting material to be applied in conformity with the recommendations and instructions of the manufacturers.

4.10 All material shall be delivered to site in their original unbroken containers or packages and bear the manufacturer's name, label, brand and formula and will be mixed and applied in accordance with manufacturer’s recommendations.

4.11 All sprit polish or wax polish shall be first grade of reputable manufacturer as approved by the Engineer.

5 DELIVERY STORAGE AND CONTAINER SIZES

Paints shall be delivered to the site in sealed containers which plainly show the type of paint, colour (formula or specifications number) batch number, quantity, date of manufacture, name of manufacturer and instructions for use. Pigmented paints shall be supplied in containers not larger than 20 liters. All materials shall be stored under cover in a clean storage space which should be accessible at all times to the Engineer. If storage is allowed inside the building, floors shall be kept clean and free from paint spillage.

6 SURFACE PREPARATION

6.1 All oil, grease, dirt, dust, loose mill scale and any other foreign substance shall be removed from the surface to be painted, polished and white washed by the use of a solvent and clean wiping material. Following the solvent cleaning, the surfaces shall be cleaned by scrapping, chipping, blasting, wire brushing or other effective means as approved by the Engineer.

6.2 In the event the surfaces become otherwise contaminated in the interval between cleaning and painting, re-cleaning will be done by the Contractor at no additional cost.

6.3 Surfaces of stainless steel, aluminum, bronze, and machined surfaces adjacent to metal work being cleaned or painted shall be protected by effective masking or other suitable means, during the cleaning and painting operations.

6.4 All the surfaces to be painted with approved quality paint or approved equivalent shall be free from dust, dirt, fungus, lichen, algae etc. Oil paint, varnish and lime wash should always be removed by scraping and washing.

6.5 All surfaces to be painted with Duco paint or approved equivalent shall be free from dust, dirt, oil/grease, etc. Wipe over with a rag soaked in thinner or petrol before painting. The Contractor shall apply sufficient under coat to ensure that no dried film is left on all undercoated areas after flatting. Apply 2-3 coats of Duco Primer surfaces after thinning one part with one part Duco thinner. Dry for 5 to 10 minutes between coats. Leave it to hard dry and petrol wipe before applying Duco Hi-Build.

6.6 No work in this section shall be allowed until all surfaces or conditions have been inspected and approved by the Engineer.

7 APPLICATION

7.1 All paint and coating materials shall be in a thoroughly mixed condition at the time of application. All work shall be done in a workman like manner, leaving the finished surface free from drips, ridges, waves, laps, and brush marks. All paints shall be applied under dry and dust free conditions. Unless approved by the Engineer paint shall not be applied when the temperature of the metal or of the surrounding air is below 7 degrees centigrade. Surfaces shall be free from moisture at the time of painting.

All primary paint shall be applied by brushing. The first coat of paint shall be applied immediately after cleaning. When paint is applied by spraying, suitable measures shall be taken to prevent segregation of the paint in the container during painting operation.

Effective means shall be adopted for removing all free oil and moisture from the air supply lines of the spraying equipment.

Each coat of paint shall be allowed to dry or harden thoroughly before the succeeding coat is applied. Surfaces to be painted that will be inaccessible after installation shall be completely painted prior to installation.

Two coats of weather shield paint shall be applied in accordance with the manufacturer's instructions or as directed by the Engineer.

Only as much material should be mixed as can be used up in one hour. Over-thinning will not be permitted. After the first coat the surfaces will be soaked evenly four or five times and the second coat shall be applied after leaving for at least overnight.

7.2 Where shown on Drawings all exterior finishes shall be painted with Weather Shield paint in approved colours as per manufacturer's specifications. The number of coats shall be as shown on the drawings or as directed by the Engineer.

7.3 All wooden doors shall be painted with approved plasticized Duco Hi-Build paint or approved equivalent as per manufacturer's recommendation and instructions after approval of the Engineer.

7.4 Plastic emulsion paint of the approved make and shade shall be applied to surfaces as shown on Drawings as per manufacturer's instructions. The number of coat shall be as indicated on the Drawings or as directed by the Engineer.

7.5 Where mentioned on Drawings doors and glazed ventilators shall have fire resistant painting of 90 minute rating and shall be applied as per the manufacturer's recommendation and instructions after the Engineer's approval.

7.6 **POLISHING**

Surfaces to be polished shall be rubbed down with suitable sand paper to smooth surface. Filling shall be done with an approved filler and again rubbed so that the surface is smooth free from raised grains, holes, rough spots and gives a silky feeling. It shall then be finished with wax polish or spirit polish of approved manufacturer.

7.6.1 **WAX POLISH:**

The surfaces shall be dusted off and rubbed over with approved mineral oil. After an interval of at least 48 hours wax polish shall be applied in two coats and buffed to the approved finish.

7.6.2 **SPIRIT POLISH:**

Dana Lakh shall be melted in spirit overnight and clean sediment free spirit polish prepared. With a soft cloth or pad, the polish shall be applied to the surface coat after coat until the surface is shiny, smooth, satin finish to the approval of the Engineer

7.7 **WHITE OR COLOUR WASHING**

7.7.1 Fresh white lime slaked at site of work should be mixed with sufficient water to make a thin cream. The approximate quantity of water required in making the cream is 5 liter of water to 1 kg of lime. It shall then be screened through a coarse cloth and gum (glue) in the proportion of 1`00 grams of gum to 16 liters (three chattacks of gum to 6 gallon) of wash shall be added. The surface should be dry and thoroughly cleaned from dust and dirt. The wash shall be applied with ‘moonj’ or jute brush, vertically and horizontally alternatively, and fine wash kept stirred in the container while using. Two or three coats shall be applied as specified and each coat shall be perfectly dry before the succeeding coat is applied over it. After finishing, the surface shall be of uniform colour. The white wash should not splash on the floor and other surfaces. In old surface the surface should be cleaned and repaired with cement mortar where necessary and allowed to dry before white wash is applied. For final coat blue pigment powder should be mixed to the required quantity with the lime water to give a bright white surface.

7.7.2 Colour wash shall be prepared with fresh slaked white lime mixed with water to make thin cream adding the colored pigment to the required quantity to give the required tint. Gum (glue) in the proportion of 100 gm of gum to 16 liter of wash shall be added. The colour wash may be applied one or two coats as specified. The method of application should be same as for white washing. For new work the priming coat shall be of white wash.

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8 FINISHES

The finished coating film shall show uniform coverage throughout and shall be reasonably free from brush marks, runs, sags, or noticeable colour variations. Edges where coating ends, change colour or change thickness shall be clean and straight.

The completed coating shall be compared with sample areas. The completed coating shall be at least as smooth (free from orange peel effect, overspray, embedded or partially embedded particles, craters, pinholes, holes, etc.) as the approved sample areas.

The thickness of the coating shall be checked by the Engineer at random locations by cutting out sections on concrete and plaster surfaces. The cut out sections shall be patched by the Contractor, using the same material and thickness used originally. Porosities shall be marked and patched with the basic primer material, or with a mixture of the basic primer material and finely divided filler, or with a proprietary patching compound compatible with the coating. Any moisture on the surface of the coating shall be allowed to dry thoroughly before patching. In addition, all porosities and imperfections which become evident after applying subsequent coats shall be repaired. This repairing shall be done with the basic coating material or with a proprietary patching compound compatible with the specified coating, except for the top coat, where only basic coating material shall be used. The completed coating shall be free of porosity visible to the naked eye.

9 JOB CONDITIONS

9.1 Observe manufacturer's recommended minimum and maximum temperature but do not apply paint or finish to any surface unless ambient temperature is 10 degree C or above and less than 43 degree C. No painting shall be done above 90% relative humidity.

9.2 Place drop cloths to adequately protect all finished work.

9.3 Remove and replace all items of finish hardware, device plates, accessories, lighting fixtures or other removable items.

9.4 In no case shall any finish hardware or other finished item that is already fitted into place be painted, unless otherwise specified.

10 QUALITY ASSURANCE

All paint for any one surface shall be top quality, of one manufacturer and approved by the Engineer. Deep tone accent colours shall be used and the unavailability of final coat colours may be the basis for rejecting materials for any one surface.

11 SCHEDULE OF MEASUREMENT OF PAINT AREA :

11.1 Irrespective of prime coats and number of paint coats applied to exposed painting surface area of column, walls, projections; ceilings and other surfaces (Except gates, doors windows and ventilators the cost thereof shall be deemed to have been included in quoted unit rate of the respective items of Bill of Quantities) shall be measured as per actual paint surface area for single time only and paid in accordance with quoted rate of Bill of Quantities

12 MEASUREMENT AND PAYMENT

12.1 General

Except otherwise specified herein or elsewhere in 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 Bill of Quantities.

- Preparatory works, including preparatory materials, scraping, scratching, sand blasting, cleaning, priming, protection of finished works etc.

12.2 PAINTING

12.2.1 Measurement

Measurement of acceptably completed respective type of painting works will be made on the basis of net actual areas in square feet of the surface painted as shown on the Drawings or as directed by the Engineer.

12.2.2 Payment

Payment will be made for acceptable measured quantity of respective type of painting 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.

PLUMBING WORKS

SECTION - 5100

P L U M B I N G

1 SCOPE

The work under this section consists of providing all material and equipment and performing all the work necessary for the complete execution and completion, including testing and commissioning of all systems of plumbing works as shown on the drawings and/or as specified herein and/or as directed by the Engineer. The system included in plumbing works are as follows:

i) Cold and Hot Water Supply

ii) Building Waste Water Drainage

iii) Rain Water Drainage

All the above named systems shall be completed in all respects including extension of these internal systems upto the specified limits outside the building as indicated on the drawings.

2 GENERAL

All the materials and equipments shall be of the specifications mentioned herein and the Contractor shall submit the sample, necessary catalogues, sketches, the name of manufacturer and guarantee if necessary, before installation. The system shall be installed after the Engineer approves it. All material and equipment shall be new and unused.

It is specifically intended and must be agreed to by each Contractor submitting a bid, that any material or labour which is usually furnished as a part of such equipment and which is necessary for its proper completion and best operation shall be furnished as a part of this Contract without any additional cost whether or not shown in detail on the drawings or described in detail, in the specifications.

Approval of material and equipment by the Engineer shall not absolve the Contractor of the responsibility of furnishing the same of proper size, quantity, quality and all performance characteristics to efficiently fulfill the requirements and intent of the Contract Documents.

The Contractor shall be responsible for his work until its completion and final acceptance, and shall replace any of those that may be damaged, lost or stolen without any additional cost.

All openings left in floor for passage of lines of water supply, soil, waste, vent, etc. shall be covered and protected.

All open ends of pipes shall be properly plugged to prevent any foreign material from entering the pipe.

Misuse of plumbing fixtures to be installed under this Contract is prohibited during the currency of the contract.

All metal fixture trimmings shall be thoroughly covered with non- corrosive grease which shall be maintained until all work is completed.

Upon the completion of work, all fixtures and trimmings shall be thoroughly cleaned, polished and left in first class condition.

Before erection, all pipes, valves, fittings, etc. shall be thoroughly cleaned of oil, grease or other material.

All special tools for proper operation and maintenance of the equipment provided under this Contract shall be delivered at no additional cost.

The Contractor shall allow in his bid for cost of all cutting, making holes and subsequent making it good to the desired finish as per approval of the Engineer. No separate payment shall be made for this item.

The Contractor shall allow in his bid for the cost of providing protective painting or coating as specified in the relevant sections and no claim shall be entertained for this item.

All pipes shall be properly installed as shown on the drawings and/or as directed by the Engineer, and shall be as straight as possible forming right angles and parallel lines with the walls and other pipelines. The position, gradients, alignment and inverts shall be as shown on the drawings and/or as directed in writing and set out by the Engineer.

The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings. The Engineer reserves the right to change the location etc. Special precautions shall be taken for the installation of concealed pipes as shown on the drawings and/or as required. Should it be necessary to correct piping so installed, the Contractor shall be held liable for any injury caused to other works in the correction of piping. The Contractor shall closely coordinate with other works during the entire stage of execution.

A minimum distance between different services shall be maintained as shown on the Drawings and/or as approved by the Engineer.

Pipes should be installed in such a manner that minimum distance should always be maintained between pipe and wall, beams, columns, etc. Pipes shall be supported on hangers and brackets as shown on the drawings or as directed by the Engineer.

Waste-water outlet from each fixture shall be individually trapped.

Each vent terminal shall extend to the outer air and be so installed as to minimize the possibilities of clogging and the return of foul air to the building.

When the roughing-in is completed, the plumbing system shall be subjected to test prior to concealing the roughing-in, in order to ascertain that all threads and connections are watertight.

Cast iron soil and drainage fittings for change in direction shall be used as follows:-

*Vertical to horizontal:	sweep or long-turn for diameter 3 inch (75mm) and larger; long sweep or extra- longturn for less than 3 inch (75 mm). dia.
*Horizontal to vertical:	bend or short turn.

All fittings with hubs shall be aligned so that the hub faces upstream.

No drainage or vent piping shall be drilled.

All exterior openings provided for the passage of piping shall be properly sealed with snugly fitting collars of metal or other approved rodent-proof material securely fastened into place.

Joints at the roof, around vent pipes, shall be made water-tight by the use of lead, copper, galvanized iron, or other approved flashings or flashing material. Exterior wall openings shall be made watertight.

Each length of pipe and each pipe fitting, trap, fixture, and device used in a plumbing system shall have cast, stamped or indelibly marked on it the maker's mark or name, the weight, type, and classes of the product, when such marking is required by the approved standard that applies.

Where different sizes of pipes, or pipes and fittings are to be connected, the proper size increasers or reducers or reduced fittings shall be used between the two sizes.

Any fitting or connection which has an enlargement, chamber, or recess with a ledge, shoulder, or reduction of pipe area that offers an obstruction to flow through the drain pipe is prohibited.

The vertical distance form the fixture outlet to the trap weir shall not exceed 2 feet (600mm).

Each fixture trap shall have a water seal of not less than 2 inch (50 mm) and not more than 4 inch (100 mm).

Full S, bell, crown vented traps and traps/depending for their seal upon the action of movable parts are prohibited.

No fixture shall be double trapped.

Where fixture comes in contact with wall and floors, the joint shall be water-tight.

Piping in ground shall be laid on a firm bed for its entire length.

Piping in the plumbing system shall be installed without undue strains and stresses. Vertical piping shall be securely held to keep the pipe in alignment and carry the weight of the pipe and contents. Horizontal piping shall be supported to keep it in alignment and prevent sagging. Hangers and anchors shall be of metal of sufficient strength to maintain their proportional share of pipe alignments and prevent rattling. Hangers and anchors shall be securely attached to the building under construction. It must be clearly understood that the Contractor shall be fully responsible for hangers and supports and shall obtain prior approval of design as to the shape, material, dimensions, spacing etc.

Piping in concrete or masonary walls or footings shall be placed or installed in sleeves which will permit access to the piping for repair or replacement.

3.0 ASBESTOS CEMENT PIPES, FITTINGS AND SPECIALS

These shall conform to International Organization for Standardization Recommendation R 160 "Asbestos Cement Pressure Pipe" or British Standard Specification 486 "Asbestos Cement Pressure Pipe" of the class capable of withstanding a 400 ft. head test pressure. Short lengths of pipe machined overall shall be used at fittings for tying in

The fittings and specials for asbestos cement pipes shall be cast-iron conforming to British Standard Specification 78: PART 2 Fittings: "Cast Iron Spigot and Socket Fittings", Class AV, except that the fittings and specials shall have the shapes, dimensions and tolerance required to fit the asbestos-cement pipes. Fittings and specials for asbestos cement pipe shall be supplied by the manufacturer of the asbestos cement pipe.

3.1 INSTALLATION

3.1.1 Handling

Pipe and accessories shall be handled in such a manner as to ensure their delivery to the trench in sound, un-damaged condition. If any pipe or fitting is damaged, the repair or replacement shall be made by the Contractor at his expenses in a satisfactory manner. No other pipe or material of any kind shall be placed inside of a pipe or fittings. Pipe shall be carried into position and not dragged. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Employer. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place and protected against the direct rays of the sun.

3.1.2 Cutting of Pipe

This shall be done in a neat and workman-like manner without damage to the pipe. Unless otherwise authorized by the Engineer or recommended by the manufacturer, cutting shall be done with a mechanical cutter of approved type. Wheel cutters shall be used wherever practicable.

3.1.3 Location

Where the location of the water pipe is not clearly defined by dimensions on the Drawings, the water pipe shall be located as directed by the Engineer.

3.1.4 Deflection

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be 2^{o} degrees for Asbestos Cement Pipe unless otherwise recommended by the manufacturer. If the alignment requires deflections in excess of the specified limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit setforth, as approved.

3.1.5 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick ropes, belt slings, or other suitable equipment. Under no circumstances shall any of the water line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers shall be of wood and shall have broad flat faces to prevent damage to the pipe. Except where necessary in making connections with other lines or authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bell coupling and joints. Pipe that has the grade or the joint disturbed after laying shall be taken out and relaid. Pipe shall not be laid in water shall be kept out of the trench until the materials in the joints have hardened or until chalking or jaunting is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substances will enter the pipes or fittings.

Where any part of a coating or lining is damaged, the repair shall be made by the Contractor at his own expense in a satisfactory manner

3.1.6 Jointing

a. The joints shall be in accordance with the recommendations of the manufacturer or as approved by the Engineer.
b. Connections between different types of pipes and accessories shall be made with transition fittings where recommended by the pipe manufacturer.
c. Service connections shall be made as indicated and in accordance with the recommendations of the pipe manufacturer.

3.1.7 Setting of Valves and Surface Boxes

Valves and surface boxes shall be installed as shown or directed, and shall be set plumb. Surface box shall be centered on the stems. Concrete, concrete pipe, brick, brick ballast used in chambers shall conform to the relevant clause of the Specifications. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to the satisfaction of Engineer on all sides of the box, or to the undisturbed trench face if less than 4 ft.

Valves shall have the interiors cleaned of all foreign matter before installation. Surface boxes shall be lighted and the valve shall be inspected in open and closed positions to ensure that all parts are in working condition.

3.1.8 Thrust Blocks

Plugs, caps, tees, bends and fire hydrants shall be provided with concrete thrust blocks. Backing shall be placed between solid ground and the hydrant or fitting to be anchored. The area of bearing shall be as shown on the Drawing. The backing shall be so placed that fitting joints shall be accessible for repair. The concrete shall be of class B (3000 psi) plain cement concrete.

3.2 FLUSHING

The Contractor shall provide facilities for flushing the line. Water for flushing the line shall be arranged by the Contractor. Flushing of line shall be done section by section. For each valved section of pipeline, the Contractor shall make a temporary hose connection between the water pipeline and the pipeline under test. Water shall be pumped into the section flushed. Other arrangements for storing and pumping of water shall be subject to the approval of Engineer. Due precautions shall be taken by the Contractor for the disposal of water. The pipeline shall be flushed by keeping all the branch pipes open. Flushing shall be continued until clean water starts flowing through the other end. Section by section, the entire pipeline shall be flushed at a minimum flushing velocity of 2.5 ft./sec.

3.3 LEAKAGE TEST

Flushing of the pipeline shall be followed by a leakage test. The Contractor shall provide facilities for performing the leakage test. Water and pumping facilities shall be provided by the Contractor. Before the testing of pipeline, the Contractor shall ensure that concrete backing blocks have been provided where necessary. The test shall be performed only after all concrete work in contact with pipe to be tested has set for a minimum of 24 hours. All joints shall be left exposed. Leakage test shall be performed by keeping the end of

the pipeline closed by proper plugs blocked to resist 150 per cent of the actual working pressure. While filling the line all valves and openings shall be kept open and water shall be filled in slowly. When the pipeline is completely filled with water and all air expelled, water shall be pumped into the pipeline to a minimum pressure of 150 percent of actual working pressure and the test pressure shall be maintained for at least 30 minutes for each section of 330 feet. Each and every joint shall be inspected for leaks and for all visible leakage, a displacement leakage test shall be performed by the Contractor, for the newly laid pipeline. The pipeline shall be filled with water and all the air from the pipeline shall be expelled. No piping installation will be accepted until the leakage is equal or less than the number of imperial gallons per hour as determined by the formula:

$L = 0.00054.ND./P$

L = Leakage in Imperial Gallons

N = Number of joints

D = Nominal diameter of pipe in inches

P = Average test pressure (psi) during test

In the event of the pipeline failing the leakage test, the Contractor shall locate and repair the defective pipe, fitting or joint at his expenses. For dewatering the line for repairs the Contractor shall follow the instructions given by the Engineer for disposal of water. After repairs of the line, the Contractor shall retest the line. The line will not be accepted until it passes the leakage test.

3.4 RETESTING AFTER BACKFILL

After the pipe trench has been backfilled, the entire length shall be subjected to a leakage test as a whole unit. The Contractor shall repair the line if it fails to pass the leakage test requirements specified hereinbefore. The test shall be repeated and repairs effected until the pipeline passes the leakage test.

3.5 PIPELINE DISINFECTION

3.5.1 General

The Contractor shall furnish all equipment, labour and material for the proper disinfection of the pipeline. Disinfection shall be accomplished by chlorination after the lines have been tested for leakage but before they have been connected to the main system. Disinfection of the pipelines shall be done in the presence of the Engineer's representative with equipment approved by him.

3.5.2 Chlorination

A chlorine and water mixture shall be supplied by means of a solution feed chlorination device. The chlorine solution shall be applied at one end of the pipeline through a trap, in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be atleast 25 ppm or enough to meet the requirements given hereinafter.

3.5.3 Retention Period

Chlorination water shall be retained in the pipeline for a period of at least 24 hours. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe extremities and at such other representative points shall be at least 10 parts per million. This procedure shall be repeated until the required residual chlorine concentration is obtained.

3.5.4 Chlorination of Valves

During the process of chlorination of the pipeline, all valves or other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.

3.6 FINAL FLUSHING

Following complete disinfection of the pipeline, all treated water shall be thoroughly flushed from the pipeline at its extremities. Treated water and water used for flushing the pipelines shall be disposed of in a manner instructed by the Engineer. Fresh treated water shall be filled in the line and water tested from presence of coliform. The test result should indicate negative coliform presence. If the test indicates any positive coliform, the entire process of disinfection shall be repeated or improved upon until coliform free samples are obtained.

3.7 WATER SAMPLING AND TESTING

Disinfection of the pipeline and appurtenances shall be the responsibility of the Contractor. The first set of samples will be collected for analysis by the Engineer. Should the sample reveal presence of coliform, the Contractor shall again disinfect the pipeline and appurtenance and shall pay the Owner for sampling and testing for subsequent retests until coliform free samples are obtained. The charges for resampling and retesting shall be paid by the Contractor.

4.0 GALVANIZED IRON PIPES AND PIPE FITTINGS

4.1 SCOPE

The work under this section of the specifications consists of providing all plant, equipment, appliances, material and labour for proper supply and installation of G.I. Pipes and pipe fittings for cold and hot water supply including jointing, clamping, cleaning, painting if needed etc. both above ground and underground and embeded in walls as shown on the drawings or as specified herein.

4.2 COLD AND HOT WATER SUPPLY PIPES & FITTINGS

4.2.1 Material

The galvanized pipes and fittings shall be of Class "B" and conform to latest addition of British Standard Specifications 1387 for **"Steel Tubes and Tubulars suitable for screwing to BS 21 pipe threads"**.

All screwed tubes and sockets shall have BS pipes thread in accordance with BS 21. In order to prevent damage to the leading thread, the ends of the sockets shall be chamfered internally.

A complete and uniform adherent coating of zinc will be provided for galvanized pipes.

Every tube/pipe shall be tested at the manufacturer's works to a hydraulic test pressure of 4.90 MPa and shall be maintained at the test pressure sufficiently long for proof and inspection.

Tubes/Pipes which are bundled shall be secured together by rope or soft iron or other suitable material.

The threads of all tubes shall be effectively covered with a good quality grease or other suitable compound, and each tube above 50

mm nominal bore shall have a protecting ring affixed to the unsocketed screwed end.

4.2.2 Installation

The run and arrangement of all pipes shall be as shown on the Drawings and as directed during installation. All vertical pipes shall be erected plumb and shall be parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls. If required to change the location etc. during the currency of the work, the Contractor will do so at no additional cost.

Screwed joints in G.I. pipes shall be made perfectly tight, without the use of any filler except approved jointing compound or tape. Wherever required to make flanged joints, they shall conform to BS 10 Table D.

Furnish and install all pipe passing through floors and walls with sleeves of G.I. sheet, 18 gauge, the inside dia. of which shall be at least 12mm greater than the outside of the pipe passing through it. Sleeves in exterior walls and pits shall have anchor flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

All embedded cold water supply piping shall be wrapped with approved anti-corrosion polyetheylene tape. All exposed piping shall be painted with two coats of enamel paint over a coat of red oxide.

4.2.3 Insulation

All hot water supply and return piping shall be instulated as specified herein. Prior to insulation the pipes shall be hydraulically tested and cleaned.

Nominal Pipe Dia (Inch)	**Insulation Thickness (inch)**
½	1
¾	1
1	1
1 1/2	1
1 3/4	1
2	1
2 1/2	1
4	1

Insulation shall consist of preformed fibreglass pipe insulation, with factory applied reinforced alumunium vapour barrier, single layer in semi-circular halves, consisting of long, fine glass fibres, bonded with a temperature resistant binder, free from shot or coarse fibres, damage resistant, light in weight, easy to handle, cut and fit. The product shall comply with the requirements of B.S. 3958: Part 4: 1968. The instulation shall be rotproof, odourless, non-hygroscopic, and shall not sustain vermin. The fibreglass insulation shall be covered with a layer of approved polytheylene tape in the field. Further reinforcement shall be provided by the use of ¾ inch (20 mm) wide soft aluminium bands, generally spaced at 1/1/2 feet (457 mm) and on either side of elbows and tees. All butt joints shall be sealed with self adhesive type of approved quality adhesive tape.

All trimmed sections shall be secured by wrapping of approved type of self adhesive tape to form a complete water proof seal. All work shall be done in a neat and workmanlike manner, and should reflect recommended practice.

4.2.4 Pipework Supports

All supports, clips, steels rods and hangers shall be of mild steel painted with two coats of approved metallic zinc primer.

All clips and brackets shall be equipped with 9 mm sectional rubber liners

Pipework supports shall be installed in order to allow free movement due to expanions and contraction. Supports shall be arranged adjacent to joints, chanages of direction and branches.

Each support shall carry the overall weight of pipework and water to be borne by it. The intervals between pipe supports shall not exceed the following :

Maximum interval between supports (metres)		
Nominal dia (mm)	**Pipes**	
	Horizontal	**Vertical**
10	1.7	1.7
15	2.0	2.0
20	2.4	2.4
25	2.7	2.7
32	2.7	2.7
40	3.0	3.5
50	3.4	3.9
65	3.7	4.3
80	3.7	4.3
100	4.1	4.4
125	4.4	4.9
120	5.4	6.0
150	4.8	5.0

Dimensions of Support Materials			
Nominal dia (mm)	**Flat iron bands (mm)**	**Support rods (mm)**	**U-bolts (mm)**
10	25 x 3	6	6
15	25 x 3	6	6
20	25 x 3	6	6
25	25 x 3	6	6
32	40 x 5	10	10
40	40 x 5	10	10
50	40 x 5	10	10
65	50 x 6	12	12
80	50 x 6	12	12
100	50 x 6	12	12
125	50 x 6	12	12
150	50 x 6	12	12
120	60 x 7	14	14

Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle form shall be fitted to the underside of slab by two hangers and the pipes shall be suported from the channel iron by rod hangers and flat iron bands.

All hanger rods shall have double nuts and bevelled washers to allow the hanger rod to swing.

Multiple pipe runs along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

Exposed pipe work shall be supported on channel, angle iron or with U-bolts to form a rigid guide.

All U-bolts, except used as anchors, shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide and allowing the pipe to slide axially,. U- bolts shall be provided on alternate pipe bracket.

Small pipework running along skirtings shall be supported by standard built-in or screw-on type clips.

Pipes shall be individually supported. Pipes shall not hang from other pipes.

Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means-of support for the riser.

Vibration isolators to be provided with the hangers as approved by the Engineer.

4.2.5 Testing and Commissioning

All water distribution system shall be tested whole or in part to 1 1/2 times the working pressure. The contractor shall pay for all device, materials, supplies, labour and power required for the test. The test will be run for two hours at the specified pressure and there should be no leakage in the system. Defects revealed by the test shall be repaired and the whole test rerun until the system proves to be satisfactory.

After all the pipes and fixtures have been properly laid and tested, they shall be flushed clean with water and then disinfected with water solution of chlorine of at least 50 ppm strength for a contact period of 6 hours. The system will be finally flushed with clean water.

5.0 SOIL, WASTE, VENT, RAIN WATER DRAINAGE PIPES & PIPE FITTINGS

5.1 SCOPE

The work under this section of the specifications consists of providing all plant, equipment, appliances, material and labour for supply and proper installation of soil, waste, and vent pipes and pipe fittings including, clamping, cleaning, painting etc., as shown on the drawings or as specified herein.

5.2 CAST IRON SOIL, WASTE AND RAIN WATER PIPES AND FITTINGS

5.2.1 Material

The cast iron pipe shall conform to British Standard Specifications No.416/1973 for "Cast Iron spigot and socket soil, waste and ventilating pipes and fittings" with socket and spigot or hubless ends. Cast iron pipe below ground shall conform to BS. 437 "cast iron spigot and socket drain pipe and fittings".The joint shall be lead caulked or elastomeric (Rubber Ring) to BS. 2494.Cast iron pipes shall be centrifugally spun cast. The quality of material shall be according to B.S.S No. 1452 for grade 10.

The contractor shall supply coated pipes and fittings. The coating composition shall be of tar basis or a mixture of natural bitumen with a suitable hardner and natural asphalt. The coatings shall be smooth, tenacious, sufficiently hard, not to flow when exposed to a temperature of 63^{O}C and not so brittle at zero degree centrigrade that it chips soft when scribed lightly with the point of a pen knife.

Every pipe shall be tested as per requirements of B.S at the manufacturer's work to a hydraulic test pressure of 0.07 MPa. Every pipe and fitting shall ring clearly when tested for soundness by being struck all over with a light hammer.

5.2.2 Installation

All cast iron soil waste and rain water pipes and fittings shall be installed to the lines and grades shown on the drawings or as directed by the Engineer. When required to be installed above ground floor level, suitable and substantial number of hangers and supports of approved type and make shall be provided. No piping shall be hung from the piping of other systems. Clamps shall be provided on not more than 1.5 meter centres or a minimum of one hanger per each length of pipe whichever is smaller. Where excessive number of fittings are installed, additional clamps shall11 be provided.

All steel clamps, hangers and support etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint. All exposed C.I. soil/vent pipes shall be given two coats of synthetic enamel paint. Materials for painting shall be high quality product of well known manufacturer and will be approved by the Engineer before using. The instructions of the manufacturer regarding all painting work shall strictly be adhered to.

Caulked joints for cast iron bell-and-spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 1 inch (25 mm) deep and not to extend more than 1/8 inch (3 mm) below the rim of the hub. Rubber ring joints shall also be allowed. No paint, varnish, or other coatings shall be permitted on the jointing material until after the joint has been tested and approved.

Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. All vent pipes to be installed in the system shall be provided with approved cowl and will rise at least 28 inches (0.70 meter) above the roof.

The entire system of drains, waste, and vent piping inside the building shall be tested by the Contractor under a water test. Every portion of the system shall be tested to a hydrostatic pressure equivalent to at least 10 ft. (3 meter) head of water. After filling this Contractor shall shut off water supply and shall allow it to stand two hours, under test during which time there shall be no loss or leakage.

The Contractor shall furnish and pay for all devices, materials, supplies, labour and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

The Contractor shall also be responsible for the repair of this work and other trades work that may be damaged or disturbed by the tests.

Defects disclosed by the tests shall be repaired. Defective work shall be replaced with new work without extra cost to the Employer. Tests shall be repeated as directed, until all work is proven satisfactory.

All fixtures shall be tested for soundness, stability or support and satisfactory operation.

5.3 R.C.C SEWER PIPES

5.3.1 Materials

All materials used in the manufacture of reinforced cement concrete pipes for use under this contract shall conform the latest revision of ASTM Designation C-76-79 or latest revision and also with the following specifications.

5.3.1.1 Cement

The ordinary portland cement to be used in the manufacture of reinforced concrete pipes shall conform to the requirement of ASTM Designation C 150 (latest revision).

5.3.1.2 Aggregates

The coarse/fine aggregate to be used in the manufacture of concrete pipes to be furnished and installed under this contract shall be generally in accordance with the provisions of section of these specifications.

5.3.1.3 Water

Water to be used in the manufacture of pipes shall be approved by the Engineer.

5.3.1.4 Steel Reinforcement

The material shall conform to the specifications contained in 2400 of these specifications.

5.3.1.5 Brick Ballast

Brick ballast shall have a maximum gauge of 38mm and shall be graded down to 19mm and shall not contain more than 10% which will pass through screen made of 6mm diameter bars spaced at 19mm center to center in both directions.

5.3.2 Classes Of Pipe

The reinforced cement concrete pipes to be furnished and installed under this contract shall be of the strength ClassII or specified other wise on the Drawings.

Following technical criteria shall be adhered to:

Class of Pipe: Class II

Concrete Strength: 27.58N/mm^2(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 repective strength calsses. Unless otherwise

called for in other parts of these Technical Specifications or applicaable variation order, all reinforced cement concrete pipes under this contract 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.

5.3.3 Basis Of Acceptance

Acceptance of reinforced cement concrete pipes will be on the basis of three edge bearing and material test as per ASTM Designation C-76-79 or latest revision and inspection of manufactured pipes for defects and imperfectins. 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.

5.3.4 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.

The lengths of reinforced concrete pipes under this contract shall be as required to provide the designated laying length plus any overlap needed for the pipe joint. Pipe shall be standard length of 8 ft. unless otherwise approved in writing by the Engineer. Only one laying length shall be permitted for each size of reinforced concrete pipe under this contract and pipes not of the approved uniform laying length shall not be used in the work. Each layer of circumferential reinforcement shall be assembled into a rigid case supported by 4 Nos. longitudinal bar of 6mm dia.

The strength test requirements in Kg per linear meter 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 loads as specified below, multiplied by the internal diameter of the pipe in ft.

D-Load to produce a 0.01 in crack = 1000 pounds

D-Load to produce the ultimate load= 1500 pounds

Lift holes in the walls of reinforced cement concrete pipes will not be permitted under this contract for the purpose of handling and laying. Other approved liffing methods shall be emoployed.

5.3.5 Joints For Concrete Pipe Sewers

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 tolerance 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 C433, entitled "Joints for Circular Concrete Sewer and Culvert pipe, using Flexible Watertight Rubber Type Gaskets"

The groove end of tongue and groove pipes shall have at least one line of wire reinforcement of 8 gauge size placed in the center 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 preassembled to the pipe at the pipe manufacturing plant. The pipes shall be handled with special care at all times to prevents 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 300mm or larger diameter in accordance with the recommendations of the rubber gasket manufacturer. Pipes of 9 inches (225mm) dai. may be coupled manually using a cross member and bar. Under no circumstances will bars alone be used nor shall any motor driven equipments be used to force the pipe home.

5.3.6 Gully Grating

Gully grating shall made through manholes as indicated in the drawing or as diretecd by the Engineer.

Gully grating shall be provided on the road junctions as mentioned in the drawings by means of a 9 inches (225mm) dia RCC sewer pipe connecting the nearest manhole with the chamber of size 18” x18” (450x450mm). 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 work of laying RCC pipe shall conform to the specifications laid down in the relevant section of the contract. Mild steel grating shall be fixed at the top.

5.3.7 Installation

5.3.7.1 Handling of Pipes

Concrete sewer pipes shall be handled with special care in all stages during the manufacture, while transporting to the site of work, and while laying. 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's opinion may cause defective joints, shall be sufficient cause for the rejection of any concrete pipe.

5.3.7.2 Placing of Bedding

5.3.7.2.1 Brick Ballast Bedding

The brick ballast shall be cleaned sound, tough produce from overburnt bricks material of 1" to 1½" (25 to 38 mm) 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 or 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" (100 mm) 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 not more than ½" (13 mm) 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's Representative.

5.3.7.2.2 Crushed Stone Bedding

Crushed stone bedding shall be from an approved source. It shall be obtained from a dark coloured igneous rock such as granite etc. It shall be strong, durable, hard and impervious, having crystalline structure. The broken stone shall have no sharp edges and clear fractured faces, shall be free from thin elongated or laminated pieces.

The crushed stone shall have a maximum size of 1 ½" (38 mm) and shall be graded down to 3/8" (9 mm). When shifted through a screen made of ¼" (6 mm) diameter bars spaced 3/8" (9 mm) center to center, it shall pass no more than 10 percent by volume of fine material.

5.3.7.3 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 trenched 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 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" (13mm) 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 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.

5.3.8 Testing Of Sewer Lines

5.3.8.1 General

All sewer built under this contract shall be tested for infiltration or exfiltration as specified below. The tests shall be made at times selected or approved by the Engineer. Sections of the completed sewer shall be isolated and measurements of the infiltration or exfiltration shall be made by approved method. The contractor shall furnish all labour, 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.

5.3.8.2 Exfiltration Tests

The sewers which are laid under normal condition shall be tested for exfiltration by isolating a section of sewers between manholes by means of approved temporary type of water tight bulk heads. The method of testing for exfiltration shall be generally as follows:

1. After isolation of sewer section, it shall be filled with water to a level which is 3 ft. (1 m) above the crown of the pipe at the higher end of the isolated section under test. The level will not be more than 6 ft. (2 m) above the invert level of the sewer pipe at its lower end.
2. The duration of the exfiltration test shall be one hour after the filling with water has been completed.
3. Determination of the amount of exfiltration shall be made by measuring the total loss of volume of water in the manholes.
4. The amount of exfiltration over a 24 hour period will then be calculated from the measured loss of volume during the test observation period.

5.3.9 Allowable Exfiltration

The calculated amount of infiltration or exfiltration over a 24 hour period shall not exceed 146 liters per mm of pipe diameter per km of sewer which rate shall be applied to the actual sewer size and length tested to determine the allowable infiltration or exfiltration over the 24 hour period.

If the measured infiltration or exfiltration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs so as to reduce the leakage to less than the permissible maximum stated above.

5.3.9 Smoke Test

The sewerage system after laying shall be subjected to smoke tests in order to determine any leakage.

Cleaning Of Sewer Lines

The contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Owner.

6 PLUMBING FIXTURES

6.1 SCOPE

The work under this section of the specifications consists of providing all material and labour for supply and proper installation of plumbing fixtures including wash basins, kitchen sinks, water closets, urinal, alongwith all their accessories, water inlet connection, waste outlet connection etc. complete in all respect as specified herein or as shown on the Drawings and/or as directed by the Engineer.

6.2 MATERIALS AND INSTALLATION

6.2.1 General Requirements

Materials shall conform to the latest referenced standard specifications and other provisions stipulated herein and shall be new and unused.

All fixtures shall be of high class quality and finish and shall be of approved manufacturer.

Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer for his approval, a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams, drawings and such other technical data as may be required by the Engineer to satisfy himself as to the suitability, durability, quality and usefulness of the material to be purchased.

Approval of the schedule shall not be construed as authorising any deviations from the specifications unless the attention of the Engineer has been invited to the specific changes. If the material or equipment offered under this provision is, in the opinion of the Engineer, equal to or better than specified, it will be given consideration.

Plumbing fixtures shall have smooth impervious surfaces, be free from defects and concealed fouling surface. They shall be true to line, angles, curves and colour etc. Normally they shall be of local make and of the best quality available, provided.

All taps and cocks to be installed with plumbing fixtures shall be chrome plated (CP) and shall be of appropriate class to work without damage or leakage on the specified pressure of potable water system, which is 0.88 MPa (128psi).

When any fixture is provided with an overflow, the waste shall be so arranged that the standing water in the fixture cannot rise in the over flow when the stopper is closed or remain in the overflow when the fixture is empty.

Plumbing fixtures shall be installed in a manner to afford easy access for cleaning. The space between the fixture and the wall shall be

closely fitted and pointed so that there is no chance for dirt or vermin to collect.

When practical, all pipes from fixtures shall be run to the nearest wall.

Where fixture comes in contact with wall and floors, the joint shall be watertight.

Wall hung fixtures shall be rigidly supported by metal supporting members so that no strain is transmitted to the connections. Flush tanks and similar appurtenances shall be secured by approved non-corrosive screws or bolts.

Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet shall be set closer than 400mm from its centre to any side wall. No urinal shall be set closer than 300mm from its centre to any side wall or partition nor closer than 600mm centre to centre.

The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow.

All cuttings, making holes etc and making it good shall be included in the work.

6.2.2 Wash Basins

Wash basin shall be Vitreous China or approved make and of at least 18" x18" (450x550mm) size. It shall be installed as a complete unit including 5/8' (15mm) CP mixer for hot and cold supply 5/8" (15 mm) CP stop-cocks, CP brass chain with 1/14" (32 mm) rubber plug, CP brass bottle trap for individual wash basin and CP brass P trap for battery of wash basins as applicable, CP brass strainer, heavy cast iron brackets with bolts, screws etc. plastic water inlet connection pipe, CP brass steel waste outlet and/or waste pipe, joints jointing and sealing material, etc, with all other minor accessories required to complete the job in all respect.

6.2.3 Water Closets (European Type)

European type water closet of size and manufacture approved by the Engineer shall meet all the requirements.

Flush tank shall be of low level type, trap shall be cast integral with pan. The seat shall be of smooth non- combustible non-absorbent materials like Bakulite and of the open front type fixed to the pan with hinges. The toilet paper roll holder shall be of CP brass with CP brass with CP brass brackets and screws etc. and fixed to the wall adjacent to water closet.

The fittings shall also include 5/8" (15 mm) C.P. stopcock, plastic water inlet connection pipe nuts bolts etc. required for installation.

6.2.4 Water Closets (Asiatic Type)

The Asiatic type pan shall be of white Virtreous China or approved equivalent glazed fire clay, stoneware, earthenware, or any other approved non absorbent material with 4" (100 mm) diameter trap of the same material and foot rest. The surface shall have a glazed finish with minimum of fouling area and a seal depth greater than 2" (50 mm). The outlet shall be placed well back and the pan shall be sufficiently long to prevent urine from splashing out. The flushing water connection shall be from the rear end.

6.2.5 Urinals

Urinals shall be Vitreous China or approved make and size and of wall hung type either with integral water seal trap or with separate CP brass P trap. The complete unit shall be installed including 5/8" (15 mm) CP stop cock, plastic water inlet connection pipe automatic cast iron with stone enamel painted flush tank of 4 litres capacity with heavy duty cast iron bracket bolts, screws and all internal accessories CP steel flush pipe. CP steel waste pipe, joints, jointing and sealing material etc. with all other minor accessories wherever two urinals are located nearly, one flush tank for a set of 2 urinals shall be required.

6.2.6 Kitchen Sinks

Kitchen sinks shall be stainless steel of approved make single bowl or double bowl with integral drain board of at least 40"x20" (1000x500 mm) size. It shall be installed as a complete unit with arrangement for both cold and hot water supply & shall include 5/8" (15 mm) C.P. stop cocks, 5/8" (15 mm) C.P. mixer, water inlet connection C.P. brass strainer, C.P. brass/steel waste outlet and uPVC waste pipe, heavy cast iron brackets with bolts screws etc., joints jointing & sealing material, etc., with all other minor accessories.

6.2.7 Electric Water Cooler

Automatic electric water cooler of capacities as shown on the drawing shall be supplied, the manufacturer/colour shade and shape of the cooler shall be subject to the approval of the architect. The electric water cooler.

Cabinet shall be of heavy gauge mild steel construction painted with non corrosive paint from inside and with special hammer finish paint from outside.

Push button type water taps shall be chrome plated. Drain pot shall be made of hard plastic with stainless steel tray. Back panel shall be easily removable for cleaning and servicing top cover shall be of scratch proof Formica.

Water storage tank shall be either of stainless steel or copper alloy, tinned inside and outside with proper fibre glass insulation to maintain water temperature, with special arrangement for cleaning the tank.

Condensing unit shall be heavy duty, of renowned make, hermetically sealed with thermal overload protection for refrigerant F-12 and capillary expansion with valves for easy gas charging.

Thermostat and other control necessary for proper functioning of the unit shall be provided. The electric water cooler shall be installed at location shown on the drawings and connected to the water distributions and drainage system.

The thermostat shall control the temperature of cooled water between + 11 degree C + 20 degree C.

Water storage tank shall be rated for working pressure of 4 kg/cm2 and test pressure of 6 kg/cm2.

7 MISCELLANEOUS ITEMS

7.1 SCOPE

The work under this section of the specifications consists of providing all material and labour, equipment, appliances etc., for supply and proper

installation of miscellaneous plumbing items of cock, floor traps, floor drains, roof drains, rain water shoe cleanouts, glass mirror, towel rail, toilet paper holder, water cooler etc., as specified herein or as shown on the Drawing or as directed by the Engineer. The Contractor shall furnish appropriate catelogues and literature and obtain approval of the Engineer before purchase.

7.2 MATERIAL AND INSTALLATION

7.2.1 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 area of the waterway throughout the body shall be not less than the area of a circle of diameter equal to the nominal size of tap/cock/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.

7.1.2 Glass Mirror

The glass mirror shall be of specified size, 5mm thick, securely fixed on hard board packing and of first class quality as approved by the Engineer. The mirror shall be fixed on wall as shown on the drawing or as directed by the Engineer.

7.1.3 Towel Rail

The towel rail shall be specified size of chrome plated steel/plastic and shall be fixed to wall with chrome plated bracketrs.

7.1.4 Toilet Paper Holders

Toilet paper holdrs shall be local and installed with all water closets. They shall be of best quality of chromium plated steel/plastic and shall be fixed to wall at locations indicated on the drawings.

7.1.5 Gas Water Heaters

Hot water heater shall be of automatic storage type gas operated heaters of capacities as shown on drawings, including all necessary fittings for complete installation and operation.

Outer shell or the storage water should be constructed of steel finished in backed enamel.

Inner Vessel shall be glass coated to protect against corrective effect of the hot water.

The annular space between outer vessel and inner vessel shall be filled with fiber glass, glass wool or similar insulation material.

The working and test pressure of the heater shall be of 6 bar and 10 bar respectively and shall deliver water at 150oF

Heater shall be provided with following accessories.

i. Thermostatic control.

ii. Safely pilot.

iii. Temperature & pressure relief valve.

iv. Burner.

v. Drain valve.

7.1.6 Electric Water Heater

Automatic electric water heater of capacities as shown on drawings shall be supplied of and approved make having steel tank factory fitted with glass linning and test to 150 psi working pressure, including thermostat and a high temperature cut-off, fibre glass insulation, safety valve etc. Electric water heater shall be intalled at location shown on the drawings and connected to the water distribution pipe.

7.1.7 Floor Traps and P- Traps

Floor traps and P- traps shall be of cast iron or of other anticorrosive metal. They shall have minimum water seal of 2" (50mm) and shall be provided with removable nickle bronze strainers. The traps shall be of self clearing type. The open area of the strainer shall be greater than the cross section area of the drain line to which it connects. The traps shall be well set in position so that there is no leakage at the joint between trap and the floor.

7.1.8 Floor drains

Floor drains shall be of cast iron or of other anticorrosive metal. They shall have minimum water seal of 2" (50mm) and shall be provided with removable metal strainers. The traps shall be of self-clearing type. The open area of the strainer shall be at least two-thirds of the cross section area of the drain line to which it connects. Floor traps shall be well set in position so that there is no leakage at the joint between trap and the floor.

7.1.9 Roof Drains

Roof drains shall be of bitumen coated cast iron brass. They shall have strainers extending at least 5/8" (15 mm) above the roof surface immediately adjacent to them, when installed on flat part. Bottom of strainer shall be flush with the roof surface, when installed on vertical part. Strainer shall have an available inlet area, above roof level, of not less than 1-1/2 times the area of the down-pipe to which the drain is connected. The connection between roof and roof drain shall be made watertight by the use of proper flashing material

7.1.10 Rain Water Shoe

Rain water shoe shall be of bitumen/asphalt coated cast iron antisplash type to BS 416. The grade of shoe shall be same as that for rain water pipe to which it connects. The shoe shall be fixed 12" (300 mm) above the surface to which it discharges freely.

7.1.11 Cleanouts

Cleanouts shall be of the same nominal size as that of the pipe on which it is installed. Cleanout shall consist of tapped heavy duty cast iron ferrule caulked into cast iron fitting and heavy duty brass tapered even plug. Cleanouts shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of cleanout shall be

flush with the floor by means of finished metal plate secured in position and screwed firmly to the plug.

Cleanout shall be so installed that there is a clearance of at least 12" (300mm) for pipes less than 3" (75mm) diameter and at least 18" (457mm) for pipes of 3" (75mm) and larger diameter, for the purpose of rodding.

Cast iron pipe used with cleanout shall be measured and paid under cast iron pipe item. All other work of ferrule, plug, concrete work, frame and cover etc. shall be measured and paid under cleanout item.

7.1.12 Cowel

All vent pipe terminating above the building shall be provided with best quality cast iron cowel and a stainless clamp for clamping of water proofing membrane as approved by the Engineer.

7.1.13 Ferrule Assembly

Ferrule assembly shall consist of brass ferrule assembly including corporation cock for disconnection of approved quality including C.I saddle, M.S strap and all other items related to make complete house connection.

7.1.14 Bronze Gate Valve/Sluice Valve

All valves of 4" (100 mm) diameter and smaller shall be of bronze unless otherwise specified conforming to BS 5154 and shall be of appropriate class for the working pressure of the system on which they are installed. Open and shut indicators shall be marked on the handle. The ends may be screwed or flanged.

7.1.15 Bronze Check Valves

Bronze check valves shall be swing type conforming to B.S. 5154. The direction of flow shall be permanently marked on the body of the valve. The end of valves shall be either screwed or flanged, as specified. Threads shall conform to B.S.21. Flanges shall conform to B.S. 4504. Valves and flanges unless otherwise shall be rated for a working pressure of 10 bars for potable water and 16 bars for fire water and shall be tested to 1-1/2 times the working pressure. Check valves shall be installed on horizontal or vertical pipes in the direction of flow.

7.2.16 Cast Iron Gate Valves/Sluice Valve

All gate valves shall be of cast iron body and shall conform to B.S.5163 "Specifications for Double Flanged Cast Iron Wedge Gate Valves for Waterworks purposes". Body of the valve shall be tested to 1-1/2 times the service pressure and the seat shall be tested at maximum service pressure. No leakage shall be observed under the above tests. The material used shall be corrosion resisting, free from toxic substances and shall not foster microbiological growth or give rise to taste, odour, cloudiness or discolouration of water. Two sets of valves key suitable for opening all valves shall be provided to the Owner free of cost. The external surface of the valves shall be painted with a minimum of two coats of black bituminous enamel paint.

7.2.17 Cast Iron Check Valves

Check Valves shall conform to B.S. 5153 "Specifications for Cast Iron Check Valves for general purposes" the service rating shall be 10

bars for potable water and 16 bars for fire water. The direction of flow shall be permanently marked on the body of the valve. Body of the valve shall be tested to 1-1/2 times the service rating and seat shall be tested at the pressure of service rating. No leakage shall be permitted under the above tests. The check valves shall be swing type.

Ends of the valves shall be flanged to join with the standard fittings. Flanges shall be of appropriate class and material.

Valves shall be installed at positions shown on the detail drawings. The interior shall be cleaned of all foreign matter before installation. They shall be inspected to ensure that all the components are sound and in working condition. Valves shall be adequately supported, wherever required.

8 MEASUREMENT AND PAYMENT

8.1 ASBESTOS CEMENT PIPES

8.1.1 Measurement

Measurement will be made for the number of running meter length of asbestos cement pipes acceptably installed complete in all respects including earthworks, pipe fittings, jointing, hangers, clamps and brackets, sleeves as per relevant Drawings or as directed by the Engineer.

8.1.2 Payment

Payment will be made for the number of running meter length of pipe work as measured above at the Contract Unit price of each unit and shall constitute full compensation to provide, handle, lay and joint asbestos cement pipes including flushing, leakage testing before & after backfilling, final flushing and all other work related to the item.

8.2 COLD & HOT WATER PIPES

8.2.1 Measurement

Measurement for acceptably completed works of G.I. cold and hot water pipes shall be made in running meter length. including earthworks, pipe fittings, jointing, hangers, clamps and brackets, sleeves, insulation of hot water pipes, cutting and breaking concrete and then making it good, applying protective painting, coating, cleaning, testing and disinfecting etc. and the measurement will be for the full work specified herein.

8.2.2 Payment

Payment for acceptably measured quantity of works will be made at the unit rate per running meter length of G.I. cold and hot water pipes as quoted in the Bill of Quantities. and shall constitute full compension for all the works related to the item

8.3 R.C.C SEWER PIPES

8.3.1 Measurement

Measurement for acceptably completed works of R.C.C Sewer Pipes shall be made in running meter length. including earthworks, sand bedding, pipe fittings, jointing, sleeves, breaking concrete and then

making it good, cleaning, testing etc. and the measurement will be for the full work specified herein.

8.3.2 Payment

Payment for acceptably measured quantity will be made at the unit rate per running meter length of R.C.C Sewer pipes as quoted in the Bill of Quantities. and shall constitute full compension for all the works related to the item.

8.4 C.I.PIPES

8.4.1 Measurement

Measurement for acceptably completed works of C.I. pipes will be made in running meter length earth work, sand bedding pipe fittings, jointing, cutting and breaking concrete and then making it good, applying protective painting, coating, cleaning and testing.

8.4.2 Payment

Payment for the acceptably measured quantity will be made at the unit rate per running meter length of C.I. pipe as quoted in the Bill of Quantities and shall constitute full compension for all the works related to the item.

8.5 FLOOR TRAPS, P- TRAPS, CLEAN OUTS, WASH BASINS, WATER CLOSETS, KITCHEN SINK, STOP COCK, PILLAR COCK, BIB COCK, TEE STOP COCK, MUSLIM SHOWER, SHOWER ROSE, GLASS MIRROR, TOWEL RAIL, TOILETS PAPER HOLDER, GAS WATER HEATER, ELECTRIC WATER COOLER AND FERRULE ASSEMBLY.

8.5.1 Measurement

Measurement for acceptably completed works of Floor traps, P-Traps, Clean outs, Wash Basins, Water Closets, Kitchen Sink, Stop Cock,Pillar Cock, Bib Cock, Tee Stop Cock, Ferrule Assembly, Muslim Shower, Shower Rose, Glass Mirror, Towel Rail, Toilets Paper Holder, etc. shall be made on the basis of actual number acceptably provided and installed in position. The Contractor's bid against these items shall include providing and installation complete as specified herein and/or as directed by the Engineer.

8.5.2 Payment

Payment for acceptably measured quantity of Floor traps, P-Traps, Clean outs, Wash Basins, Water Closets, Kitchen Sink, Stop Cock, Pillar Cock, Bib Cock, Tee Stop Cock, Muslim Shower, Shower Rose, Glass Mirror, Towel Rail, Toilets Paper Holder, etc. shall be made at the applicable unit rate per number quoted in the Bill of Quantities and constitute full compension for all the works related to the item

8.6 VALVES

8.6.1 Measurement

Measurement of acceptably completed work of gate and check valves will be made on the basis of actual number of valves provided and installed in position as shown on the drawing or as directed by the Engineer.

8.6.2 Payment

Payment will be made for acceptable measured quantity of gate and check valves on the basis of unit rate per number quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 5233

CAST IRON COVERS WITH FRAMES & LADDER RUNGS

1 Scope

The work to be done under this section of the specifications consist of furnishing all plant, labour, equipment, appliances, material and performing all operations required in connection with supply and proper installation of C.I. cover with frame, and ladder rungs, complete as specified herein, as shown on the drawings, or as directed by the Engineer.

2 Cast Iron Cover with Frame

Cast iron cover and frame shall be of the size and duty as specified on the drawings. The specified size means the clear opening. The cover shall be complete with frame. Top of cover shall be roughened in an approved pattern. Locking and lifting arrangement shall also be provided. The frame shall be well set in place at the time of pouring of concrete. The cover shall tightly fit in the frame. It shall be air-tight and water-tight. The duty, weight, test and working load for 600mm circular or square C.I. cover and frame shall be as follows:-

Class/Duty of Cover and Frame	Gross Weight	Peak or Test Load	Service Working Load
Extra Heavy Weight	275-285Kg	35 Ton	11.5 Ton
Heavy Weight	200-210Kg	15 Ton	5 Ton
Medium Weight	130-140Kg	5 Ton	1.5 Ton
Light Weight	70- 80Kg	1 Ton	upto 1 Ton

3 Ladder Rungs

Galvanised mild steel ladder rungs shall be fabricated to the size specified on the drawings or as directed by the Engineer. The galvanised mild steel ladder rungs shall be fitted by approved fittings at locations shown on the drawings or as directed by the Engineer.

4 Measurement and Payment

4.1 Cast Iron Manhole Cover

4.1.1 Measurement

Measurement of acceptably completed work of each type/size of Cast Iron Manhole Cover with frame will be made on the basis of actual number of Cover with frame provided and installed in position as shown on the drawing or as directed by the Engineer.

4.1.2 Payment

Payment will be made for acceptable measured quantity of each type/size of Cast Iron Manhole Cover with frame on the basis of unit rate per number quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 5330

MANHOLE/GULLY TRAP AND CHAMBER WITH C.I. COVER AND FRAME

1 SCOPE

The work to be done under this section of the specifications includes furnishing all plant, labor, equipment, appliances, material and performing all operations required in connection with construction of manhole/gully trap in chamber including provision and installation of cast iron cover with frame, ladder rungs, C.I gully trap, etc., complete as specified herein, or as shown on the drawings, or as directed by the Engineer.

2 APPLICABLE SECITONS OF SPECIFICATIONS

The following specification sections shall be followed for carrying-out civil works associated with this section.

S. No.	Description	Section No.
1.	Earthwork	1100
2.	Formwork	2100
3.	Reinforcement	2200
4.	Plain and Reinforced Concrete	2300
5.	Brick Work	4200
6.	Plaster	6521
7.	Plumbing	5100
8	Cast Iron Cover with Frame and Ladder Rungs	5233

3 CONSTRUCTION

Manhole, gully trap and chambers base shall be in plain cement concrete (3000psi) and wall in 230mm thick brick work or block masonry of size and shape as shown in drawings. The trap shall be in reinforced concrete (3000psi) as shown on the drawings or as directed by the Engineer. Each Manhole/Gully trap and chamber shall have a C.I. Cover and frame of approved size and shape The work of excavation, backfilling, disposal of surplus/rejected earth, plain and reinforced cement concrete, formwork, reinforcement, benching, pipe connections and provision and installation of C.I. cover with frame, ladder rungs, C.I gully trap, etc., are to be done under this section and shall be executed in accordance with the specifications as stated above. C.I. frames, C.I gully trap, and ladder rungs shall be well set in place at the time of pouring concrete.

4 MEASUREMENT AND PAYMENT

4.1 Measurement

Measurement of acceptably complete works of manhole/gully trap in chamber will be made on the basis of actual number of manholes constructed and installed in position as specified herein, as shown on the drawings and/or as directed by the Engineer.

4.2 Payment

Payment will be made for acceptable measured quantity of manholes/gully trap in chamber on the basis of unit rate per number quoted in the Bills of Quantities and shall constitute full compensation for the works related to the item.

ELECTRICAL WORKS

SECTION - 8001

GENERAL SPECIFICATIONS FOR ELECTRICAL WORKS

1.0 SCOPE OF WORK

The works related to the electrical system which are included in the Scope of this Contract are shown on the Drawings, stated in the Specifications and Bill of Quantities and explained in these Specifications. The works shall broadly include but not limited to the following:

- Main & Sub-main Distribution Boards
- Internal Illumination (Electrification)
- Power Distribution
- Earthing
- Telephone System

The Contractor shall also be responsible to supply any other equipment not specifically mentioned in these Documents but which is necessary for proper operation of the works/system included in the scope of this Contract. The Contractor shall solely be responsible for ensuring proper functional requirements of various equipments. He shall also be responsible for furnishing any additional piece of equipment and for making modification in the equipment as desired and/or approved by the Engineer to achieve proper co-ordination with various equipment offered in the bid and also with those installed by others.

2. RULES & REGULATIONS

The entire electrical installation/work shall be carried out by licensed Contractor, authorized to undertake such work under the provisions of the Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified up to date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers-London, the Contract Documents, The Electricity Rules 1937 and bye-laws that are in force from time to time. Any discrepancy between these Specifications and any other rules and regulations shall be brought to the notice of Engineer for his instructions and the discussion of the accepting/controlling shall be final and conclusive.

The Contractor shall be responsible for completing all formalities and submitting the test certificates as per prevailing rules and regulations, and shall have the installation passed by the Government Electric Inspector of that region. All requirements of the Electric Inspector and WAPDA shall be complied with.

3. AMBIENT CONDITIONS

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material/equipment.

Maximum indoor ambient temperature	:	50 Degree Celcius
Minimum indoor ambient temperature	:	- 10 Degree Celcius
Maximum outdoor ambient temperature	:	60 Degree Celcius
Minimum outdoor ambient temperature	:	Zero Degree Celcius
Maximum Relative humidity	:	100 Percent (dry bulb at 43^0 C)
Maximum Altitude of Project	:	218 meters above the mean sea level.

4. STANDARDS

The latest standards and codes of reputable organization shall be applicable for the material and equipment specified herein and for installation work. Such organizations to be BSS, VDE, etc. In case the Specifications laid down herein differ from those given in the standards, then the equivalent or better specifications shall govern. Where applicable the equipment shall also conform to the requirements of Pakistan Standards Institution (PSI).

Contractor shall maintain at the sire office one copy of the standards/codes applicable to the works.

5. SYSTEM DATA

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate satisfactorily with the following minimum requirements without any de-rating.

a)	Voltage rating of equipment:	LT:	400 V, 3 phase +/- 10%
			230 V, 1 phase +/- 10%
b)	Frequency	:	50 Hz ± 2Hz

6. SHOP DRAWINGS AND DATA TO BE FURNISHED BY THE CONTRACTOR

The shop drawings and/or technical data to the furnished by the Contractor for each electrical equipment shall include, but not limited to the following:

a) Structural drawings showing foundations, RCC details, dimensional plans, elevation and sections on a suitable scale.

b) Electrical drawings showing:

- Line diagrams of switchboards, distribution boards, and motor control centers with detailed wiring diagrams, elevations/internal component layout and other standard details.
- Complete tender drawings with necessary execution details such as no of wires, size of conduit, etc.

At least three (3) copies of the shop drawings and/or technical data of the equipment shall be submitted to the Engineer for rechecking and approval.

7. MANUFACTURER'S INSTRUCTIONS

The Contractor shall supply to the Engineer in properly bound form, six (6) copies of manufacturer's instruction manuals for installation, testing commissioning, operation and maintenance of the specified equipment including manuals of spare parts, and tools of the equipment. At least two copies of the documents shall be submitted in original. The installation instructions shall be submitted 2 weeks prior to commencement of installation of each equipment, and operation and maintenance instruction at the time of commissioning. If the Contractor fails to provide the documents the Engineer shall withhold issuance of requisite certificates and deduct suitable amount from the payments to the Contractor.

8. GUARANTEE

The Contractor shall furnish written guarantee of the manufacturer or supplier with respect to satisfactory performance of each equipment. Guarantee shall be given for replacement and repair of part or whole for the equipment, which may be found defective in material or workmanship. The guarantee shall cover the duration of Maintenance Period as defined in the Conditions of Contract. This guarantee shall not relieve the Contractor of his obligations and he will be fully responsible for the repair or replacement of any defective material in time, so as not to cause any undue delay in carrying out the repairs and/or replacements.

9. MARKINGS

The Contractor shall provide "Danger Boards" and "Shock Charts" wherever required to comply with the requirements of local Electricity Rules and according to normal practice.

10. ASSOCIATED CIVIL WORKS

Except where separately stated in the Bill of Quantities the cost for all civil works associated with any BOQ item of electrical works, such as excavation and back filling of earth, compaction of the earth, foundation pads, chiseling, making openings, etc. shall be included in the price quoted against respective items. No separate payment for such works will be made. Such work will also include repair of any damage to civil works caused by the Contractor during electrical installation.

11. INSTALLATION INSTRUCTIONS - GENERAL

The Contractor shall furnish all labour, materials, tools and equipment required to install, connect, test and commission all electrical equipment specified herein, whether or not such equipment is furnished by him or by others.

For all equipment to be installed by the Contractor, the Contractor shall supply and install all erection materials such as foundation bolts, washers, nuts, etc. as required and without any additional costs.

The Contractor shall set out the works himself as per Specifications and Drawings and shall properly position the equipment on specified foundation/location. In general, the manufacturer's instructions for installation shall be followed. Any defect or faulty operation of equipment due to the Contractor not following the manufacturer's instructions shall be corrected and repaired by the Contractor at his own cost.

For any deviation from the working drawings or specification that are deemed necessary by the Contractor due to site conditions, he shall submit the details and obtain the Engineer approval before starting such works.

12. FACTORY TESTS

All type and routine tests on transformer, switchgear and all other equipment shall be performed at the manufacturer's works in the presence of the Engineer or his Representative. Type tests may be waived off in case test certificates are submitted as certified by an Engineer approved standard laboratory of international repute, but merely producing the test type certificates will not relieve the manufacturer to carry out the required standard/routine tests.

The Contractor shall inform the Engineer about the date and time of test for each equipment at least two weeks in advance. The witnessing of test by the Engineer or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment, and for furnishing the guarantee referred to in clause 8.0. All test results shall be supplied in quadruplicate. All expenses for carrying out the tests and witness by the Engineer shall be borne by the Contractor and deemed to have been included in the tender bid.

13. TESTING - GENERAL

13.1 Scope

Upon completion of the installation, the Contractor shall perform field tests on all equipment, materials and systems. All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with Specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials, etc. and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of Contractor.

The Contractor shall record all test values of the tests made by him on all equipment. Four (4) copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment, diagrams, etc.

The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantee for materials, equipment and workmanship, or as any other obligations of Contract.

13.2 **Insulation Resistance Test**

Insulation resistance test shall be made on all electrical equipment by using a megger of 500 Volts for circuits up to 250 Volts and 1000 Volts for circuits between 250 and 500 Volts. For testing of 11 kV circuits, up to 5 kV megger shall be used, the exact voltage shall be as advised by the equipment manufacturer unless otherwise advised by the Engineer.

The insulation resistance values of cables, transformer, switchgears, etc., shall be as per BSS, IEEE, NEC, ICEA and Pakistan Electricity Rules.

Before making connections at the ends of each cable run or joint between cables, the insulation resistance test of each cable section shall be made. H.T cables shall be subjected to high voltage test as per recommendations of standards to which the cable is manufactured. Each conductor of a multicore cable shall be tested individually with each of the other conductor of the group and also with earth. If insulation resistance test readings are found to be less than the specified minimum in any conductor, the entire cable shall be replaced and tests repeated on new cable. If cable joint is provided, then each cable section shall be tested, and joint made only after the tests have been made satisfactorily. Finally the completed cable length including the joints shall be tested.

The transformer and switchgear shall be given an insulation resistance measurement test after installation, but before any wiring is connected. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit under test is less than the specified value, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters, if equipment is found to contain moisture. Where corrective measures are carried out, the insulation resistance readings shall be taken after the correction has been made and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all tests have been made, the equipment shall be reconnected as required.

13.3 **Earth Resistance Test**

The Contractor shall make Earth resistance tests on the earthing system, separating and reconnecting each earth connection.

If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The electrical resistance of the ECC together with the resistance of the earthing leads measured from the connection with earth electrode to any other position in the complete installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical Inspector’s requirements. Where more than one earth electrode is installed, the earth resistance test of each electrodes shall be measured by means of resistance bridge instrument.

The complete lightning protection system shall be tested for continuity and earth resistance. The combined earth resistance at any point in the lightning protection system shall not exceed 10 ohms.

13.4 **Switchgear**

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams given by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for connections to give proper phase sequence.

Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses, disconnect switches, number of interlocks, indicating lights, alarms and remote control devices shall be in accordance with approved manufacturer drawings. Nameplates shall be checked for proper designation of equipment served. Protective relays shall be tested and set at site prior to commissioning of the equipment.

13.5 **Transformer Tests**

In addition to the insulation resistance test of the transformer, a polarity and phase rotation test shall also be made. Buchholz relay shall be tested for proper operation. Di-electric test shall be carried out on transformer oil prior to putting the same in operation.

13.6 **Special System Test**

The special systems such as telephone, intercom, public address, etc., shall be tested according to the procedures laid down in the respective sections of the technical specifications. However, any specific tests recommended by the manufacturer shall also be carried out as approved by the Engineer.

13.7 **Completed Tests**

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer the Contractor shall be responsible for the proper protection of that equipment so that subsequent testing of other equipment do not cause any damage to the already tested equipment.

13.8 **Expenses**

All expenses, i.e., traveling, boarding and lodging for carrying out the tests and witnessing by the Engineer shall be borne by the Contractor and are deemed to have been included in the BOQ rates of the respective equipment(s) by the Contractor.

14. ANNEXURES TO BE FILLED IN BY THE TENDERER

The details regarding equipment manufacturers, deviations, technical data, etc., are to be furnished in the annexure attached with form of tenders, in accordance with the provisions of the clause “Requirements of Electrical Works” given in the instructions to Tenderer, Volume - 1.

15. PAYMENT

No separate payment shall be made for work involved within the scope of this section unless specifically stated in the Bill of Quantities or herein.

SECTION - 8133

LOW TENSION DISTRIBUTION BOARDS

1.0 SCOPE OF WORK

The work under this section consists of design, manufacturing, fabricating, supplying, installing, connecting, testing, and commissioning of all material and services of the complete Low Tension Distribution Boards as specified herein, shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact and position of the electrical lines and equipment.

The Low Tension Distribution Boards with all shall also comply with the General specifications for Electrical & Communications Works Section-8001 and with other relevant provisions of the Tender Documents.

2.0 GENERAL

The Low Tension Distribution Boards shall be sheet steel fabricated. These shall be suitable for surface mounting, semi-recessed or recessed in wall mounting. The Low Tension Distribution Boards shall be totally enclosed, dust and damp proof. The Low Tension Distribution Boards shall be shall be complete in all respects with material and accessories, factory assembled, tested and finished according to the Specifications and to the normal requirements.

All components shall be installed on a common mounting plate inside the enclosure and protected from the front with screwed sheet steel front plate. The enclosure shall be provided with rubber gasketting and a lockable hinged door with cam fastener.

The distribution board shall be supplied complete with all installation materials as ecommended by the manufacturer. The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box for accommodating the cables and conduits may be provided. The box shall be of the same material and finish as the distribution board.

The cabling inside the distribution board shall be suitably harnessed by means of straps or cords. An earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of distribution board at two points.

The LT Distribution Boards, in general, shall;

- be suitable for indoor installation & operation.
- be suitable for operation and maintenance from front side.
- be suitable for both 400Volts AC, Three phase 4 wire and 250Volts AC, Single phase 2 wire, 50 Hz system.
- have all components rated for insulation class of 600V minimum for three phase and 300 Volts for single system.
- be designed for flush mounting of all instruments on the front.
- be provided with adequate clearance from live parts so flash overs can not be caused by switching, vermins, pests, etc.
- have incoming/outgoing cable termination arrangements. The power cables shall be directly connected to the terminals of TP 500V MCCBs of current ratings of 100 Amps and above. The SP/ TP MCBs and/ or MCCBs of current ratings upto and including 100 Amps shall be connected to DIN rail mounted wiring terminals of appropriate ratings, numbers and sizes for the outgoing wiring cables
- be provided with name plate on the front side of door.
- be provided with pocket inside of door for safe keeping of the detailed as-built wiring/ shop diagrams of the switch board.
- have provisions for incoming and outgoing cables entry, connections and termination arrangements from top and/ or bottom plates as per site requirements.
- have all openable doors grounded with the use of flexible copper cable/strip of 10 sqmm cross-sectional area.

3.0 APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope of this Section :

BS 4752-1	-	Triple Moulded Case Circuit Breaker
BS 3871	-	Single and Triple Miniature Circuit Breaker
IEC 157		
VDE 0641		
IEC 157	-	Low Voltage Switch gear and Control gear
&158		
IEC 439	-	Factory Built Assemblies of LV Switch gear
IEC 4752	-	Switch gear and control gear for Voltages upto & including 1KV
BS 88	-	HRC Fuses
IEC 73	-	Colors for indicator lights and push buttons.
IEC 446	-	Identification of insulated/bare conductors

4.0 MATERIAL

4.1 Sheet Metal Work

The Surface mounting Low Tension Distribution Board shall be fabricated with 14 SWG sheet steel and the semi-recessed or recessed mounting type shall be fabricated with 16 SWG sheet steel.

The complete sheet steel metal work of the Low Tension distribution board shall be:

- cleaned down to bare shining metal
- de-rusted and de-greased
- painted with two base coats of anti-corrosive RED oxide paint.
- Two coats of weather proof powder paint in approved colour.

4.2 Components

The Low Tension Distribution Board shall be provided with components as specified in the specifications, mentioned in the Bill of Quantities, as shown on the Tender Drawings required for the satisfactory operation of the distribution board and of the electrical system.

Typical component specifications are given below:-

4.2.1 Bus Bars

The bus bars shall be made of high conductivity electrolytic copper and shall be completely isolated and mechanically braced for the specified fault level. The phase identification of bus bars shall be by colours applied on bus bars and these shall be red, yellow and blue for phase and white for natural. The earth bus bar shall be green.

The bus bars shall be triple pole and neutral and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 45 degrees centigrade at rated current.

4.2.2 Moulded Case Circuit Breaker (MCCB)

The MCCB shall be moulded case, triple pole, rated for 500 Volts AC. The Operating current ratings and Rupturing capacities shall be as mentioned in the relevant items of the Bill of Quantities and as shown on the drawings. The MCCB's shall have fixed Magnetic Short circuit and fixed Thermal Overload protections. However, the short circuit breaking capacities of triple pole moulded case circuit breaks shall be more then or atleast 10,000 Amperes as per IEC category P2 unless specified elsewhere. All Triple pole circuit breakers of current ratings above 40 Amperes shall be Moulded Case Circuit Breakers.

The Moulded Case Circuit Breakers shall be installed in the LT SwitchBoards such that the Switching lever of the Main Incoming MCCB shall be accessible from the front of the panel with the front door in closed position and the switching levers of all outgoing MCCB's and MCB's are accessible through the front plate inside the SwitchBoards for operations. Circuit Numbers and Designation on all circuits shall be clearly marked to facilitate connection and maintenance.

4.2.3 **Miniature Circuit Breaker (MCB)**

The MCB's shall be Single pole 250 Volts and Triple pole 500 volts of current ratings as shown on the drawings. These shall have fixed magnetic short circuit and fixed thermal overload protections. The Single pole and Triple pole miniature circuit breakers shall have a 10,000 Amperes short circuit breaking capacity as per International standards IEC 157 Category P2, 9 kA short circuit breaking capacity as per British standard specifications BS 3871 (M9) and 15 kA short circuit breaking capacity as per German Standards specifications VDE 0641.

The Miniature Circuit Breakers shall be installed such that their switching levers are accessible through the front plate inside the Switch Boards for operations. Circuit Numbers and Designation on all circuits shall be clearly marked to facilitate connection and maintenance. These Circuit Breakers shall be suitable for working on lighting and power circuits.

All Single pole and Triple pole circuit breakers of current ratings upto and including 40 Amperes ratings shall be Miniature Circuit Breakers.

4.2.4 **Push Buttons**

Push buttons shall be momentary make break contact type (normally open/normally close). These shall be suitable for flush mounting. Distribution board, plastic face plate etc. Push buttons shall have round/square head. These shall be of red color for 'ON' and green color for 'OFF' operations.

4.2.5 **AC Voltmeters**

AC Volt meters shall be DIGITAL type and shall be suitable for flush mounting on front door of the Distribution Boards. The front dimensions shall be 96 mm Wide and 48 mm high. The volt meters shall shall have 3-1/2 digit, 0.55 inch display. The AC DIGITAL voltmeters shall have measuring range of 0 - 1999 volts.

It shall be suitable for power supply of 110/220 VAC +10% at 50/60 HZ.

4.2.6 **Ammeters**

AC Ampere meters shall be DIGITAL type and shall be suitable for flush mounting on front door of the Distribution Boards. The front dimensions shall be 96 mm wide and 48 mm high. The Ampere meters shall shall have 3-1/2 digit, 0.55 inch display. The AC DIGITAL voltmeters shall have measuring ranges as shown on the drawing and given in the Bill of Quantities.

It shall be suitable for power supply of 110/220 VAC +10% at 50/60 HZ.

4.2.7 **Volt meter Selector Switch**

The voltmeter selector switch shall be complete with front plate, grip handle, and RY-YB-BR-OFF-RN positions.

4.2.8 **Ampere meter Selector Switch**

The ampere meter selector switch shall be complete with front plate, grip handle, and R-Y-B-OFF positions.

4.2.9 **Current Transformers**

Air cooled, ring type current transformers shall be provided having transformation ratio as indicated on the drawings. The current transformers shall be of suitable burden having accuracy class 1.0 and have 5 amps secondary.

4.2.10 **Air Break Magnetic Contactors**

The contactors shall be air break, triple pole, 400V suitable for the type of duty to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with 230 VAC single phase operating coil, and minimum two normally open (NO) and two normally closed (NC) auxiliary contacts wired upto terminals. The number of working auxiliary contacts shall be provided according to the system requirements.

4.2.11 **Indicating Lamps**

Indicating lamps shall be suitable for flush mounting, complete with base, 230 volt incandescent lamp and shall have rosettes of suitable colour.

4.2.12 **Line up Terminals**

Line up terminals wherever provided for control of lighting, power and control circuits shall be suitable for voltage and size of conductors as indicated on drawings and as mentioned in the respective BOQ items. The line-up terminals shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

5.0 INSTALLATION

The location of distribution boards are shown diagramatically on the drawings. The actual location shall be determined at site, keeping in view the site conditions and in coordination with other equipment.

Low tension distribution board for recessed mounting in wall shall be installed such that the door shall finish flush with the surface of wall. The recess mounted distribution board shall be installed before the plastering of walls. The DB shall be protected to avoid any damage due to the civil work.

All loose parts dispatched separately with the DB shall be installed as per manufacturer instructions and all adjustments or setting shall be made as required. All screws, nuts and bolts used for fixing the distribution board shall be galvanized. The distribution boards installation shall include connecting all incoming and outgoing cables. The cable entry in the boards shall be provided from top or bottom as required.

The distribution board body shall be connected to earth as per instructions given in section "Earthing" of these Specifications. The switchboard shall be tested and commissioned in the presence of the Engineer. The LT distribution boards shall be tested before energizing as per instructions contained in the article "Testing" of General Specifications for Electricial Works, Section-8001 of these Specifications.

6.0 MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each item of Bill of Quantities as given below shall include design, fabrication, supply, installation, testing, commissioning and completion for all works specified herein and/or as shown on the Tender Drawing related to the item.

6.2 LT Distribution Board

6.2.1 **Measurement**:

Measurement shall be made for the number of each type/ designation of LT distribution boards acceptably supplied and installed by the Contractor as a complete job.

6.2.2 **Payment**:

Payment shall be made for the number of each type/designation of jobs measured, as provided above, at the Contract unit price each for design, fabricating, supplying, installing, testing, and commissioning of the LT distribution boards, including fixing arrangement and accessories for complete installation.

SECTION - 8220

SWITCH FITTINGS & ACCESSORIES

1.0 SCOPE OF WORK

The work under this section consists of supplying, installing, and commissioning of all material and services of the complete switch fittings and accessories as specified herein, as shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact location and position of all electrical equipments.

The switch fittings and accessories shall also comply with the General Specifications for Electrical & Communications Works Section-8001 and with other relevant provisions of the Tender Documents.

2.0 GENERAL

The Light control switches, switch socket units, Fan Controllers, Industrial socket units, etc. shall be of following ratings;

- Light Switches rated for 5A,250V
- Fan dimmers rated for 100W, 250V,
- combined 2 & 3 pin rated for 10A, 250V,
- Shuttered 3 pin rated for 15A, 250V,
- Shuttered 3 pin rated for 20A, 250V,

The locations of the switch fittings & accessories such as sockets, switches etc. are tentatively shown on the drawings. The Contractor shall ensure the exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer.

3.0 APPLICABLE STANDARDS/CODES

The latest edition of following standards codes shall be applicable for the materials within the scope of this section:

BS	-	Switches for domestic and similar purposes.
BS 2135	-	Capacitors for radio interference suppression.
BS	-	3 pin plugs, socket outlets and socket outlet adapter.
BS67/PS 116	-	Two and three terminal ceiling roses.
BS	-	Light dimmers and Fan Controllers.
BS 4934	-	Safety requirements for electric fans and regulators.
BS 5060	-	Performance of circulating fans and their regulators.

4.0 MATERIAL

4.1 One Way Switches - Indoor type

Switches for controlling light points shall be single pole, rated for 10 Amps, 250V AC. The body of the switches shall be suitable for flush mounting on PVC back box/ outlet box. The switches shall have screw contacts and shall operate with snap action.

4.2 Two Way Switches - Indoor Type

Two way switches for control of lights shall be of same make and specifications as for one way switches above, except these shall be of use to control light circuits from two different locations.

4.3 Switched Socket Outlets

Switched Socket units shall be of the following combinations and ratings:

- combined 2 & 3 pin rated for 10A, 250V,
- Shuttered 3 pin rated for 15A, 250V,
- Shuttered 3 pin rated for 20A, 250V,

Front faceplate shall conform to the requirements stated above for switches - Indoor type. The outlets shall be heavy-duty type suitable for mounting on PVC outlet box. The 3 pin 15 amps and 3 pin 20 Amps sockets shall have shrouded live contacts and designed such that the earth pin of plug is engaged to socket earth before mating of live contacts.

4.4 Fan Controller

Fan Controller for fan speed regulating shall be suitable for Ceiling fans, rated for 10 Amps, 250V AC. The body of the fan Controller shall be suitable for flush mounting on PVC back box/ outlet box. The fan Controller shall have ON/OFF switch that shall operate with click action.

4.5 Outlet Box

The outlet boxes for installation of switches, Dimmers and socket outlets shall be of PVC having appropriate dimensions. The box shall have suitable arrangement for receiving the conduit.

5.0 INSTALLATION

5.1 General

The mounting heights of all wiring accessories fixtures are stated on the drawings. In case the mounting height is not mentioned, the instructions of the Engineer Incharge shall be obtained before fixing.

5.2 Light Control Switches

The Light Control Switches shall be installed directly on back boxes/ outlet boxes recessed in CC/ RCC walls or columns. The fixing of Light Control Switches shall be by means of screws provided with them so as to finish flush with the surface.

5.3 **Switched Socket Outlets**

The Switched Socket Outlets shall be installed directly on back boxes/ outlet boxes recessed in CC/ RCC walls or columns. The fixing of Switched Socket Outlets shall be by means of screws provided with them so as to finish flush with the surface.

5.4 **Fan Controllers/Light Dimmers**

The Fan Controllers/Light Dimmers shall be installed directly on back boxes/ outlet boxes recessed in CC/ RCC walls or columns. The fixing of Fan Controllers/Light Dimmers shall be by means of screws provided with them so as to finish flush with the surface.

6.0 MEASUREMENT AND PAYMENT

6.1 **General**

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

6.2 **Light Control Switches**

6.2.1 **Measurement:**

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

6.2.2 **Payment:**

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each type and rating of the Light Control Switch including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

6.3 **Switched Socket Outlets**

6.3.1 **Measurement:**

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

6.3.2 **Payment:**

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each type and rating of the Switched Socket outlet including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

6.4 **Fan Controllers**

6.4.1 **Measurement:**

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

6.4.2 **Payment:**

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each type and rating of Fan Controller unit including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

6.5 **Light Dimmers**

6.5.1 **Measurement:**

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

6.5.2 **Payment**:

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each type and rating of Light Dimmer unit including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

SECTION - 8310

TELEPHONE SYSTEM

1.0 SCOPE WORK

The work under this section consists of supplying, installing, testing, commissioning of all material and services of complete telephone system as specified herein, as shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and position of the system.

The telephone system with accessories shall also comply with the General Specifications, Section 8001 and with other relevant provisions of the Tender Document.

The work shall be undertaken in accordance with applicable rules and regulations of Pakistan Telecommunication Company Limited. Any approval/NOC required from PTCL shall be Contractor's responsibility.

2.0 GENERAL

The system shall comply with the general requirements for telephone system as specified by the Pakistan Telecommunication Authority (PTA). The system shall be capable of accepting analog as well as digital incoming signals. The system shall be capable of connecting telefax etc.

3.0 STATEMENT OF COMPLIANCE

Prospective tenderers shall point by point confirm in writing their compliance with the items of this specifications in the form of a qualified statement of compliance. No consideration will be given to a quotation without this important document.

4.0 APPLICABLE STANDARDS AND CODE

The latest editions of the following standards/codes shall be applicable for the materials covered within the scope of this section:

DIN	47614	-	Terminal Strips
DIN	40040	-	Class and Reliability of units in Telecommunication
DIN	57800	-	Regulations for installation and operation of Telecommunication.
DIN	57804	-	Telecommunications. Manufacture and Test of Apparatus.
			CCITT recommendation for ISDN system and local PTCL/PTA regulations.
ISO 9000-Series		-	Manufacturer for quality control.
Certified			

5.0 EQUIPMENT

5.1 Operator Console

Operator Console shall provide common answering facilities, pertain of console shall be by means of a handset or headset. To enhance the operator convenience attendant console shall also have LEDs and a 48-digit alpha-numeric display panel showing the current status, call type call charges etc. Additional keypads shall be provided for the connection of priority.

5.2 Channel Conduit and Conduit Accessories

The specifications for channel conduit and conduit accessories shall be same as given for electrical channel conduit in section “Conduits Channel and Pipes” of these specifications.

5.3 Telephone Cable

Telephone cable shall be PVC insulated, PVC sheathed multipair 0.6mm diameter tinned copper conductor conforming to IEC publication 189.

The PVC insulation shall comply with BS 6746. The conductor shall be tinned solid high conductivity soft annealed copper complying with BS 6360. The insulation of conductors shall be colour coded as per above-mentioned publications. The cable shall have the approval of the Pakistan Telecommunication Company and also the Engineer.

5.4 Telephone Outlet

The telephone outlet back boxes shall have appropriate dimensions made of 16 SWG (1.63mm) sheet steel and suitable arrangement for termination of conduits or of teak wood for installation in dry partitions.

The telephone outlet shall be type RJ11 single unit in accordance with BS 5733. The outlet shall be of Clipsal Australia or `MK’ UK make or approved equivalent.

5.5 Distribution Box

Telephone distribution box shall be made of 16 SWG (1.63mm) sheet steel having required dimensions to accommodate the terminal strips with adequate space available for wiring. The terminal strips shall have provision for tag numbers for telephone extension and with suitable capacity for terminating all incoming and outgoing cables including direct lines. The strip shall be installed on insulated material sheet inside the sheet steel boxes. The termination strip shall provide Insulation Displacement Contact (IDC) technique for easy and quick connection for 0.6mm. wire size. The termination strip shall have following minimum specifications:

Insulation Resistance	:	> 105 ohm
Dielectric Strength	:	> 2kV rms.
Termination Resistance	:	< 1 ohm
Capacitance between		
Adjacent Contacts	:	< 5 pF
Current Carrying Capacity	:	Disconnection Contact 5 kA 8/20U Sec.
	:	Connection Contact 10 kA 8/20U Sec.

Contacts	:	Silver-plated brass alloy
Material	:	Self extinguishing plastic component according to UL94.

The steel box shall be provided with a lockable hinged door. The distribution box shall be suitable for recess mounting.

The distribution box shall be of Krone make or approved equivalent.

6.0 INSTALLATION

6.1 Conduit Channel

The telephone conduit channel shall be installed in accordance with the instructions and details given in section “Conduit, Channel and Pipes”, of these Specifications. Telephone conduit shall be laid 150mm way from the electrical conductors or cables, and wherever electrical conduits or cables, and telephone conduits cross each other, they shall do so at right angles.

Identification marking shall be given at the termination or free end of conduit so that it may not be confused with the electrical conduits. The marking shall be both by colour and by attaching an approved brass tag using brass or bronze tie wire. Each tag shall be clearly stamped with “T” for telephone conduit.

6.2 Telephone Distribution Box

Distribution boxes for telephone cables shall generally recessed type. The frame of the telephone distribution box shall finish flush with the surface of wall. However, surface type telephone distribution box shall also be acceptable with the approval of the Engineer.

All screws, nuts and bolts used for fixing the box shall be galvanized. Soft metal bushes shall be used at conduit entries in the box.

6.3 Telephone Outlet

These shall be installed on the outlet box fixed in the wall, partition and floor.

6.4 Telephone Cable

The telephone cable shall be installed as outlined in section T.T. ‘Cables’ of these specifications. All cables shall be provided with plastic identification tags at termination, which shall be clearly shown on the As-Built drawings. The complete wiring shall be checked for continuity, identification and insulation before connections are made.

7.0 MEASUREMENT AND PAYMENT

7.1 General

The Contractor’s bid amount against each Bill of Quantities items as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawings related to the item.

7.2 Conduits, Channels

7.2.1 **Measurement:** Measurement shall be made for the total running feet of each size of conduits and channel acceptably supplied and installed by the Contractor.

7.2.2 **Payment:** Payment shall be made for the number of running feet of conduit and channel measured as provided above at the Contract unit price and shall constitute full compensation for supplying, installing & completion of the laying of the conduits and channels including jointing materials and accessories, cutting chasing of civil works, excavation and backfilling of ground for underground PVC conduits, painting, plugging, tagging, etc., as applicable for each type of work.

7.3 **Telephone Cable**

7.3.1 **Measurement**: Measurement will be made of the total number of running feet for each size of telephone cable acceptably supplied and installed by the Contractor.

7.3.2 **Payment:** Payment will be made for the number of running feet of each size of cable at the Contract unit price and shall constitute full compensation for supply, installing, testing and commissioning of the telephone cables including all accessories.

7.4 **Telephone Outlet**

7.4.1 **Measurement**: Measurement shall be made of the total number of each type of telephone outlet acceptably supplied and installed outlet box by the by the Contractor as a complete unit.

7.4.2 **Payment:** Payment shall be made for the number of units measured as provided above at the Contract unit price and shall constitute full compensation for supply, installing, testing and completion of the telephone point including all civil works and other accessories.

7.5 **Telephone Distribution Box**

7.5.1 **Measurement**: Measurement shall be made of the total number of each type of telephone distribution box acceptably supplied and installed by the Contractor as a complete unit.

7.5.2 **Payment**: Payment shall be made for the total number of units measured as provided above at the Contract unit price each, and shall constitute full compensation for supplying, installing and completion of the telephone distribution box including all civil works and other accessories.

7.6 **Wiring of Telephone Outlet/Distribution Boxes**

7.6.1 **Measurement**: Measurement shall be made of the total number of each type of wiring of telephone outlet/distribution boxes, acceptably carried out by the Contractor as a complete job.

7.5.2 **Payment**: Payment shall be made for the number of units measured as provided above at the Contract unit price each, and shall constitute for supplying, installing and completion of the wiring between telephone outlet, telephone outlet and distribution box and between distribution boxes including required pair of multi-core telephone cable and appropriate size conduit and all accessories.

PART-2
PUBLIC HEALTH WORKS

TABLE OF CONTENTS

SECTION - 1

EXCAVATION, TRENCHING AND BACKFILLING

1.1 SCOPE

The work covered by this section of the Technical Specifications consists of furnishing all plant, labour, equipment, appliances, and the materials for performing all operations in connection with excavation, trenching and back-filling for water supply, sewerage and structures including all incidental works necessary for excavation to the required depth and dimensions in accordance with the applicable drawings, or as directed by the Engineer. The work shall be carried out in complete conformity with the specifications, setforth hereunder.

1.2 SETTING OUT

The Contractor shall set out the works in accordance with the dimensions, lines and levels shown on the Drawings. Where no precise positions or levels are shown on the drawings, the works shall be set out by the Contractor to the positions and levels determined by the Engineer's Representative as the work proceeds.

1.3 CLEARING AND GRUBBING

The sites of all excavations shall be cleared of all shrubs, plants, bushes, large roots, rubbish and other objectionable materials. All such materials shall be removed from site of work or otherwise disposed of at no extra cost in a manner satisfactory to the Engineer. All trees and shrubs that are designated by the Engineer to remain shall be adequately protected and preserved in an approved manner.

1.4 EXCAVATION

1.4.1 General

All excavation of whatever substance encountered shall be performed to the depths indicated or as otherwise specified. During excavation, material suitable for back-filling shall be stockpiled in an orderly manner at a sufficient distance from the banks of the excavation to avoid overloading and to prevent sides from caving . All excavated material unsuitable for backfill shall be removed and placed at a location approved by the Engineer. Grading shall be done as may be necessary to prevent surface water from flowing into the trenches or other excavations, and any water accumulated therein shall be removed by pumping or by other approved methods. Unless otherwise indicated or approved by the Engineer, excavation shall be open cut. For Contract purposes hereunder the earth excavation work has been classified into two categories, earth excavation in trenches and earth excavation for structures.

1.4.2 Earth Excavation in Trenches

Unless otherwise directed or permitted by the Engineer not more than 100 ft of any trench in advance of the end of the pipeline already laid shall be opened at any time. Trenches shall be excavated to the dimensions and depths shown on the drawings or ordered by the Engineer or in such a position or to such dimensions and depths as shall allow for the proper construction of the relevant structure or proper excavation of the relevant operation. Pipe trenches shall be excavated to give a clear width of 6 inches on either side of the pipe. Additional excavation shall be carried out to give ample space for making joints and, where necessary, for concrete bedding or surround.

The banks of the pipe trench shall be as nearly vertical as practicable. Bell holes and depressions for joints shall be dug after the trench bottom has been prepared. The pipe, except for joints, shall rest on the prepared bottom for its full length. Bell holes and depressions shall be only of such length, depth, and width as required for properly making the particular type of joints. Stones shall be removed to avoid point bearing. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe as determined by the Engineer is encountered in the bottom of the trench, such material shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, or other suitable approved granular material. Such replacement of unsuitable material will be paid for at the contract unit price for that item of work as shall be agreed upon, before execution of this work, with the Engineer.

Where the Contractor has excavated to depths in excess of the requirements, from his neglect or from causes within his control, he shall refill and compact the excess excavation with suitable material approved by the Engineer, upto corrected level, at his own expense.

Excavation of appurtenances shall be sufficient to leave at least 12 inches but not more than 24 inches between the outer surface and the embankment or timber that may be used to hold and protect the banks. Any over-depth excavation below such appurtenances that has not been directed by the Engineer, will be considered un-authorized and shall be refilled with compacted sand, gravel or concrete, as directed by the Engineer and at no additional cost to the Employer.

1.4.3 Earth Excavation for Structures

All earth excavation under this contract, which is not included under the classification of "Earth excavation in Trenches" shall be classified and paid for as earth excavation for structures.

The Contractor shall provide adequate timbering or shoring for excavations, should the sides and ends of any excavations give way the Contractor shall, at no extra cost, remove all disturbed ground. Any excavation carried outside the limits shown on drawings and specified herein as the payment limits, shall not be treated as excavated and shall not be paid for.

When foundation level or base of excavation is reached, the Engineer's representative will inspect the exposed ground and give directions as to what further excavation, if any, he considers necessary. The excavation should be done in such a manner, as to ensure that the work rests on a solid and perfectly clean foundation. If the Contractor allows any portion of such foundations to deteriorate due to exposure, he shall make good the foundation to the satisfaction of the Engineer without extra cost.

1.4.4 Replaced Soil Under Foundations

1.4.4.1 Material

Selected well graded granular material shall be used for filling beneath the structural foundations. This material should meet the requirements of A-2-4 & A-3 (AASHTO soil classification).

The suitability of the material shall be supported by adequate tests in the laboratory.

1.4.4.2 Equipment and Procedure

Suitable equipment shall be selected by the Contractor on the basis of field trials for compaction. The contractor shall indicate his planning to carry out compaction in his Method Statement for Engineer's approval before undertaking actual compaction. A test section would be required to select the most suitable equipment, layer thickness, moisture content, No. of passes etc.

1.4.4.3 Compaction Standard

The contractor shall place the material to be compacted in layers. Each layer shall be of specified thickness and shall be compacted by the optimum number of passes as explained in above section. Compaction less than 75% of relative density or 95% of Modified Proctor Density shall not be acceptable.

1.4.4.4 Quality Control

Every compacted layer shall be tested for quality of compaction by performing in-situ density tests. Sand replacement method of density measurement shall be used. The evaluation of 75% relative density or 95% Modified Proctor Density shall be based on measurement of maximum, minimum and maximum Modified Proctor Densities in the laboratory. The frequency of this testing shall be instructed by the Engineer at the site.

1.5 PRECAUTIONARY AND REMEDIAL MEASURES

1.5.1 Protection of Existing Facilities and Structures

The Contractor shall take every necessary precaution not to endanger the safety, occupation or operation of any property, structures, installations or services in the vicinity of his operations and shall observe any restrictions imposed by the Authority concerned and the Engineer to this end. Should any such property, structures, installations or services be endangered or damaged as a result of the Contractor's operations, he shall immediately report any such danger or damage to the Engineer's Representative and any Authority concerned and shall forthwith undertake remedial measures to the satisfaction of the Engineer and the appropriate Authority with out additional cost.

1.5.2 Planking and Strutting

The Contractor shall provide at his own expense to the satisfaction of the Engineer all timbering, poling, shoring, strutting and other approved supports to the sides of all excavations, trenches and all other works in such a way as will be sufficient to secure them from falling and to prevent any movement. All responsibilities connected with this part of the work shall rest with the Contractor.

In removing timbering, shoring and strutting and all other supports from excavation and trenches, special care shall be taken to avoid pressure on fresh concrete or any other work until it is sufficiently safe to resist such pressure.

1.5.3 Dewatering

The Contractor shall build all drains and do ditching, pumping, well pointing, bailing, and all other work necessary to keep the excavation clear of ground water, sewage and storm water during the progress of the work and until the finished work is safe from injury. All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Engineer and necessary precautions against flooding shall be taken. The procedure for dewatering of subsoil water from excavation for the purpose of construction of sewer lines and other structures shall be in accordance with the method given below:

- Dewatering of subsoil water from excavations of trenches and excavations for other structures shall be arranged by an adequate process of well-pointing, bailing and/or pumping or by any other suitable method approved by the Engineer on the basis of the method (statement to be submitted by the Contractor).

- If well-points are used then the following requirements shall be met with. Well-pointing shall consist of bore holes, provided with necessary strainers, blind pipes and pumping machinery, and these shall be of suitable size and depth and shall be located on both sides of the trench and along the periphery of water level to a sufficient depth to keep the excavations clear of subsoil water during the process of construction.

- As a part of the work and at no extra cost, the Contractor shall provide all strainer pipes and other requisite material, and boring tools and plant, etc. for the well pointing and shall also provide pumping equipment as well as operating personnel, power, etc. Dewatering of subsoil water shall be continuous process round the clock during the progress of the work and until the finished work is safe, from injury to the complete satisfaction of the Engineer's representative and any interruption in continuous pumping and causing injury to the works done or under construction shall require the Contractor to repair or rebuild the works to the entire satisfaction of the Engineer's representative at no extra cost. No extra payment shall be made to the Contractor for the disposal of storm water and for dewatering in trenches and building structures less then 5 ft. depth.

1.5.4 Maintenance of Excavation

All excavation shall be properly maintained while open and exposed. Sufficient suitable barricades, warning lights, flood lights, reflective signs, and similar items shall be provided by the Contractor. The Contractor shall be responsible for any damage due to his negligence.

1.5.5 Surplus Materials

All surplus materials shall be disposed of at locations approved by the Engineer. The disposal of surplus material shall not interfere with other works and shall not damage or spoil other material. When it is necessary to haul earth or rock material over street or pavement, the Contractor shall prevent such material from falling on the street or pavement.

1.5.6 Cutting Pavement

In cutting or breaking street surfacing, the Contractor shall not use equipment which will damage the adjacent pavement. Existing paved surfaces shall be cut back beyond the edge of trenches to form neat square cuts. The road ballast, brick pavement, and other materials shall be placed on one side and shall be preserved for reinstatement when the trench is filled. Wherever necessary or required for the convenience of the public or individual residents, at street crossings and at private driveways, the Contractor shall provide suitable temporary bridges which shall be maintained in service until backfilling has been completed. The Contractor shall keep the road crossings manned 24 hours per day. During night time, enough red lights shall be provided to warn the traffic. If detour is necessary, the Contractor shall make proper detour for the traffic and shall install signs 3 ft. x 4 ft. in size indicating the detour.

1.6 TRANSPORTATION OF MATERIAL

All carts, trucks or other vehicles used by the Contractor for transportation of the material shall be suitably constructed or lined not to permit any leakage/spillage of soil while the vehicles are on the move. These would be so loaded and arranged as not to spill on the site and public roads. Whenever any vehicle so used is found leaking/spilling and unsuitable, it shall be immediately withdrawn from the work on notification by the Engineer.

1.7 COMPACTED FILL AND BACKFILL

1.7.1 General

After the completion of water and sewer lines, foundations, walls and other structures below the elevation of the final grade, all voids shall be backfilled with suitable materials, as specified below.

1.7.2 Backfilling for Structures

Backfilling operations for structures shall be performed as part of the Contractor's work under the payment items for earth excavation and at no extra cost to the Employer. It would comprise returning and filling the selected excavated material around foundations, and at back of walls etc., upto finished levels shown on the Drawings or as required in layers not exceeding 6 inches, carefully rammed and consolidated (with addition of water if required) so as to achieve a minimum relative density of 90% of modified proctor test at optimum moisture content. No fill shall be made until the concrete foundations and footings etc., have been inspected and approved by the Engineer. Earth to be used for filling must be free of all the organic impurities, debris or any other foreign matter. Earth which contains more than 1% of salts particularly sulphates, will not be used in filling.

1.7.3 Backfilling of Trenches

The trenches shall not be completely backfilled until all required pressure tests are performed and until the water lines as installed conform to the requirements of specifications. Where in the opinion of the Engineer, damage is likely to result from withdrawing sheeting, shoring, the same shall be left in place and cut off at a level 1 ft. below ground surface. Sheeting left in place shall be paid for at the approved rate for that item of work. Trenches shall be backfilled to the ground surface with selected excavated material or other material that is suitable for proper compaction. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted to the specified density. The surface shall be restored to its original or better condition. Pavement and base course disturbed by trenching operations shall be replaced.

1.7.4 Lower Portion of Trench

Backfill material below and around pipe shall be deposited in 6 inch maximum thickness layers and compacted with suitable hand tampers to 90% of maximum density until there is a cover of not less than 1 ft. over the pipe. The backfill material in this portion of trench shall consist of sandy clay or other approved materials free from stones and lumps.

1.7.5 Remainder of Trench

The remainder of the trench portion above pipe shall be backfilled with material that is free from stones larger than 6 inch in any dimension. Backfill material shall be compacted to achieve a minimum relative density of 90% of modified proctor test at optimum moisture content for cohesive soils and 95 percent of maximum density for others.

1.8 BORROW

In case of insufficiency of excavated material and un-suitability of earth for backfilling, conforming to the above specifications, such material shall be brought from the source approved by the Engineer.

1.9 GRADING

After the completion of all backfilling operations, the Contractor shall grade the work areas to the lines, grades and elevations shown on the drawings or as directed by the Engineer. Finished grading shall not be done until the installation of all utilities or appurtenance. All damage due to settlement shall be repaired by and at the expense of the Contractor.

1.10 TESTING OF SOIL IN PLACE

The Engineer will make tests using the calibrated cone method/core cutter method to determine the density of soil in place. If soil in place fails to meet the specified degree of compaction the areas represented by the failing tests shall be removed, replaced and compacted to the specified density in the manner directed by the Engineer and at no additional cost to the Employer.

1.11 MEASUREMENT AND PAYMENT

1.11.1 Excavation and Backfilling

1.11.1.1 Method of Measurement

The measurement shall be made in cubic feet of earth acceptably excavated and backfilled for trenches and structures within the lines and grades shown on the drawing or as directed by the Engineer.

The measurement of dewatering in trenches or structures shall be made in cubic feet of earth acceptably excavated for trenches or structures and extra over the normal excavation rates, within the lines and grades shown on the drawing or as directed by the Engineer.

1.11.1.2 Basis of Payment

Payment for earth excavation and backfilling in trenches or structures will be made at unit price per cubic ft. stated in Bid Schedule of this contract or in applicable Variation Orders.

Payment for dewatering for trenches or structures shall be made extra over the normal excavation in the quantity at unit price per cubic ft. stated in Bid Schedule of this contract or in applicable Variation Orders.

Pay Item	D e s c r i p t i o n	Unit
1.1	Excavation for structures and compacted backfill.	Cft.
1.2	Extra over pay item 1.1 for Dewatering in structures	Cft.
1.3	Excavation of Trenches and compacted backfill.	Cft.
1.4	Extra over Pay item 1.3 for Dewatering in Trenches	Cft.

SECTION - 2

CONCRETE

2.1 SCOPE

This section covers the manufacture, forming, transporting, placing, stripping of forms, finishing and curing of plain and reinforced normal concrete in the structures included herein.

2.2 SPECIFICATIONS

Concrete work shall conform to all requirements of ACI 301-84, (Revised 1985), Specifications for Structural Concrete for Buildings, except as modified by supplemental requirements below. The Contractor shall submit, for the approval of the Engineer, before commencement of any work, his Method Statement which would provide complete details of the procedures and equipment to be used for the satisfactory execution of the work. The approval of such Method Statement shall not relieve the Contractor of any of his responsibilities under the Contract.

2.3 COMPOSITION AND QUALITY

Concrete shall be composed of cement, water, fine and coarse aggregates and any admixtures as and when specified. The concrete mixes will be designed by the Contractor and submitted to the Engineer for approval. The desired strength of concrete for various parts of the structures have been shown on the Drawings. Such concrete mixes shall not relieve the Contractor of the responsibilities to achieve the desired strength of concrete for various parts of structures as specified in the Technical Specifications or shown on the Drawing and to the full satisfaction of Engineer.

2.4 CEMENT

2.4.1 General

Cement shall be furnished in sacks or in bulk form as approved by the Engineer. Unless otherwise permitted, cement from not more than two plants shall be used and in general, the product from only one plant shall be used in any particular section of the work. No cement recovered through cleaning sacks shall be used. Sulphate Resistant Cement shall be used in structures below finished ground/ plinth level when directed by the Engineer.

2.4.2 Sulphate Resistant Cement

Sulphate resistant (SR) cement must be used where directed by Engineer. Sulphate resistant cement must meet the minimum requirement limits set in the BS4027-1996 (42.5N/R Grade).

2.4.3 Portland Cement

Portland cement shall conform to latest British Standard 12:1978, Specifications for Portland Cement or to ASTM Designation C150 - 86, Standard Specifications for Portland Cement for Type I. Portland cement conforming to ASTM Designation C150-86, Type II or IV may also be used in certain parts of work as directed by the Engineer.

2.4.4 Tests

Cement shall be sampled at storage site and tested from time to time at the discretion of the Engineer in accordance with the ASTM Designation C150-86 or its equivalent British Standards. Expenses for such tests shall be borne by the Contractor. If the tests prove that the cement has become unsatisfactory, it shall be discarded and thrown as rejection as directed and to the full satisfaction of

the Engineer. Cement which has been in storage at the project site longer than four months, shall not be used until retesting proves it to be satisfactory.

2.4.5 Storage

Cement shall be stored in dry, weather tight and properly ventilated structure. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification of each consignment. Sufficient cement from a single source shall be in storage at the work site to complete any lift of concrete stored. Adequate storage capacity shall be furnished to provide sufficient cement to meet the peak needs of the project. Cement in sacks shall be stored on a damp proof floor and shall not be piled to a height exceeding 6 feet.

The Contractor shall use cement in the approximate chronological order in which it is received at the site. All empty sacks shall be promptly disposed of as permitted and directed by the Engineer so as to avoid any confusion in use of quantity of cement.

Cement storage facilities shall be emptied and cleaned by the Contractor when so directed, however the interval between required cleaning normally will not be less than four months. Suitable, accurate scale shall be provided by the Contractor for weighing the cement in stores and elsewhere on the work, if required, and he shall also furnish all necessary test weights.

2.4.6 Delivery and Usage Record

Accurate records of receipts of cement at site and its use in the work shall be kept by the Contractor. Copies of these records shall be supplied to the Engineer in such a form as he may require.

2.5 AGGREGATES

Materials used as aggregates shall be obtained from sources known to produce satisfactory results for the different classes of concrete. The use of aggregates from sources which have not been approved by the Engineer shall not be permitted.

2.5.1 Fine Aggregate for Concrete

Fine aggregate for all the classes of concrete shall be well graded natural sand, stone screenings or other inert material of similar characteristics or a combination of these. The whole of it shall be perfectly clean, free from coagulated lumps, soft and flaky particles, shale alkali, organic matter, loam mica and injurious amount of other deleterious substances. Maximum allowable content of silt and other deleterious inert substances is 5 percent by washing. Material derived from stone unsuitable for coarse aggregate shall not be used as fine aggregate. Fine aggregate derived from stone screenings shall be sharp, cubical, hard, dense and durable and shall be stacked on a platform so as to adequately protect it from dust and other admixtures.

Grading for the above specified fine aggregate shall be within the following limits, as determined by the Employer:

Sieve Size	Percentage Passing (Dry Weight)
3/8 inches (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	80 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (0.60 mm)	25 to 60
No. 50 (0.30 mm)	10 to 30
No. 100 (0.15 mm)	2 to 10

Fine aggregate for class D concrete may be good quality bank run sand obtained from the River in vicinity. It shall be clean natural material graded from fine to coarse, free from lumps, clay, cinder, ashes, rubbish and other debris. It shall not contain more than 5 percent of material finer than No. 200 mesh screen, not more than 5 percent remaining on No. 4 sieve; all material shall pass through 3/8" screen.

2.5.2 Coarse Aggregate for Concrete

Coarse aggregate for the first 3 classes of concrete shall consist of quarried or crushed stone/river run gravel or inert material or a combination of these, with maximum size of 3/4 inch and shall be clean, hard durable, sound, cubical and well shaped, free from soft or friable matter, or thin elongated pieces, alkali, organic matter or injurious amounts of other deleterious substances. Deleterious inert matter shall not exceed 3 percent.

Grading for above specified coarse aggregate shall be within the following limits:

Sieve Size	**Percentage Passing (Dry Weight)**
1 inch	100
3/4 inch	90 to 100
1/2 inch	20 to 55
3/8 inch	0 to 15
No-4	0 to 5

Coarse aggregates for Class D concrete shall be broken stone or river run gravel from dense hard stone, or boulders. The stone or gravel should not be porous or slaty it must be free from earth, sand or other foreign matters. The broken aggregate or gravel shall be of the prescribed size for the class D. The broken aggregate or gravel shall be will max. size 1 inch or 1 1/2 inches and not contain any thing which will pass through No.4 sieve.

2.5.3 Storage of Aggregate

Each class of aggregate is to be stored separately and the Contractor is to provide means of ensuring that aggregates are stored on a suitable hard clean surface or platform to prevent contamination from the ground.

2.5.4 Proportions of Coarse and Fine Aggregates

The nominal ratio of the Volume of coarse aggregate to the volume of fine aggregate shall be decided by compression test of concrete cubes or cylinders to be furnished by the Contractor but the Employer may order these ratios to be varied slightly according to the grading of the aggregates by weight, if necessary, so as to produce required grading. Engineer can get the tests carried out at Contractor's cost.

At the beginning of the work and where there is any change in the coarse or fine aggregates or in their source of supply, the Contractor is to have a series of tests on cubes/cylinders made representative of and marked as to the aggregates and their grading and mix of concrete. Such cubes are to be tested in the laboratory under identical conditions, except for small variations in the

relative proportions of the coarse and fine aggregates up and down from the best proportions derived from the sieve analysis. The cubes etc. are to be tested at 7 days.

2.5.5 Water

Water for washing aggregates and for mixing and curing concrete shall be clean and free from injurious amounts of oil, acid, alkali, salt, organic matter, or other deleterious substances as determined by standard tests selected by the Engineer. It shall meet the requirements of ASTM D596 and BS 3148.

The water for curing concrete should have pH value between 6 to 8 and shall not contain impurities which cause discoloration of concrete.

2.6 CONCRETE MIX REQUIREMENTS

2.6.1 Strength

The concrete shall be one of four different classes to be paid for at their respective unit prices designated. The numerical classifications refer to the approximate proportions of cement, fine aggregate and coarse aggregate, according to the common practice. However, the actual concrete mix requirement shall consist of proportioning and mixing for the following strengths when tested in the form 6" cubes, 3 for 7 days and 3 for 28 days test shall be made for each class of concrete. The cubes are to be made, cured, stored, transported and tests are to be carried out at a testing laboratory approved by the Engineer. All such tests shall be at the cost of the Contractor.

STRENGTH REQUIREMENTS FOR PORTLAND CEMENT CONCRETE
WITH AGGREGATES COMPLYING WITH B.S.882/ASTM C33

Concrete Class	Minimum Cube Crushing Strength at 28 days (MPa)
A	31.00 (4500 psi)
B	26.00 (3750 psi)
C	21.00 (3000 psi)
D	10.00 (1500 psi)
E	7.00 (1000 psi)

2.7 WATER CEMENT RATIO

The water-cement ratio is the ratio of the weight of water in the mix to the weight of cement therein. Water content shall be sufficient to produce a workable mix of the specified strength. Maximum water cement ratio shall be 0.45 for water tight concrete and 0.55 for other concrete except class "E".

2.7.1 Consistency

Proportions of ingredients shall vary to achieve the desired concrete consistencies when tested, conforming to the following slump requirements or as desired by the Engineer:

Use of Concrete	Minimum and Maximum Slump (inch)
Normally reinforced sections compacted by vibration, hand compacted mass concrete.	1 to 3
Heavily reinforced concrete sections compacted by vibration, hand compacted concrete in normally reinforced slabs, beams, columns and walls.	2 to 4

In all cases, the proportions of aggregates for concrete shall be such as to produce mixes which will work readily into the corners and angles of the forms and around the reinforcement without permitting the segregation of materials or liateance. Uniformity in concrete consisting from batch to batch shall be ensured.

2.8 MEASUREMENT OF MATERIALS

The coarse and fine aggregate are to be weighed or accurately measured to the Engineer's satisfaction. In no event they are to be measured by the shovel or barrow.

2.9 MIXING METHODS

The concrete shall be mixed in an approved mechanically operated batch mixer. The mixer, its hopper and working platforms shall be protected from rain and wind.

The aggregates and cement shall be mixed together before adding water until the concrete is of even colour and consistency throughout. Dirt and other undesirable substances shall be excluded. Water shall not be added indiscriminately from a hose or can. All concrete shall be thoroughly mixed by a modern reliable batch mixer to produce maximum output of concrete necessary to complete the work within the specified time without reducing the required mixing time. Concrete shall be mixed in the concrete mixers for the duration required for uniform distribution of the ingredients to produce a homogeneous mass of consistent colour but for not less than 1 1/2 minutes. The mixer shall be operated by trained operators, who have previous experience of running and operation of concrete mixers.

At the conclusion of mixing, the mixer and all handling plants shall be thoroughly cleaned out before the concrete remaining in them has had time to set.

No concrete shall be mixed by hand without the Engineer's written consent, and such consent shall be given only for small quantities under special circumstances.

2.10 TEST OF CONCRETE

2.10.1 Strength Test During the Work

Strength tests of the concrete placed during the course of the work will be made by the Engineer in an approved laboratory at the Contractor's expenses. The Contractor shall assist the Engineer in obtaining, for control purposes, such number of cylinders or cubes as the Engineer may direct, but in general, three beams taken from each 2650 cu.ft.or fraction thereof, or from each days pour, whichever is less, of each class of concrete placed, shall govern. Test specimen will be made and cured by the Engineer in accordance with the applicable requirement of ASTM Designation C31-86, Standard Method of Making and Curing Concrete Compressive and Flexural Test Specimens in the Field. Cubes and beams will be tested by the Engineer in accordance with the applicable requirements of ASTM Designation C39-86, Standard Method of

Test for Compressive Strength of Cubical Concrete Specimens and ASTM Designation C78-84, Standard Method of Test for Flexural Strength of concrete (Using Simple Beam with Third Point Loading). The test result will be based on the average of the strength of the test specimens except that if one specimen in a set of three shows manifest evidence of improper sampling, molding, or testing, the test result will be based on the average of the remaining two specimens. If two specimens out of a set of three show such defects, the results of the set will be discarded and average strength determined from test results of the other two sets. The standard age of test will be 28 days, but 7 day tests may be used at the discretion of the Engineer, based on the relation between the 7 days and 28 days strengths of the concrete as established by tests for the materials and proportions used. If the average of the strength test of three specimen cured under laboratory controls, for any portion of the work, falls below the minimum allowable compressive or flexural strength at 28 days required for the class of concrete used in that portion, the Engineer may change the proportions of the constituents of the concrete, as necessary to secure the required strength for the remaining portions of the work. If the average strength of the specimens cured under actual field conditions as specified herein before falls below the minimum allowable strength, the Engineer will make such changes in the conditions for temperature and moisture under which the concrete work is being placed and cured as may be necessary to secure the required strength.

2.11 CONVEYING OF CONCRETE

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 latest edition of ACI Code Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

Any wet batch hopper through which the concrete passes shall be conical in shape. There shall be no vertical drop greater than 5 ft. except where suitable equipment is provided to prevent segregation and where specifically authorized. Belt conveyers, chutes, or other similar equipment will not be permitted either for conveying concrete except where the use of such equipment is approved in writing by the Engineer, in advance of any use. Each type or class of concrete shall be visually identified by placing a coloured tag or marker on the bucket as it leaves the mixing plant so that the concrete may be positively identified and placed in the structure forms in the desired position.

2.12 PLACING

2.12.1 General

Concrete placing shall follow the Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete, latest ACI Code requirement. No concrete shall be placed until all formwork, reinforcement, installation of parts to be embedded, bracing of forms and preparation of surface involved in the placing and the method of placement have been approved by the Engineer. Approval of the method of placement proposed will not relieve the Contractor of his responsibility for its adequacy and he shall remain solely responsible for the satisfactory construction of all work under the Contract.

Before concrete is placed, all surfaces upon or against which concrete is to be placed shall be free from standing water, mud, debris or loose material. All surfaces of form and embedded material that have become encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed. The surfaces of absorptive material against or upon which concrete is to be placed shall be moistened thoroughly so that the moisture will not be drawn from the freshly placed concrete. Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the materials to its final position in the forms. The depositing of concrete shall be regulated so that the concrete may be effectively compacted

with a minimum of lateral movement into horizontal layers approximately 1.5 ft. in thickness. No concrete that has partially been hardened or contaminated by foreign materials shall be deposited in the structure, nor shall retampered concrete be used unless approved by the Engineer. The surfaces of construction joints shall be kept continuously wet for at least eighteen hours during the twenty four hours period prior to placing concrete except as otherwise directed by the Engineer. All free water shall be removed and the construction joint shall be completely surface dry prior to approval All concrete placing equipment and methods shall be subject to approval. Concrete placement will not be permitted, when in the opinion of the Engineer weather conditions prevent proper placement and consolidation.

2.13 COMPACTING CONCRETE

All concrete, except that in blinding layers and in- situ-concrete in very small sections, shall be compacted by vibration. After any necessary hand spading, working and ramming into place, each layer of concrete shall be compacted with mechanical immersion vibrators of types approved by the Engineer.

The immersion vibrators shall produce a vibration frequency of not less than 6000 impulses per minute. Under no circumstances shall the immersion vibrators be allowed to come into contact with reinforcement or shuttering. Immersion vibrators shall penetrate vertically for a few inches into any previous unset layer in order to establish a satisfactory bond, but no concrete shall be vibrated in such a manner as to cause injury to concrete (already set or otherwise) in other parts of works. Care shall be taken to keep the vibrators vertical, to insert them at regular intervals and withdraw them slowly to prevent the formation of voids, so that the entire mass of the concrete is properly compacted. Haphazard or random penetration of the vibrators without sufficient depth of insertion shall be avoided. A sufficient number of vibrators shall be used to ensure compaction of each batch of concrete before the next batch is delivered. At least one extra vibrator shall be in hand for emergency use.

Vibration shall be supplemented by hand punning with approved small-diameter smooth steel rods with rounded ends in order to achieve complete compaction around reinforcement and other embedded fittings and a completely dense mortar finish against the shuttering.

Excessive vibration shall be avoided and vibration shall not be continued after a good surface finish, without free water, has been achieved. Vibration and punning shall be just sufficient to produce a dense, homogeneous concrete properly filling the molds and free from air voids, segregation, bleeding, honey combing and other imperfections. Only highly skilled operators and workmen, subject to constant supervision, shall be employed in vibrating and punning concrete.

2.13.1 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 agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be completed within 1 1/2 hours after introduction of the cement to the aggregates. The concrete shall be placed within 20 minutes after it has been discharged. In all cases, concrete shall be placed and compacted well within the initial setting time.

2.14 CONCRETE FINISHES

Concrete finishes shall be made in accordance with the provision of ACI 301-84 (Revised 1985) or as directed by the Engineer

Workmanship in shuttering and concreting shall be such that concrete work shall normally require retouching and the surfaces being dense, watertight and where steel shuttering has been used, perfect and smooth. Should there be faults in these respects, the Contractor shall cut out and replace the whole of the lift concerned or such amount as the Engineer decides, or make good if permitted by the Engineer and to his approval. Concrete which is honey-combed or otherwise shows voids shall invariably be cut out and replaced in an approved manner as suggested by the Engineer.

Any making good shall be carried out immediately after striking the shuttering and shall be restricted to light rubbing down with wet carborundum or the approved correction of minor blemishes. In no circumstances shall surfaces be made good with cement or washes or rendering.

Exposed concrete surfacing not requiring shuttering and not subsequently to be given extra finishes shall be given perfectly dense smooth finish with a wooden float.

Where concrete slabs, ducts, bases or machine plinths will themselves form the finished floor surface the concrete shall be troweled immediately after the first laying process only just sufficiently to give a level surface. Thereafter, when the concrete has stiffened to a condition such that a hard compacted surface can be obtained without bringing up laitance, a final surface troweling shall be given with a steel float to produce a smooth finish.

2.15 CONCRETE AND WEATHER

No concrete shall be placed when the atmospheric temperature is below 15 degree centigrade without the written permission of the Engineer. When directed by the Engineer the Contractor shall provide adequate means for maintaining a temperature of not less than 20 degree centigrade for 3 days or 15 degree centigrade for five days after placing the concrete.

If Rapid-Hardening Portland Cement is used, the period may be reduced as directed by the Engineer.

The Contractor shall supply such heating apparatus as stoves salamanders or steam equipment and the necessary fuel. When dry heat is used, means of maintaining atmospheric moisture shall be provided. All aggregates and mixing water shall be heated to temperature of at least 20 degree centigrade, but not more than 75 degree centigrade, the aggregates may be heated by either steam or dry heat, if permitted by the Engineer the torch method of heating mixed aggregate shall be such as to heat the mass uniformly and avoid spots which will burn the materials. The temperature of the concrete shall be not less than 10 degree centigrade at time of placing in the forms.

In case of extremely low temperature, the Engineer may, at his discretion, raise the minimum limiting temperature of water, aggregates and mixed concrete. When the shade temperature is above 32 degree centigrade, special precautions shall be observed during concreting to the satisfaction of the Engineer. Concreting will be permitted when it is not raining. Thermometer shall be kept at the Site by the Contractor.

2.16 CURING OF CONCRETE

Unless otherwise specified or ordered by the Engineer all concrete shall be cured by water. It shall be kept wet continuously for at least fourteen days after placement. It shall be covered with water saturated material like gunny bags, canvas, clean sand, matting, etc. or any other improved method duly approved by the Engineer.

In order that tensile stresses on the cooling of concrete shall be kept to a minimum, all materials shall be as cool as practicable when mixed and placed. To this end, aggregates shall be covered, coarse aggregates shall be cooled with water and mixing plant etc., water storage tanks and pipelines shall be covered or insulated from the effects of the sun. The temperature of concrete on placing shall in no case exceed 32 degree Centigrade.

Concrete shall be placed only against surfaces which are damp and no such work shall be started until arrangements for keeping the shuttering continuously cool and wet are in place. Shuttering and exposed faces of concrete and mortar shall be covered by at least 3 thicknesses of approved stout hessian kept continuously cool and wet by an efficient and comprehensive system of sprinklers and diffused jets of water, with appropriate temporary drainage arrangements, for at least 14 days after placing.

As an alternative to continuous curing with water after stripping of shuttering a proprietary membranes method of curing may be used provided that it is used strictly in accordance with the manufacturer's instructions, is coloured to show its presence, contains no bituminous substance, does not prejudice the appearance of permanently exposed concrete surfaces and is in all other respects to the approval of the Engineer. Wherever practicable, both faces of concrete structures shall be appropriately treated in order to prevent tensile stresses due to differential shrinkage or temperature across the section. Further more, the Contractor shall continue to provide facilities for covering and/or keeping wet such exposed surfaces of the Work as are, in the opinion of the Engineer liable at any time to be damaged by weather.

At no time shall any further work involving concrete proceed until the Contractor has satisfied the Engineer that all such work previously carried out is being protected and cured in accordance with this clause.

2.17 CONCRETE IN EXCAVATION AND FILLING

Before concrete is placed in or against any excavation or filling, the surface of such earthwork shall have been compacted and shall be free from running and standing water, oil and other deleterious matter. Loose earth and other material shall be removed. The excavation or filling shall be damp but not wet and special precautions shall be taken to prevent groundwater from damaging unset concrete or causing movement of the concrete.

Immediately after the excavation or filling has been trimmed and prepared as above, the exposed foundation shall be protected by a blinding layer or "No-fines" concrete or of cement mortar or other protection as shown on the Drawings or ordered by the Engineer. Such blinding layers and coatings shall be thoroughly cleaned and moistened before further concrete work is placed thereon.

Reinforced concrete shall not be cast against an unprotected face of earth or any other material liable to become loose or to slip; the greatest possible care shall be taken to avoid falls of material on to the concrete, by leaving the timbering in place (if permitted) or by removing the timbering in small depths and lengths at a time and by any other approved means. If any such falls occur, all soiled concrete shall be removed and replaced at Contractor's own cost.

2.18 SHUTTERING

The Contractor shall submit, for the approval of the Engineer full proposals and design calculations for all shuttering and proposals for the period of time to elapse before each item of the shuttering is struck. Not withstanding the approval of the Engineer to any actual shuttering or proposals for its striking, the Contractor shall retain complete responsibility for its adequacy as to the provisions of this clause and for any consequences of the striking being premature or harmful. In general the minimum time for the removal of form work

shall be as under:

	Form Work	Removal Time	Normal Weather above 15°C
a)	Form work of vertical surfaces such as Beams side walls and columns.	4 days	2 days
b)	Slabs, props left under.	10 days	5 days
c)	Props to slab	14 days	10 days
d)	Beam soffits, prop left under.	14 days	7 days
c)	Removal of props to Beams.	21 days	21 days

Shuttering shall be designed with easily sealed access hatches for inspection purposes and for removal of water and deleterious materials, and with connections to facilitate striking without damaging the concrete. Shuttering for soffits of slabs shall be erected with an upward camber of 1/4" for each 10 feet of span. When props are to be left in position under slabs the shuttering shall be made and removed in such a way that the props are not disturbed in any way.

A tolerance of plus or minus 1/8 inch in line or level will normally be permitted after erection of the shuttering which shall nevertheless be sufficiently strong, stiff and rigidly braced against loads due to the wet concrete and vibration and against constructional loads, to remain true to the line and level accepted before concreting. It shall be sufficiently watertight to ensure that there shall occur no "fine" or escape of mortar at joints or of liquid from the concrete.

All exterior angles for concrete work not permanently buried in the ground shall be given 3/4" x 3/4" chamfers unless otherwise indicated on the Drawings.

Timber for shuttering shall be well seasoned, free from loose knots, splits, projecting nails and the like and from any adhering foreign matter.

Steel shuttering shall be used to produce a fair face concrete with only a faint but consistent pattern of plate marks on exposed concrete surfaces. The shuttering shall be assembled from wrought tongued and grooved boarding, true and tightly fitted with joints as necessary, the whole surface and all edges being rendered smooth before and after oiling. Bearing in mind the quality of the finish required, wrought, plain-edged and butt-joint boarding may replace the tongued and grooved boarding or purpose-made steel- faced shutters of first-class quality may be used, solely at the discretion of the Engineer.

Rough shuttering shall be used for surfaces to be buried in the ground and shall be assembled from sawn boards with smooth and true edges or from approved steel shutters. In either case all joints shall be suitably filled.

The inside faces of all shuttering shall be treated with an approved material to prevent adhesion of the concrete, all such materials being kept clear of the reinforcement and other items to be embedded.

Shuttering shall be struck by static force alone without shock and vibration causing any damage to the concrete. Shuttering being reused shall be

thoroughly repaired and cleaned before re-assembly.

2.19 WATER STOPPERS

2.19.1 Scope

The work to be done under this item consists of providing and installing PVC/Metal water stoppers as shown on the Drawings or as directed by the Engineer.

2.19.1 (a) Polyvinylechloride Water Stoppers

Polivinylchloride water stoppers shall be extruded from an elastomeric plastic compound, the basic resin of which shall be polyvinylechloride (PVC) of 10" width. The compound shall contain such additional resins, plasticizers, stabilizers or other materials needed to ensure that when the material is compounded and extruded to the shapes and dimensions shown, it will have physical characteristics when tested by the U.S. Corps of Engineers Tested Method specified below:

Physical Characteristics	No. of Specimens	Requirement	USCE Test Method
Tensile strength using die III, not less than.	5	1750 psi	568
Ultimate elongation using die III, not less than	5	350%	573
Low temperature brittleness, no sign of failure such as cracking or chipping at	5	-35^{o}F	570
Stiffness in flexure, 1/2 inch span, not less than	3	400 psi	571

Installation

The PVC water stoppers shall be laid in continuous lengths. Splices in the continuity or at the intersections of runs of PVC water stoppers shall be performed by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations or as directed by the Engineer. A thermostatically controlled electric source of heat shall be used to make all splices. The correct temperature at which splices should be made will differ with the material used but should be sufficient to melt but not char the plastic. After splicing, a remolding iron with ribs and corrugations to match the pattern of the water stopper shall be used to reform the ribs at the splice. The continuity of the characteristic components of the cross section of the water stopper design (ribs, tubular center axis, protrusions, and the like) shall be maintained across the splice.

2.19.1 (b) Metal Water stoppers

Copper, stainless steel and steel water stoppers shall be installed in joints at the locations shown on the Drawings. The thickness, shape, dimensions and splicing of metal water stoppers shall be as shown on the Drawings or as approved by the Engineer.

2.20 TERRAZZO WORK

2.20.1 Scope

The work to be done under this item consists of providing terrazzo finish inside the water tanks and at any other place shown on the Drawings. The subgrade shall comprise of (i) cement plaster (ii) cement concrete.

2.20.2 Material

Marble Chips of the specified grade, and colour shall be of approved quality obtained from quarries in Pakistan. Before any material is purchased, the Contractor shall submit to the Engineer for approved samples in duplicate. The material used in the work shall correspond with the approved samples, in quality, colour texture and finishes etc.

2.20.3 Subgrade

The subgrade under terrazzo top shall be 3000 psi cement concrete or 1:2 cement sand plaster of the thickness specified on the Drawings. The subgrade shall be constructed in accordance with the applicable stipulations and requirements, Cement Plaster of the Specifications. The subgrade surface shall be kept wet for proper adhesion of terrazzo topping, which shall be laid when the subgrade has still not hardened.

2.20.4 Topping

Terrazzo top finishing of thickness as shown on the Drawings or the Finishing Schedule shall consist of marble chips and cement mixed in ratio of 1:2 (one part grey cement and 2 parts chips of approved grading and shade with admixture of approved pigment). Terrazzo topping shall be laid true to the pattern as given on the Drawings or as directed by the Engineer. The terrazzo topping shall be well compacted and all voids and dips made good.

2.20.5 Final Finish

Smooth Finish: After 48 hours of laying the terrazzo topping requiring smooth finishes shall be grinned with No.80 Carborundum stone until the marble chips are evenly exposed.

After the first grinding neat coat of suitably coloured cement slurry be applied to repair the pores if any, formed during the course of grinding and cured for 24 hours. The second and the third grinding shall be suitably carried out with grinding stone ranging from No. 80 to 240 respectively. Electric grinders shall be used to ensure that the grinding is adequate.

The surface after all chips have been evenly exposed will be cured for one week and left undisturbed for another week. After this period the surface shall be cleaned of dirt and dust by rubbing gently with pumice stone with sufficient water. If this treatment is not successful in removal of the white scum or other materials and hardened deposits, the floor shall be lightly rubbed with grinding stone while washing soda solution is being used. it would then be treated with oxalic acid (1:10) solution using felt or an old blanket. After oxalic acid treatment the surface shall be cleaned and washed with plenty of water and dried.

2.21 STEEL REINFORCEMENT

2.21.1 Scope

The work to be done under these items shall include furnish, cut, bend, and place all steel reinforcement as indicated on the Drawings or otherwise required. All reinforcement when surrounding concrete is placed, shall be free from loose, flaky rust, and scale, and free from oil grease or other coating which might destroy or reduce its bond with the concrete. All placing shall be in accordance with Drawings furnished or approved. The use of reinforcement for the transmission of current for welding will not be permitted. All reinforcement, including dowels, remaining exposed in the work shall be suitably protected until embedded in concrete.

2.21.2 Cutting and Bending

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

2.21.3 Quality

Concrete reinforcement bars shall be of following quality:

Intermediate grade Steel: It shall be deformed bars conforming to ASTM 615-81(a,b) grade 40/ grade 60 or equivalent having a minimum yield strength of 40,000 psi/ 60,000 psi. The Contractor shall provide labour, materials, arrange measuring and testing facilities to ascertain quality, weight or quantity of steel at his own expense, No steel shall be incorporated in the Works without prior approval of the Engineer.

2.21.4 Spacing of Bars

The spacing of bars shall be as shown on the Drawings or as directed by the Engineer. The variation from indicated spacing, provided that the total area of reinforcement is in accordance with the Drawings, shall not be more than 1 inch.

2.21.5 Relation of Bars to Concrete Surface

The cover of all main reinforcement shall conform to the dimensions shown on the Drawings. The protective covering shall not be less than, and shall not exceed more than 1/4" from the values specified on the Drawings, indicate the clear distance from the edge of the main reinforcement to the concrete surface. The concrete covering of stirrups spacer bars, and similar secondary reinforcement may be reduced by the diameter of such bars.

2.21.6 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 American Concrete Institute 318-77, Building Code Requirements for Reinforced Concrete. All splices and locations of laps in reinforcement shall be as shown on the Drawings or as directed by the Engineer. Additional bar splices shall be provided as required,

subject to approval of the Engineer. 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 bars by butt-welding or by approved mechanical methods such as the Cadweld splice or other type splice using positive connectors shall be adopted where indicated or directed by the Engineer. Butt welding of reinforcing bars, where indicated or directed shall conform to the requirements of American Welding Society's Recommended Practice for Welding Reinforcing Steel, Metal Inserts and Connections, D.12.1. Concrete shall be protected from heat during welding operations.

2.21.7 Supports

All reinforcement shall be secured in place by use of metal or concrete supports, spacers, or using 16 gauge G.I wire ties or suitable clips at intersections as approved by the Engineer. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation. The supports shall be used in such a manner that they will discoloration or deterioration of the concrete. Concrete supports shall be manufactured of the same concrete mix as used in the structure to be concreted.

2.22 MEASUREMENT AND PAYMENT

2.22.1 Material

Measurement and payment for concrete, reinforcement, precast concrete, PVC water stop and Terrazzo/Mosaic work will be made in accordance with the provisions of this clause specified hereinafter.

12.22.1.1 Method of Measurement

Concrete will be measured for the number of cubic feet acceptably placed complete in all respects as per Drawings and in strict accordance with this section of specification.

Measurement for steel reinforcement will be made of number of Tons of reinforcing steel acceptably placed on the basis of the lengths of bars installed in accordance with the approved Drawings or bar schedules or as directed, converted to weight for the size of bars listed by the use of unit weights per linear foot as follows:

Bar Size	Unit Weight lbs. per foot
1/4"	0.167
3/8"	0.376
1/2"	0.668
5/8"	1.043
3/4"	1.502
7/8"	2.044
1"	2.670
1 1/8"	3.775
1 1/4"	4.172
1 3/8"	5.049

Steel in laps and embedments indicated on the Drawings or as required by the Engineer will be paid for at the steel unit price. No measurement for payment will be made for the steel consumed in providing supports and for the additional steel in laps which are authorized for the convenience of the Contractor.

Polyvinylechloride and/or metal water stopper of the size and gauge as shown on the Drawings will be measured for the number of linear feet acceptably placed in the work. In computing the quantities, no allowance will be made for laps.

Measurement for terrazzo/mosaic work will be made in square feet as shown on the Drawings.

2.22.1.2 Basis of Payment

Payment will be made in accordance with the unit prices in the Bill of Quantities for the various items in accordance with the specifications and shall constitute full compensation for furnishing all materials, shuttering, equipment and labour and for performing all operation necessary to complete the work.

Pay Item	D e s c r i p t i o n	Unit
2.1	Provide and lay concrete	Cft.
2.2	Furnish and Fix Reinforcing Steel Tons including Cutting, Placing and Binding complete.	
2.3	Furnish and Install Water Stopper	
	(i) PVC	L.ft.
	(ii) Stainless Steel	L.ft.
2.4	Provide and Lay Terrazzo/Mosaic Work	Sft.

SECTION - 3

BRICK AND CEMENT CONCRETE BLOCK WORK

3.1 SCOPE

This section consists of construction of brick/ cement concrete block work walls of any thickness with first class hand-mould and/or machine pressed bricks/cement concrete blocks with the specified ratio of cement mortar in foundation, plinth superstructure or for any other structure as directed by the Engineer, or shown in the Bid Schedule. The Contractor shall furnish all materials and all other requirements to produce finished brick/block work. Brick/block work and materials for brick/block work shall be in strict accordance with this section of the specifications and applicable drawings and subject to the terms and conditions of the Contract.

3.2 MATERIALS

3.2.1 Portland Cement

Portland cement shall conform to the stipulations and requirements set forth in Section "CONCRETE".

3.2.2 Mortar Sand

Sand for mortar used in construction of brickwork/blockwork required under these Specifications shall be furnished by the Contractor in accordance with the provisions and in conformity with the stipulations and requirements of ASTM Designation C144-70 or latest revision and shall have a fineness modulus between 1.6 to 2.5.

3.2.3 Water

The water used in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali salts and other impurities and it will be tested in accordance with BS-3148 and approved by the Engineer at the Contractor's cost.

3.2.4 Aggregate

Aggregates for mortar shall comply with the requirements of ASTM C144. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the Engineer.

3.2.5 Additives

Additives where used, shall be proprietary products used in the proportions and manner recommended by the manufacturer. The additives shall in no way adversely affect the mortar strength or contain chemicals, which may e harmful to other building materials. To add gypsum to cement is strictly forbidden.

3.3 MORTAR AND GROUT

Materials for mortar, sand binding agent and water shall be mixed by volume 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. For small jobs, hand mixing may be permitted, the ingredients being mixed with sufficient water to produce a correctly mixed workable mortar. Mortar used in masonry construction shall conform to ASTM C-270 standard.

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. Mortar shall not be retained for more than 30 minutes and shall be constantly worked over with hoe or shovel until used.

3.4 MORTAR BATCHING

Methods or equipment used for mixing mortar shall be such as will accurately determine and control the amount of each separate ingredient entering into the mortar and shall be subject to the approval of the Engineer. If a mixer is used it shall be of approved design and the mixing time after the ingredients are in the mixer, except for the full amount of water, shall not be less than two minutes.

Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of water to the mix shall be wasted. Retampering of mortar shall not be allowed. Mixing pans and troughs shall be thoroughly cleaned and washed at the end of each day's work.

3.5 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 Engineer shall not be used until it has 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.

3.6. JOINTING

Jointing is the forming of joints as work proceeds. Joints shall be as follows:

3.6.1 Exterior exposed joints shall be tightly formed to a weather joint with the point of the trowel.

3.6.2 Interior exposed joints shall be tightly formed to a concave joints.

3.6.3 Joints which are subsequently covered with plaster or other finish materials shall be struck flush.

3.7 BRICKS

The bricks used shall be of standard size (9"x4.5"x3") first class well burnt, uniform in shape, size, texture, colour and should produce a ringing sound when struck. The bricks shall be free from flaws, cracks, chips, stone nodules of lime or kan-kar or any other blemishes. The brick shall not absorb more than one sixth of its weight when soaked in water for one hour. Compressive strength shall not be less than of 1400 psi. Bricks over burnt, under burnt vitrified and irregular shall not be used. Bricks of uniform size shall be used throughout the work and source of supply shall not be diversified.

3.7.1 Soaking

Before use all bricks shall be soaked in clean water in tanks or pits for at-least two hours.

3.7.2 Laying of Bricks

All brickwork shall be skillfully laid with level courses, uniform joints, square corners, plumb verticals and true surfaces except when otherwise shown on the Drawings or directed by the Engineer. Brickwork will be of best standard of workmanship obtainable and objectionable offsets in the brickwork shall be avoided. Smoothest practicable finished surface of the brickwork shall be ensured. Unless otherwise specified bricks shall be laid in English Bond with frogs (Manufacturer's marks) upward.

All horizontal joints shall be parallel and truly level. Vertical joints in alternate coarses shall come directly over one another. Thickness of joints unless otherwise specified shall not be less than 1/4 of an inch and not more than 3/8 of an inch. The height of 4 coarses and 3 joints as laid shall not exceed by more than 1 inch the height of 4 bricks as piled one upon the other.

3.7.3 Curing

All brick work involving use of cement shall be cured by water curing or other acceptable methods. The Engineer shall approve all methods and operations of the Contractor in curing different portions of work.

When curing by water brickwork shall be kept wet for at least 14 days by covering with water saturated materials or by a system of perforated pipes, mechanical sprinklers, porous hose, ponding or by any other approved method which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements given in Clause 3.2 of these specifications.

3.8 BLOCKS

Cement, aggregates and water for concrete blocks shall conform to the requirements as specified in the section for plain and reinforced concrete or as approved by the Engineer.

3.8.1 Concrete Block Making

3.8.1.1 The solid and hollow blocks as and where used by planning, shall be machine moulded. The block making machines shall be of the standard approved by the Engineer. They shall be operated according to the instructions laid down by the manufactures.

3.8.1.2 The blocks shall be continuously water cured by sprinkling water for a minimum of 10 days and covered between sprinkling operations with 4 mils thick polyethylene sheeting. After the 10 days water curing period the blocks shall be air dried. Under no circumstances will blocks be used in the work until they are completely dry. During curing period no surfaces of the block will be allowed to dry.

3.8.1.3 Cured concrete blocks shall be stored off the ground, stacked on level platforms, which allow air circulation under stacked units. Units shall be covered and protected against wetting.

3.8.1.4 Care shall be exercised in the handling of all concrete blocks. No damaged blocks shall be used in the work.

3.8.1.5 The blocks cast on different dates shall be stacked separately and must be labeled showing the date on which they were cast.

3.8.2 Properties of Blocks

3.8.2.1 All blocks shall be of size and shape required to complete the work shown in the Drawings or as instructed by the Engineer.

3.8.2.2 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 in a concrete mixer.

3.8.2.3 All blocks shall conform to ASTM C 145 standard. The compressive strength based on gross area shall be minimum 8.30 MPa for an average of 3 blocks and minimum 7.0 MPa for lowest individual blocks with 28 days after casting Cement Concrete Solid Blocks.

3.8.2.4 The Contractor shall provide test certificates show in the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test certificates shall be provided as required by the Engineer, to ensure that all batches of block strengths are to be determined in accordance with ASTM C- 140 Standard.

3.8.2.5 The test shall be carried out by a laboratory approved by the Engineer. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The Engineer will require to test samples of blocks periodically and the Contractor shall make necessary arrangements accordingly. The method of sampling for all test shall be in accordance with ASTM C-140.

3.8.2.6 All properties or specifications of blocks, not explain in these Specifications or ASTM C 145 shall comply with the requirements of PS 419, as directed by the Engineer.

3.8.3 Soluble Salt Content

For exposed block work, the contents by weight percent of soluble sulphate, calcium, magnesium, potassium and sodium radicals, shall not exceed 0.30, 0.10, 0.30, 0.03 percent respectively when ascertained in accordance with BS 3921, at the cost of the Contractor.

3.8.4 Erection

3.8.4.1 Block 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. Courses of block shall be kept plumb throughout and corner reveals shall be true and in plumb.

Standard with of mortar joints for both horizontal and vertical joints shall be 7/16 inch (maximum). Mortar joints in wall 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. Blocks terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joints shall be packed solidly with mortar between the top of the block and the bottom of slab or beam. Control expansion joints shall be kept free from mortar or other debris.

Unless otherwise shown on the drawings or specified by the Engineer, the spaces around door frames and other material or built in items shall be solidly filled with mortar. Spaces around the door and window hold fasts shall be filled in with Class C concrete. Work required to be built in with masonry including door frame anchors, wall plugs, dovetail anchors and accessories shall be built in as the erection progresses.

3.8.4.2 The block work shall be carried out in a uniform manner and no portion shall be carried more than one metre above the adjoining one at any times. All masonry shall be kept strictly true and square and the whole properly bonded together and levelled round each floor.

3.8.4.3 Sleeves, Chases, holes, sinking and mortices for other trades shall be correctly located and formed to the sizes as required by the relevant trades. Chiselling of completed walls or the formation of holes shall only be carried out with the approval of the Engineer.

3.8.4.4 Walls of blocks indicated as being non-load bearing shall be constructed on insitu concrete floor slab unit after the floor formwork is struck and the concrete has obtained sufficient strength to support their weight. Toothing into load-bearing walls shall not be permitted.

3.8.4.5 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.

3.8.4.6 Walls or partitions abutting concrete columns or walls shall be securely anchored and tied with metal anchors or ties at not more than 18 inches vertical centres. Wall ties cast in with concrete shall be bent down after the removal of form work and shall be securely jointed into the mortar beds of walling.

3.8.5 Curing and Repairs

3.8.5.1 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 specifications for water used in the manufacture of blocks.

3.8.5.2 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 wall shall be $\pm$ 1/8 inch.

3.8.5.3 If, after the completion of any block masonry work, the block is not in alignment or level, or does not, conform to the lines and grades shown on the Drawings or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the Engineer grants permission, in writing, to patch or replace the defective area.

3.9 MEASUREMENT AND PAYMENT

3.9.1 Material (Brick and cement concrete block work)

Measurement and payment for brick/cement concrete block work shall be made in accordance with the provisions given hereafter.

3.9.1.1 Method of Measurement

Measurement for brick/block work shall include number of cubic ft. of brick/block work provided within the limits as shown on the Drawings or as directed by the Engineer.

3.9.1.2 Basis of Payment

Payment for brick/block work shall be made at the contract unit price per cubic feet. Payment shall constitute full compensation for furnishing all materials, equipment and labour including all incidentals necessary to complete the work:

Pay Item	Description	Unit
3.1	Provide and Lay Brick Masonry with cement sand mortar in foundation and super structures.	Cft.
3.2	Provide and Lay Block Masonry with cement sand mortar in foundation and super structures.	Cft.

SECTION - 4

SURFACE RENDERING

4.1 SCOPE

The work covered by this part of the Specifications consists of supplying all materials, labour, equipment, appliances in performing all operations required for doing the work of cement plastering, pointing, white washing in accordance with the herein stated requirements except when specifically modified by the Engineer.

4.2 CEMENT PLASTER

4.2.1 General

The work to be carried out under this item shall consist of providing 1/2" thick plaster in grey cement as specified below. The work shall be carried out in accordance with applicable requirements of British Code of practice 211:1966 or latest revision.

4.2.2 Materials

4.2.2.1 Cement

All cement required for incorporation in this Section shall conform to the applicable requirements of Section "CONCRETE"

4.2.2.2 Sand

The sand shall be of medium to coarse grain and having a fineness modulus varying between 1.10 to 1.50 obtained from an approved quarry e.g. Lawrencepur/Local. The material shall be free from clay, vegetable matters and other impurities. Sand bearing clay shall be washed at the discretion of the Engineer.

4.2.2.3 Water

Water required for cement sand paste and curing purposes shall conform to applicable requirements of Section "CONCRETE"

4.2.3 Mortar Composition

Mortar for plastering shall consist of one part of Portland cement to 3 parts of sand by volume.

4.2.4 Material Batching

Material batching for preparation of mortar shall conform to stipulations and requirements set for in the Section "BRICK AND CEMENT CONCRETE BLOCK WORK".

4.2.5 Application of Plaster

The surface on which plaster is to be applied shall in case of brick work, be properly raked and wetted before application of plaster. Plaster shall be applied in a thickness of 1/2". If the specified thickness sis more than 1/2" then plaster shall be applied in two coats viz rendering coat and the final coat. Plaster shall be carried out to the full length of the wall or to the natural points. Vertical or horizontal joints which show themselves shall not be allowed. Rendering coat shall be roughened with waving lines drawn by wire brushes to provide bond for the final coat and it shall be properly moistened before application of subsequent coat. The final coat shall be finished with floats to provide smooth and uniform surface. All arises shall be straight and either truly horizontal or perpendicular and finished with 1/8" radius. Defective finishes if any shall be cut out and replastered at the expense of the Contractor. Plaster after finishes shall be kept moist for about 10 days to the satisfaction of Engineer.

4.3 POINTING

4.3.1 Surface Preparation

The joints of brickwork which is to be pointed shall be raked out with a hook to a depth of 1/2". The raking shall be done while the mortar is still green and not later than 48 hours of time of laying. After raking, the brick work is brushed to remove all loose dust from the joints and thoroughly washed with water, all putlog holes shall be filled up before pointing as the scaffolding for masonry has been taken down. The work shall be watered for 24 hours before pointing is done.

4.3.2 Materials

4.3.2.1 Cement

All cement required for incorporation in this section shall conform to the applicable requirements of Section "CONCRETE".

4.3.2.2 Sand

The sand required for incorporation in this Section shall conform to the applicable requirements of "CEMENT PLASTER" as per Clause 4.2.

4.3.2.3 Water

Water required for cement sand paste and curing purposes shall conform to applicable requirements of Section "CONCRETE".

4.3.3 Mortar Composition

Unless otherwise specified, the mortar shall be mixed by volume. The ratio of Cement Sand shall be as specified in the BOQ.

4.3.4 Material Batching

Material batching for preparation of mortar shall conform to stipulations and requirements setforth in Section "BRICK WORK".

4.3.5 Precautions

Before starting work of pointing the following precautions shall be taken.

i) Fine aggregate i.e. sand shall be washed before use.

ii) It shall be ensured that all joints are properly raked.

iii) The surface to be pointed shall be kept moist but excessive moisture shall be avoided.

iv) The scaffolding for pointing shall always be provided double.

4.3.6 Type of Pointing

Unless otherwise specified, the following types of pointing shall be done.

4.3.6.1 Deep or Struck Cement Pointing

This type of pointing shall be done to all unplastered faces of brickwork where the brickwork is liable to be affected by dampness and saltpetre, such as in the plinths of buildings. The mortar shall be filled in the joints flush with masonry or brickwork with a pointing trowel and then pressed with proper pointing tools. Lining with a spike on a mass of mortar shall not be allowed.

4.3.6.2 Flush Cement Pointing

This type of pointing shall be done at all brickwork with exposed face, when `the finish of the face is not important or when a flush floor surface is required or when the floor or brickwork is subject to wear or to the effects of dampness and saltpetre. The mortar shall be filled and pressed into the joints with a jointing trowel, and finished off level with the edges of the bricks to give the smoothest possible appearance to the work.

4.3.7 Pointing Tools

The pointing tools for horizontal joint shall be such as to form weathered and struck joints; and for vertical joint, triangles, so as to make a (v) notch. Care shall be taken not to develop a cutting edge in the tools since the idea is to compress the green mortar into the joints and not to cut it away.

4.3.8 Edges of Bricks

The mortar shall not be spread irregularly over the edges and corners of the bricks which shall be left clearly visible. The practice of smearing mortar over defects in bricks, to hide them shall not be allowed and shall render the whole brickwork liable to be rejected.

4.3.9 Washing after Pointing

After pointing, the face of the work shall be cleared off all surplus mortar sticking to the face. No washing shall be done till the pointing has set.

4.3.10 Protection during curing.

After completion, pointing shall be kept for 10 days and shall be protected during that period from extreme fluctuations of temperature and weather

All defects detected during curing or afterwards shall be treated at the Contractor's expenses according to directions of the Engineer.

4.4 PAINTING

The following codes and standards shall be followed wherever relevant and applicable and/or directed by the Engineer.

BS 242-66	Linseed Oil.
BS 245-76	Specification for mineral solvents (white spirit and related hydrocarbon solvents) for paints and other purposes.
BS 2523-83	Lead-based priming paint
BS 2569-64/45	Sprayed metal coatings.
BS 2992-70	Painters and decorators brushes.
BS CP. 3012-72	Cleaning and preparation of metal surfaces.
BS 4800-81	Paint colours for building pruposes.
BS 5082-74	Water-thinned priming paints for wood.
BS 5358-76	Specifications for low-lead solvent-thinned priming paint for woodwork.
BS 6150-82	Code of practice for painting of buildings.

4.4.1 White or Colour Washing

The whitewash shall be made from pure fat lime brought to site of work in the form of un- slaked lime. Water shall be added to this lime in a container until the mixture is of consistency cream and allowed to rest until cracks shall appear on its surface (48-72 hours). After screening through coarse cloth, gum at the rate of 4 oz. boiled with 10 oz. of rice shall be added to each cubic feet of white wash. The colour pigment if required shall be added and mixed with white wash and stirred to give the required shade. Enough quantity shall be prepared in one go so as to meet the requirement of one complete room.

4.4.2 Weather Resistant Paint

4.4.2.1 Selection of Paints

Concrete and Masonry

Cement based paints or one of the three common types of the exterior latex paints (polyvinyl acetate, styrene-butadiene and acrylic) of ICI/Burger make or equivalent shall be used whichever specified. Approved quality cement based or weather resistant emulsion paints shall be used as directed by the Engineer.

4.4.2.2 Primers

Concrete and Masonry

Boiled linseed oil or silicone water repellent primers ICI/Burger make or equivalent shall be used on concrete and masonry surfaces. Before application of paint, concrete and masonry surface should be allowed to dry for at least 3 weeks after cessation of curing.

4.4.2.3 Fillers

Concrete and Masonry

Paste of zinc oxide and varnish thinned with turpentine shall be used as filler on masonry and concrete.

4.4.2.4 Sealers

Concrete and Masonry

Water-insoluble and water-repellent substances dissolved in solvent such as petroleum naphtha or the special clear silicone compounds shall be used to seal masonry surfaces.

4.4.2.5 Thinners

Concrete and Masonry

Thinners such as turpentine, mineral spirit, water, xylene and linseed oil of approved quality shall only be used in accordance with the manufacturers instructions and with prior approval of the engineer.

4.4.2.6 Brushes

All brushes used for painting work shall conform to B.S 2992 or equivalent American Standards.

4.4.3 Preparation of Surface

All loose material and dirt on the surface shall be removed with a brush. Holes and irregularities of surface shall be repaired with lime putty, and the surface shall be allowed to dry before applying whitewash or colour wash and weather resistant paint. All greasy spots shall be given a coat of rice, water and sand. Surfaces discoloured by smoke shall be washed with a mixture of wood ashes and water or yellow earth before being white-washed or painted.

4.4.4 Application

Three coats of white or colour wash shall be applied on the prepared surface with a brush. Paint or finish to any surface shall be applied when ambient temperature is 10 degree centigrade or above and less than 43 degree centigrade unless other wise recommended by the manufacturer. No painting shall be done above 90% relative humidity. Drop cloths shall be placed to adequately protect all finished work.

All paint and coating materials shall be in thoroughly mixed condition at the time of application. All work shall be done in a workman-like manner, leaving the finished surface free from drips, ridges, waves, laps and brush marks. All paints shall be applied under dry and dust free conditions.

All primary paint shall be applied by brushing. The first coat of paint shall be applied immediately after cleaning.

4.5 MEASUREMENT AND PAYMENT

4.5.1 Cement Plaster

Measurement and payment for cement plaster shall be made in accordance with the provisions given hereafter.

4.5.1.1 Method of Measurement

Measurement shall be made of cement plastering for the actual area in square foot in accordance with this section of Specification or as directed by the Engineer.

4.5.1.2 Basis of Payment

Payment shall be made for the number of square foot of surface area cement plastered at the contract unit price per square foot and shall constitute full compensation for furnishing all materials, equipment and labour including all incidentals necessary to complete the work in strict accordance with this Section of Specification.

Pay Item	Description	Unit
4-1	Provide and apply Cement Sand Plaster.	Sq.ft.

4.5.2 Pointing

Measurement and payment for cement pointing shall be made in accordance with the provisions given hereafter.

4.5.2.1 Method of Measurement

Measurement will be made of cement pointing for the actual area in sq.ft in accordance with this section of Specification or as directed by the Engineer.

4.5.2.2 Basis of Payment

Payment shall be made for the number of square feet of surface area cement pointed at the contract unit price per square feet and shall constitute full compensation for furnishing all materials, equipment and labour including all incidentals necessary to complete the work in strict accordance with this section of specification.

Pay Item	Description	Unit
4-2	Provide and apply Cement Sand mortar.	
	i) Flush pointing	Sq.ft
	ii) Struck pointing	Sq.ft

4.5.3 Painting

Measurement and payment for white washing and weather resistant paint shall be made in accordance with the provisions given hereafter.

4.5.3.1 Method of Measurement

The measurement shall be made in sq.ft of the actual surfaces completed and approved.

4.5.3.2 Basis of Payment

Payment shall be made for number of square feet of the actual surface painted measured as provided above at the Contract unit price per square feet for the respective item and shall constitute full compensation for all materials, equipment, labour, including all incidentals necessary to complete the work.

Pay Item	Description	Unit
4.3	Provide and apply white wash.	Sq.ft.
4.4	Provide and apply weather resistant paint.	Sq.ft.

SECTION - 5

DAMP PROOFING

5.1 SCOPE

The work covered under this section shall consist of damp proofing concrete surface or brick/block masonry surface, in accordance with these specifications and at the locations shown on the Drawings or as directed by the Engineer.

5.2 GENERAL

The concrete surface shall be damp proofed with bitumen by the absorptive method where as brick/block masonry surfaces shall be first treated with a horizontal layer of portland cement concrete and then covered with bitumen damp proof cover with hessian base. Vertical faces of walls likely to come in contact with earth shall be first plastered with cement plaster and then treated with bitumen by the absorptive method. Damp proofing shall not be applied when the temperature is below 39^0 F and falling. The work shall be done by workmen experienced in the application of damp-proofing. Damp proofing shall be applied as shown on the Drawings.

5.3 DAMP-PROOFING MATERIALS

All asphaltic materials shall be delivered in sealed containers bearing the manufacturer's original labels. Bitumenised kraft paper shall be delivered in rolls as per manufacturer's original packing. Other materials shall be delivered as provided under relevant clauses of these Specifications. All materials shall conform to the Specifications designated and be approved by the Engineer. Damp proofing materials shall conform to the following requirements alongwith the requirements shown on the Drawings.

5.4 ASPHALT PRIMER

The asphalt primer shall consist of an asphaltic base thinned to a suitable brushing consistency, with a volatile solvent, and shall conform to the requirements set forth under ASTM 41-73 or latest revision.

5.5 ASPHALT

Asphalt for damp proofing shall meet the requirements of ASTM D 449-73, Type C or latest revision.

5.6 BITUMENISED KRAFT PAPER

3-ply brown kraft paper (0.00113 lbs/ft^2 each ply) sandwitched with two layers of Bitumen (0.00083 lbs/ft^2 each layer) as manufactured by Messrs Packages Ltd., Lahore or equivalent, as approved by the Engineer, shall be used.

5.7 PREPARATION OF SURFACES

Surfaces to receive damp proofing shall be smooth, clean and dry. Holes, joints and cracks shall be painted flush with mortar and high spots ground level with the surrounding surface. Before damp proofing, surfaces shall be swept clean of all foreign matter and shall be inspected and approved.

5.8 PLACEMENT PROCEDURES

The selection and combination of various waterproofing and damp proofing materials for different locations shall be as shown on the Drawings or as directed by the Engineer. Unless otherwise directed or approved by the Engineer, the following procedures shall be adopted.

5.9 DAMP PROOFING UNDER BRICK MASONRY WALLS

The damp proofing shall comprise of:

1 1/2" thick layer of plain cement concrete Class B shall be placed over the area to be damp proofed.

A priming coat of asphalt primer confirming to BS specification 1097 October 1973 before the application of asphalt coating.

An asphalt coat using not less than 30 lbs per 100 sq.ft. and 2 layers of Bitumenised kraft paper or polythene sheet.

5.10 QUALITY CONTROL

Sampling of asphalt for Specifications compliance shall be done in accordance with ASTM D 140-70. Samples shall be taken from each consignment, as directed by the Engineer.

5.11 MEASUREMENT AND PAYMENT

5.11.1 Damp Proofing

Measurement and payment for Damp proofing work shall be made in accordance with the provisions of this clause specified hereinafter.

5.11.1.1 Method of Measurement

Measurement, will be made per Sq.ft of superficial area or surface damp proofed as per this Section of Specification and accepted by the Engineer.

5.11.1.2 Basis of Payment

Payment will be made for the number of sq.ft of superficial area damp proofed at the Contract Unit Price and will include full compensation for furnishing and placing all materials and for all labour, equipment, tools and incidentals necessary to complete the work prescribed in the Bill of Quantities Items:

Pay Item	Description	Unit
5.1	Furnish and Apply Damp Proofing under masonry walls.	Sft.
5.2	Furnish and Apply Vertical Damp Proofing Under masonry walls.	Sft.

SECTION 06

STRUCTURAL STEEL WORKS

6.1 SCOPE

This Section covers general requirements of 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.

The applicable requirements of this section as determined by the Engineer shall apply to all structural steel works under this contract. The work covered by this section, consists of supply of 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. The scope of this section of specifications is covered with detailed specifications as laid down herein.

6.2 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 A307-80	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

6.3 SUBMITTALS

Prior to execution of work and sufficiently in advance, the Contractor shall submit the following to the Engineer for approval:

6.3.1 Shop Drawings

Shop Drawings, which shall show full construction details, quantities and locations, with metal gauges, reinforcing, cut- outs, holdfasts and attachment to adjacent construction and materials.

6.3.2 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.

6.3.3 Methodology

Methodology for fabrication, installation, erection and fixing.

6.4 QUALITY ASSURANCE

6.4.1 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.

6.4.2 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.

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.

6.4.3 Metal Window and Ventilators

- Window frame and ventilator sections shall be of mild steel.
- Hinges shall be subject to the approval of the Engineer.
- All operating hardware shall be of bronze lacquered iron.

6.4.4 Structural Steel

All structural steel shall conform to the requirements of ASTM A 36 or equivalent.

6.4.5 Welding

All welding shall be executed and inspected in accordance with the latest provision of the applicable code of the American Welding Society.

6.4.6 Bolts

All bolts, including anchor bolts shall conform to the requirements of ASTM A 307 or equivalent.

6.5 DELIVERY AND STORAGE

6.5.1 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.

6.5.2 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.

6.5.3 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.

6.6 PRODUCTS

6.6.1 GENERAL REQUIREMENTS

6.6.1.1 All contours and arises in metal door shall be true and sharp as can be produced in the thickness of metal required.

6.6.1.2 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.

6.6.1.3 Reinforcement and stiffeners shall be welded to the inside of the frame surfaces.

6.6.1.4 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.

6.6.1.5 Weather baffles shall be integrally rolled and shall provide contact on all the four sides of the operating ventilators.

6.6.1.6 Weep holes and drips shall be provided for drainage in accordance with Drawings or instructions of Engineer.

6.6.1.7 All windows shall be designed for exterior glazing to accommodate glass thickness specified.

6.6.1.8 Ventilators shall show in or out, as indicated on the Drawings and shall be mounted over heavy steel pivots with brass pins.

6.6.1.9 Push bars for out swinging windows shall be a notched device for fixed settings and designed to lock shutters in open/closed position.

6.6.1.10 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.

6.6.1.11 Windows shall be provided with all necessary clips and anchors required for securing the windows to the structure.

6.7 EXECUTION

6.7.1 FABRICATION OF DOORS AND WINDOWS

6.7.1.1 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.

6.7.1.2 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.

6.7.1.3 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.

6.7.1.4 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.

6.8 FABRICATION OF ROLLING SHUTTERS

6.8.1 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. (50mm) wide wire reinforced canvas belt shall be riveted (using aluminum rivets) to both shutter ends and aluminium rollers shall be installed at top.

6.8.2 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.

6.8.3 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.

6.8.4 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.

6.8.5 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.

6.8.6 Cover

The cover shall be fabricated from 22 gauge galvanized steel sheet of uniform shape and size without deformations.

6.9 INSTALLATION

6.9.1 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'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.

6.9.2 Wire Gauze

Unless otherwise specified or directed by the Engineer, the wire gauze to be fixed with doors, windows and ventilators shall be 22 gauges having 12 x 12 mesh.

6.9.3 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.

6.10 PRIMARY COAT AND FINISHING

6.10.1 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.

6.10.2 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.

6.10.3 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.

6.11 MISCELLANEOUS STEEL WORK

6.11.1 General

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

6.11.1.1 Steel handrails.

6.11.1.2 Steel protection angles and Channels.

6.11.1.3 Steel doors, windows, and ventilators/louvers.

6.11.1.4 Steel fencing.

6.11.1.5 Steel Gate

6.11.1.6 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 for approval.

6.11.2 Steel Stairs

6.11.2.1 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.

6.11.2.2 Material

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

6.11.2.3 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.

6.11.3 Steel Protection Angles

Steel protection angles required for the protection of concrete work shall be erected true to line and level. Steel angles shall be grouted and fixed in position by using anchors as shown on the drawings or as directed by the Engineer.

6.11.4 Steel Door

Steel doors shall be fabricated inaccordance with the Drawings or as directed by the Engineer.

6.11.4.1 Sample

Sample of materials shall be submitted to the Engineer for approval prior to fabrication.

6.11.4.2 Frames

Frames shall be fabricated form locally available hot flush hollow pressed sections, 'Z' section angle, tee, channel or pipe sections as specified in the drawings. Material shall however conform to ASTM - A -36.

6.11.4.3 Shutters

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.

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.

The internal surfaces of frames and shutter including frame shall be painted with one coat of epoxy primer.

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.

6.11.5 Steel Grating on Drains

Steel grating shall conform to the requirement of Federal specification PR-G-661 b; (except for Naval Vessels) type T all panels shall be banded on the all edges.

6.11.6 Steel Hand Rail

Steel Handrail shall be fabricated in accordance with the drawing or as directed by the Engineer and shall conform to the applicable requirement of ASTM A53 for the type and class of pipe indicated.

6.12 MEASUREMENT & PAYMENT

6.12.1 General

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

- Nuts, bolts, screw, rivets, heads, fillets, welds and welding rods.
- Anti-corrosive prime coat.
- Glazing.

- All metal embedded parts, metal fittings and fixtures required for the operational process.
- Cleaning with sand blasting.
- Paint and Painting of Steel works
- Locks, handle, hinges, hold fast, Latches, L-drops stopper, etc.
- Fly screen with openable window panel
- Steel grill with windows
- Sealant, gaskets etc.

6.12.2 Steel Hand Rail

6.12.2.1 Measurement

Measurement of acceptably completed works of Steel Hand Rail will be made on the basis of net actual Running feet fabricated, provided and installed in position as shown on the Drawing or as directed by the Engineer.

6.12.2.2 Payment

Payment will be made for acceptable measured quantity of Steel Hand Railing on the basis of unit rate per Running feet quoted in the Bill of Quantities and shall constitute full compensation for all works related to the item.

6.12.3 Steel Louver Door and Rolling Shutter

6.12.3.1 Measurement

Measurement of acceptably completed works of Steel louver Door and Rolling Shutter will be made on the basis of net actual area in Square feet fabricated, provided and installed in position as shown on the Drawing or as directed by the Engineer.

6.12.3.2 Payment

Payment will be made for acceptable measured quantity of Steel louver Door and Rolling Shutter on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all works related to the item.

SECTION - 7

FLOORING

7.1 SCOPE

The work covered in this Section consists of furnishing all plant, labour and material etc., and of performing all operations in connection with making cement concrete floor in conformity with lines and dimensions shown on the Drawings and in strict accordance with these specifications.

7.2 MATERIALS

Cement, sand and aggregate shall conform to the requirement of relevant clauses in section "CONCRETE"

7.3 BASE FOR FLOORING

The base for flooring shall be laid down when the earth filling has been done up to the specified level in a layer of 6 inches and has been properly watered and consolidated and correctly leveled.

A layer of sand about 4" thick shall be laid and rammed after having saturated so that a 4" layer is reduced to about 3" after compaction.

Portland cement concrete of Class C shall be laid in one operation in a uniform layer of specified thickness, absolutely true and parallel to the required level of the finished surface. Concrete shall be cured for at least 7 days before any topping is laid. Before laying the surface shall be washed and scrubbed with wire brushes so that the concrete in the base and the topping are well bounded.

7.4 CEMENT CONCRETE FLOORING

Before laying the topping, the surface of the base shall be divided into symmetrical panels by glass strips. The size of panels, unless otherwise specified, shall not exceed 3 ft. square and concrete shall be placed in alternative panels. The top of the glass strips shall be adjusted to the specified level of the finished floor surface.

Cement concrete floor shall consist of laying a topping of cement concrete of Class B of specified thickness over the prepared and finished base as or roughed surface of floor slabs.

Placing operation shall be specifically timed. No sooner the concrete has been evenly spread in a panel, then it shall be beaten for about 5 to 10 minutes with "wooden thapies" (about 5 lbs. weight).

Immediately after consolidation, the surface shall be leveled with a wooden trowel. Excessive trowelling in the early stages shall be avoided. The surface shall be tested with a straight edge to detect undulations, which, if found, shall be eliminated. The finer stuff in the concrete which has come to the surface with the stroking shall be quickly but carefully smoothen with the steel trowel. When the concrete has hardened sufficiently, trowelling shall be done with steel trowel. No dry cement or a mixture of dry cement shall be sprinkled on the surface for hardening the surface.

7.5 BRICK FLOORING

The work covered by this item consists of furnishing and laying 4 inch sand over prepared earth to required slope and grade. 3 inch thick layer of Class D concrete is laid over it and 4.5 inch thick brick on edge are laid in 1:3 cement sand mortar. These joints of these bricks are struckat the top by flush pointing.

7.5.1 Method of Construction

The method consists of placing bricks on edge for flooring in 1:3 cement sand mortar over 4 inch sand and 3inch Class D concrete and striking the joints of bricks with flush pointing and laid over thoroughly consolidated bottom by ramming and watering before laying this floor.

7.6 CURING

The concrete flooring properly laid shall be cured for 7 days.

7.7 MEASUREMENT AND PAYMENT

7.7.1 Flooring Material

Measurement and payment for concrete flooring , brick flooring and compacted sand fill will be made in accordance with the provisions given hereafter.

7.7.1.1 Method of Measurement

Measurement will be made for the number of square feet of flooring acceptably placed complete in all respects as per drawings and in strict accordance with this section of specification or as directed by the Engineer.

7.7.1.2 Basis of Payment

Payment will be made for the number of square feet of flooring measured as above at the Contract Unit Price per square feet and shall constitute full compensation for all work including earth and sand filling, glass strips, concrete, brick on edge and all other incidentals to complete the work.

Pay Item	Description	Unit
7.1	Provide and Lay compacted sand fill and Cement Concrete Floors using glass strips for panel.	Sft.
7.2	Provide and Lay compacted sand fill and brick on edge flooring laid over class D concrete.	Sft.

SECTION - 8

METAL WORKS AND DOORS

8.1 SCOPE

This Section of specification consists of furnishing all plant, labour, equipment and materials in performing all operations in connection with providing and fixing metal windows, doors, rolling shutters etc. All metal windows, doors, and rolling shutters including painting shall be according to the Schedule specified on drawings and manufactured by a firm to be approved by the Engineer. They shall be handled with care, shall be staked on edge on level bearers and be supported evenly against a wall or vertical bearers, under cover.

8.2 CONTRACTOR TO FIX

The Contractor shall fix the windows, doors & rolling shutters as described. He shall be responsible for storing windows etc., and carrying to their respective positions, assembling composites, bedding and jointing with mastic at the mullions and transoms, fixing lugs and screws to frames, placing in the openings and bedding with cement and pointing externally with mastic.

8.3 BUILDING IN

Where applicable metal windows, doors and rolling shutters etc., shall be built in, set to plumb and line and cement mortar shall be grouted into the channel of the frame as brickwork proceeds. Fixing lugs shall be grouted in at the jambs, head and sill. When screwing up lugs or fixing screws, care shall be taken to ensure that windows etc. are not distorted.

8.4 FIXING INTO PREPARED OPENINGS

Windows etc., to be fixed into prepared openings shall have at least 1/8 inch tolerance all round. Window frames shall be grouted with cement mortar into the channel of the frame joints between building openings and window etc. Frames shall be chalked with mastic cement of an approved make.

8.5 FABRICATION OF DOORS, WINDOWS AND VENTILATORS

Shape: The steel section shall be thoroughly straightened in the shape by methods that will not injure it before being laid off or worked in any way.

Cutting and Forming: All members shall be so cut and formed that they can be accurately assembled with out being unduly cracked strained or forced into position.

Jointing: The jointing of the 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 filling them and making smooth.

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. Following fabrication, touch up all welds with liquid Zinc. Window frames and ventilators shall be hot dipped galvanized after fabrication conforming to BS 729 Part 1. Following fabrication, touch up all welds with liquid Zinc.

8.6 PUTTY

The putty shall be of a type specially prepared for use with metal work in tropical conditions.

8.7 PROTECTION OF FITTINGS

Fittings shall be wrapped and protected from damage until all rough trades have been completed.

8.8 FABRICATION OF ROLLING SHUTTERS

8.8.1 Shutters

The shutter shall be fabricated using standard galvanized corrugated segments of the required length according to size of the shutter and of 20 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 wide wires reinforced canvas belt shall be riveted (using aluminum rivets) to both shutter ends and aluminum rollers shall be installed at top.

8.8.2 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.

8.8.3 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.

8.8.4 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.

8.8.5 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.

8.8.6 Cover

The cover shall be fabricated from 22 SWG gauge mild steel sheet of uniform shape and size without deformations.

8.9 GLAZING

Glazing shall be fixed in metal windows by proprietary PVC or neoprene molded soling strips as provided by the manufacturers of the windows, or as may be directed by the Engineer.

All windows shall be glazed with 5 mm thick glass.

The contractor shall be responsible for protecting and maintaining all glazing in its prime condition. On completion all glass shall be cleaned inside and out and all cracked and broken glass shall be replaced, all to the satisfaction of the Engineer.

8.10 PAINTING PREPARATION OF THE METAL WORK

Iron and steel surfaces shall be cleaned by means of solvents approved methods. Cleaned surfaces shall be primed as soon as practicable after cleaning.

8.11 PAINT APPLICATION

Unless otherwise specified or instructed the Contractor shall apply paints as follows:

8.11.1 Internal Surfaces of Steel Work

2 coats Zinc Chrome primer
2 under coats
1 glass finish coat

8.11.2 External Surfaces of Steel Work

2 Coats Zinc Chrome Primer
1 Aluminum bitumastic under coat
1 Aluminum bitumastic finish coat.

All painting coats upto and including the first undercoats, shall be applied under cover at □WORKS□ before despatch to the Site. (The second undercoat and the finishing coat shall be applied after erection on Site). Extreme care shall be taken to protect paint coats during transit.

8.12 PAINT

The paints for any painting sequence shall be mutually compatible and of the same approved manufacture. All paints shall be supplied in small sealed containers each not exceeding one gallon capacity.

8.13 WIRE GAUGE

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

Wire gauge shall be fixed as shown on the drawings or as directed by the Engineer. The gauze shall remain right to the full width and without any sag.

8.14 MEASUREMENT AND PAYMENT

8.14.1 Doors, Windows and Ventilators

Measurement and payment for steel doors, windows, rolling shutters and ventilators shall be in accordance with the provisions given hereafter.

8.14.1.1 Method of Measurement

The quantity to be paid for under this item shall be net openings in sq. ft. in the walls where steel doors, rolling shutters, windows and ventilators have been acceptably fixed complete in all respects as per relevant drawings or as directed by the Engineer.

8.14.1.2 Basis of Payment

Payment shall be made for the number of sq. ft. of steel doors, rolling shutters, windows & ventilators measured as provided above at the Contract Unit Price per sq. ft. for all supply of items and means of fixing, cutting, shaping, priming, painting as necessary and all other operations required for the complete erection and commissioning to the full satisfaction of the Engineer for the item:

Pay Item	Description	Unit
8.1	Provide, Install and paint Complete Steel Doors, windows and ventilators	Sft.
8.2	Provide and fix glazing complete for steel windows and ventilators.	Sft.
8.3	Provide, Install, Paint Complete Rolling Shutter.	Sft.

SECTION - 9

HAND RAILS

9.1 SCOPE

The work covered by this Section of the specification consist of furnishing all plant, labour, equipment, appliances and materials and of performing all operation in connection with construction of Hand Rails in strict accordance with these specifications and notes shown on the drawings.

9.2 MATERIALS

9.2.1 Cement

Cement shall conform to the requirement of the Section "CONCRETE".

9.2.2 Coarse Aggregate and Sand

Coarse aggregate and sand shall conform to the requirement of the Section "CONCRETE".

9.2.3 Reinforcing Steel

Reinforcing Steel shall conform to the requirement of the Section "STEEL REINFORCEMENT".

9.2.4 Zinc Coated Steel Pipe (G.I Pipes)

Zinc coated steel pipe (G.I Pipes) shall be galvanized and threaded and shall conform to BS Specification 1387-1957 "Steel tubes and Tubulars" medium tube.

9.2.5 Fitting and Specials for Zinc Coated Steel Pipes (G.I Pipes)

Fitting and specials for zinc coated steel pipe (G.I Pipes) shall be galvanized and threaded and shall conform to the applicable requirements of BS specification 1387- 1957.

9.2.6 M.S Pipe and Square Bars

M.S pipe of thickness 1/16" and square bars of 3/4" shall conform to the requirements of ASTM A36.

9.3 MEASUREMENT AND PAYMENT

9.3.1 Material for Hand Rails

Measurement and payment for Hand Rails shall be made in accordance with the provisions given hereafter.

9.3.1.1 Method of Measurement

Measurement shall be made for the number of linear feet of Hand Rail actually constructed in place and accepted in strict accordance with this Section of Specification and as shown on the Drawings or as directed by the Engineer.

9.3.1.2 Basis of Payment

Payment shall be made for the number of linear feet of Hand Rail as provided above at the contract unit price per linear feet to furnish, construct and shaping the hand rail and shall constitute full compensation for all work related to the item.

Pay Item	Description	Unit
9.1	Provide and Fix Hand Rails on staircase and on roof of over head tank including Painting as shown on Drawings or as directed by the Engineer.	L.ft.

SECTION - 10

WATER SUPPLY PIPES, PIPE LAYING AND APPURTENANCES

10.1 SCOPE

The work covered by this Section of the specification consists of furnishing all plant, labour, equipment, appliances and materials and of performing all operations in connection with water supply lines and appurtenances in strict accordance with this section of the specifications and the applicable Drawings.

10.2 MATERIALS

Material shall conform to the respective specifications and other requirements specified hereinafter and shall be new and unused.

10.2.1 Cast Iron Pipes and Fittings

Cast iron pipes and fittings shall comply with BS 78 for spigot and socket vertically cast pipes, BS 1211 for spigot and socket spun iron pipes and BS 2035 for flanged pipes.

10.2.2 Asbestos Cement pipes, Fittings and Specials

These shall conform to International Organization for Standardization Recommendation R 160 "Asbestos Cement Pressure Pipe" or British Standard Specification 486 "Asbestos Cement Pressure Pipe" of the class capable of withstanding a 400 ft. head test pressure. Short lengths of pipe machined overall shall be used at fittings for tying in.

The fittings and specials for asbestos cement pipes shall be cast-iron conforming to British Standard Specification 78: PART 2 Fittings: "Cast Iron Spigot and Socket Fittings", Class AV, except that the fittings and specials shall have the shapes, dimensions and tolerance required to fit the asbestos-cement pipes. Fittings and specials for asbestos cement pipe shall be supplied by the manufacturer of the asbestos cement pipe.

10.2.3 Galvanized Iron Pipes and Fittings

The galvanized iron pipes shall strictly conform to BS 1387-1967 "medium quality" Specifications for "Steel Tubes and Tubulars suitable for screwing to BS 21 pipe threads". All screwed pipes and sockets shall be of wrought iron have BS 1740. A complete and uniform adherent coating of zinc white will be provided for galvanized iron pipes and fittings.

10.2.4 Unplasticised Polyvinyl Chloride Pipe and Fittings

Unplasticised polyvinyl chloride (uPVC) and fittings if approved by the Engineer shall confirm to BS 3505 pipes shall be class B: Pipe and fittings shall not be stored directly exposed to sunlight handled or laid in conditions where ambient temperatures may cause distortion or damage. In extreme conditions, pipe and fittings may have to be stored under water.

10.2.4.1 Joints for Unplasticised Chloride Pipe

Joints for unplasticised polyvinyl chloride pipe shall be the Z type consisting of a socket with rubber gasket, or approved equal, and assembled in accordance with the pipe manufacture's recommendations.

10.2.5 Mild Steel Pipes

The mild steel pipes shall conform to BS 1387-1967 "medium quality" Specifications for "Steel Tubes and Tubulars". All pipes shall have thickness suitable to withstand the working pressure.

10.2.6 Polyethylene (P.E) Pipes and Fittings

High-density polyethylene pipes (HDPE) and fittings shall conform to ISO 4427/DIN 8075 standards. Material, diameters, wall thickness shall be as indicated in 4427/DIN 8074. Tests to be performed for pipes shall be Heat revision, Short term hydrostatic pressure test and Tensile strength and for P.E. compounds shall be Elongation at break, Melt flow rate and Density test.

Warning tape shall be provided for lying over P.E. pipes. It should be single fold, 0.02 inch thick and 2 inch wide, with warning for digging continuously printed in Urdu language. The tape shall be placed one foot above the P.E. pipe.

Bricks on edge shall be placed on the P.E. pipes along its edge after it is laid in order to avoid any damage to the pipe.

10.2.7 Sluice/Gate Valve

Valves shall be wedge gate valves/check valve conforming to British Standard Specification 5163 : 1974. Ends of valves shall be suitable for the type of pipe to which the valves will be connected. The direction of flow should be marked by arrow on the body of the valve.

10.2.8 Check Valve

Check valve shall comply with the requirements of BSS 5153 : 1974 or equivalent. The valve shall be of swing type and shall be of quick acting single door type.

10.2.9 Fire Hydrants

The metal of the fire hydrant shall conform to BS 750 (Type-2) and shall be of screw down streamline pattern. The body shall be best quality, closed grain, grey cast iron with spindle of manganese bronze having tensile strength of not less than 11.0 tons per square in machined from solid rolled bars. The seating valves and other parts shall be of best quality gun metal with Brinell Hardness No. 80. The direction of closing shall be by clockwise rotation and outlet shall have fire hose threads for accommodation of 2 1/2" dia hose connection. Inlet flanges of hydrant shall be suitable for jointing with flanges of hydrant bends and tees. All fire hydrants shall be coated with one coat of primer and two coats of signal red enamel paint approved manufacturer to give a uniform protective coating on cast iron.

10.2.10 Ferrule Assembly

Ferrule assembly shall consist of brass ferrule assembly including corporation cock for disconnection of approved quality including C.I saddle, M.S strap, and all other items related to make complete house connection.

10.2.11 Surface Boxes

The surface boxes shall be manufactured as per Drawings. Cover and frame shall be of cast iron.

10.3 APPROVAL OF MATERIALS AND EQUIPMENT

As soon as practicable but within 30 days after receipt of notice to proceed and before any materials or equipment are purchased, the Contractor shall submit for approval of the Engineer a complete schedule, in triplicate, of materials and equipment to be incorporated in the work, together with the names and addresses of the manufacturers and their catalogue cuts, diagrams, drawings, and such other descriptive data as may be required by the Engineer. No consideration will be given to partial lists submitted from time to time. Approval of materials and equipment with deviations from the specifications shall not be construed as approval of the deviations unless they are specifically brought to the notice of the Engineer. Laboratory results and certifications, specified or otherwise required, shall be submitted prior to delivery of the material and equipment to site.

10.4 INSTALLATION

10.4.1 Handling

Pipe and accessories shall be handled in such a manner as to ensure their delivery to the trench in sound, un-damaged condition. If any pipe or fitting is damaged, the repair or replacement shall be made by the Contractor at his expenses in a satisfactory manner. No other pipe or material of any kind shall be placed inside of a pipe or fittings. Pipe shall be carried into position and not dragged. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Employer. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place and protected against the direct rays of the sun.

10.4.2 Cutting of Pipe

This shall be done in a neat and workman-like manner without damage to the pipe. Unless otherwise authorized by the Engineer or recommended by the manufacturer, cutting shall be done with a mechanical cutter of approved type. Wheel cutters shall be used wherever practicable.

10.4.3 Location

Where the location of the water pipe is not clearly defined by dimensions on the Drawings, the water pipe shall be located as directed by the Engineer.

10.4.4 Deflection

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be as recommended by the manufacturer and as approved by the Engineer. If the alignment requires deflections in excess of the specified limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit setforth, as approved.

10.4.5 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick ropes, belt slings, or other suitable equipment. Under no circumstances shall any of the water line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers shall be of wood and shall have broad flat faces to prevent damage to the pipe. Except where necessary in making connections with other lines or authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bell coupling and joints. Pipe that has the grade or the joint disturbed after laying shall be taken out and relaid. Pipe shall not be laid in water shall be kept out of the trench until the materials in the joints have hardened or until chalking or jointing is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substances will enter the pipes or fittings. Where any part of a coating or lining is damaged, the repair shall be made by the Contractor at his own expense in a satisfactory manner. G.I pipes shall be installed in accordance with recommendations of the pipe manufacturer. Pipe ends left for future connections shall be provided with valve, plugged or capped, and anchored, as shown or as directed, where connections shall be made by using specials and fittings to suit the actual conditions.

10.4.6 Jointing

a. The joints shall be in accordance with the recommendations of the manufacturer or as approved by the Engineer.

b. Connections between different types of pipes and accessories shall be made with transition fittings where recommended by the pipe manufacturer.

c. Service connections shall be made as indicated and in accordance with the recommendations of the pipe manufacturer.

10.4.7 Setting of Fire Hydrants, Valves and Surface Boxes

Fire hydrants shall be located and installed, as shown. Hydrants shall be set plumb and in accordance with the manufacturer's instructions.

Valves and surface boxes shall be installed as shown or directed, and shall be set plumb. Surface box shall be centered on the stems. Concrete, concrete pipe, brick, brick ballast used in chambers shall conform to the relevant clause of the Specifications. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to the satisfaction of Engineer on all sides of the box, or to the undisturbed trench face if less than 4 ft.

Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Surface boxes shall be lighted and the hydrant or valve shall be inspected in open and closed positions to ensure that all parts are in working condition.

10.4.8 Thrust Blocks

Plugs, caps, tees, bends and fire hydrants shall be provided with concrete thrust blocks. Backing shall be placed between solid ground and the hydrant or fitting to be anchored. The area of bearing shall be as shown on the Drawing. The backing shall be so placed that fitting joints shall be accessible for repair. The concrete shall be of class B plain cement concrete.

10.5 FLUSHING

The Contractor shall provide facilities for flushing the line. Water for flushing the line shall be arranged by the Contractor. Flushing of line shall be done section by section. For each valved section of pipeline, the Contractor shall make a temporary hose connection between the water pipeline and the pipeline under test. Water shall be pumped into the section flushed. Other arrangements for storing and pumping of water shall be subject to the approval of Engineer. Due precautions shall be taken by the Contractor for the disposal of water. The pipeline shall be flushed by keeping all the branch pipes open. Flushing shall be continued until clean water starts flowing through the other end. Section by section, the entire pipeline shall be flushed at a minimum flushing velocity of 2.5 ft./sec.

10.6 LEAKAGE TEST

Flushing of the pipeline shall be followed by a leakage test. The Contractor shall provide facilities for performing the leakage test. Water and pumping facilities shall be provided by the Contractor. Before the testing of pipeline, the Contractor shall ensure that concrete backing blocks have been provided where necessary. The test shall be performed only after all concrete work in contact with pipe to be tested has set for a minimum of 72 hours. All joints shall be left exposed. Leakage test shall be performed by keeping the end of the pipeline closed by proper plugs blocked to resist 150 per cent of the actual working pressure. While filling the line all valves and openings shall be kept open and water shall be filled in slowly. When the pipeline is completely filled with water and all air expelled, water shall be pumped into the pipeline to a minimum pressure of 150 percent of actual working pressure and the test pressure shall be maintained for at least 30 minutes for each section of 330 feet. Each and every joint shall be inspected for leaks and for all visible leakage, a displacement leakage test shall be performed by the Contractor, for the newly laid pipeline. The pipeline shall be filled with water and all the air from the pipeline shall be expelled. No piping installation will be accepted until the leakage is equal or less than the number of imperial gallons per hour as determined by the formula:

$L = 0.00054.ND./P$
L = Leakage in Imperial Gallons
N = Number of joints
D = Nominal diameter of pipe in inches
P = Average test pressure (psi) during test

In the event of the pipeline failing the leakage test, the Contractor shall locate and repair the defective pipe, fitting or joint at his expenses. For dewatering the line for repairs the Contractor shall follow the instructions given by the Engineer for disposal of water. After repairs of the line, the Contractor shall retest the line. The line will not be accepted until it passes the leakage test.

10.7 RETESTING AFTER BACKFILL

After the pipe trench has been backfilled, the entire length shall be subjected to a leakage test as a whole unit. The Contractor shall repair the line if it fails to pass the leakage test requirements specified hereinbefore. The test shall be repeated and repairs effected until the pipeline passes the leakage test.

10.8 PIPELINE DISINFECTION

10.8.1 General

The Contractor shall furnish all equipment, labour and material for the proper disinfection of the pipeline. Disinfection shall be accomplished by chlorination after the lines have been successfully tested for leakage but before they have been connected to the main system. Disinfection of the pipelines shall be done in the presence of the Engineer's representative with equipment approved by him.

10.8.2 Chlorination

A chlorine and water mixture shall be supplied by means of a solution feed chlorination device. The chlorine solution shall be applied at one end of the pipeline through a trap, in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be at least 25 ppm or enough to meet the requirements given hereinafter.

10.8.3 Retention Period

Chlorine solution shall be retained in the pipeline for a period of at least 24 hours. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe extremities and at such other representative points shall be at least 10 parts per million. This procedure shall be repeated until the required residual chlorine concentration is obtained.

10.8.4 Chlorination of Valves

During the process of chlorination of the pipeline, all valves or other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.

10.9 FINAL FLUSHING

Following complete disinfection of the pipeline, all treated water shall be thoroughly flushed from the pipeline at its extremities. Treated water and water used for flushing the pipelines shall be disposed of in a manner instructed by the Engineer. Fresh treated water shall be filled in the line and water tested for presence of coliform. The test result should indicate negative coliform presence. If the test indicates any positive coliform, the entire process of disinfection shall be repeated or improved upon until coliform free samples are obtained.

10.10 WATER SAMPLING AND TESTING

Disinfection of the pipeline and appurtenances shall be the responsibility of the Contractor. The first set of samples will be collected for analysis by the Engineer. Should the sample reveal presence of coliform, the Contractor shall again disinfect the pipeline and appurtenance and shall pay the Employer for sampling and testing for subsequent retests until coliform free samples are obtained. The charges for resampling and retesting shall be paid by the Contractor.

10.11 CLEAN-UP

Upon completion of the installation of the water supply lines, distribution system and appurtenance, all debris and surplus materials resulting from the work will be removed and disposed of in a manner satisfactory to the Engineer

10.12 INDICATION PLATES

The indication plates shall be installed in accordance with the drawings and as directed by the Engineer.

10.13 WASHOUTS

The design and locations of washouts shall be illustrated on the Drawings and to be approved by the Engineer. Exact positioning shall be determined with regard to topography and to the approval of the Engineer. At least 10 ft. of the washout pipe work, inclusive of the isolating valve, measured from the center line of the pipeline, shall be laid at the same time as the pipeline and suitably capped to prevent ingress of foreign material. The minimum gradient for the washout pipe work shall be 1 in 100.

10.14 AIR VALVES

10.14.1 Double Orifice Air Valves

These shall be designed to meet the following conditions:

i) Expulsion of air during charging of the pipeline

ii) Admit air during emptying of the pipeline to avoid the occurrence of negative pressure

iii) Expulsion of air accumulated at summit points along the pipeline under normal operating conditions

Conditions (i) and (ii) shall be met by the employment of a large orifice capable of handling large volumes of air at high flow rate, and condition (iii) by a small orifice capable of discharging small quantities of air as they accumulate.

The large orifice shall be sealed by a buoyant rigid ball and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. The small orifice shall be sealed by a buoyant ball at all pressures above atmospheric except when air accumulates in the valve chamber.

The nominal pressure shall be NP-10 for air valves on potable water lines and NP-16 for air valves on fire water lines.

10.14.2 Single Orifice Air Valves

These shall be designed to carry out the function described in 10.14.1 above. Each valve shall be provided with only a small orifice which shall operate in the same manner as that in a double acting air valve.

Valves with air intake or exhaust facilities shall have approved screening arrangements to prevent the ingress of air borne sand.

The nominal pressure shall be NP 10 for air valves on potable water lines and NP-16 for air valves on fire water lines.

Body ends shall be flanged with raised faces and drilled according to BS 10 for the nominal pressure specified or indicated in the Drawings.

The materials for the valves shall be as follows:

Cast iron body cover and bowl for small orifice, cast iron with gunmetal seat with rubber covered ball or other approved; for large orifice, cast iron with rubber seat and vulcanite covered ball or other approved.

10.15 MEASUREMENT AND PAYMENT

10.15.1 Pipe work

Measurement and payment of pipe work, fittings, specials and appurtenances will be made in accordance with the provisions of this clause specified hereinafter.

10.15.1.1 Method of Measurement

Measurement will be made for the number of linear feet of asbestos cement, galvanized iron, cast iron, unplasticised polyvinyl chloride and mild steel pipes acceptably provided & installed complete in all respects as per relevant Drawings and specification as directed by the Engineer.

10.15.1.2 Basis of Payment

Payment will be made for the number of linear feet of pipe work as measured above at the Contract Unit price of each unit and shall constitute full compensation to provide, handle, lay and joint asbestos cement, galvanized iron, unplasticised polyvinyl chloride, mild steel, cast iron pipes and including flushing, leakage testing before & after backfilling, final flushing and works related to the item.

Pay Item	Description	Unit
10.1	Supply, lay, joint and test asbestos cement pipes complete with rubber rings and sockets as per drawings and specifications or as Directed by the Engineer.	Lft
10.2	Supply, lay, joint and test cast iron pipe complete in all respects as per drawings and specifications.	Lft.
10.3	Supply, lay, joint and test mild steel pipes complete in all respects as per drawings and specifications.	Lft.
10.3A	Supply, lay, joint and test uPVC pipes, fittings and accessories complete in all respects as per drawings and specifications.	Lft.
10.3B	Supply, lay, joint and test galvanized pipes, fittings and accessories complete in all respects as per drawings and specifications.	Lft.
10.3C	Supply, lay, joint and test polyethylene pipes, fittings and accessories including warning tape and bricks on edge complete in all respects as per drawings and specifications.	Lft.

10.15.2 Service Connection

10.15.2.1 G.I Pipe

10.15.2.1(a) Method of Measurement

Measurement will be made for the number of linear foot of galvanized iron pipe including fittings acceptably provided & installed complete in all respects as per relevant Drawings or as directed by the Engineer.

10.15.2.1(b) Basis of Payment

Payment will be made for the number of linear foot of galvanized iron pipe work as measured above at the Contract Unit Price of each unit and shall constitute full compensation to provide, handle, lay, joint and test galvanized iron pipe, fittings, including sleeves, nuts, sockets, plugs, bitumen coating and all other work related to the item.

Pay Item	Description	Unit
10.4	Provide & install galvanized iron pipe and all fittings including excavation and backfilling complete with sleeves, nuts, bends, sockets, elbows, plugs, bitumen coating and testing for making service connections.	L.ft.

10.15.2.2 Ferrule Assembly

10.15.2.2(a) Method of Measurement

Measurement shall be made for the number of ferrules acceptably provided & installed complete in all respects as per relevant Drawings or specifications.

10.15.2.2(b) Basis of Payments

Payment shall be made for the number of ferrules measured as above at the contract unit price for each unit and shall constitute full compensation for providing, tapping, drilling, fixing including M.S straps, C.I. Saddles, and all other work related to the item to make complete house connection.

Pay Item	Description	Unit
10.5	Provide & install brass ferrule assembly of approved quality including tapping, drilling, M.S strap, cast iron saddle, etc. including corporation cock for disconnection complete in all respects as per drawings.	No.

10.15.2.3 Pipe Fittings and Specials

10.15.2.3(a) Method of Measurement

Measurement will be made for the number of pounds of fittings and specials acceptably provided & installed in Asbestos Cement pipe work complete in all respects as per relevant drawings or as directed by the Engineer.

10.15.2.3(b) Basis of Payment

Payment will be made for the number of pounds of fittings/specials as provided above at the Contract Unit Price and shall constitute full compensation for the cost of providing, handling, fixing, jointing, disinfecting, respective type of fitting/special, and all other work related to the item.

Pay Item	Description	Unit
10.6	Provide & install plain ended cast iron fittings.	Lbs.

10.15.2.4 Sluice (Gate)/Check Valves

10.15.2.4(a) Method of Measurement

Measurement will be made for the number of sluice (gate) valves or check valves acceptably provided & installed complete in all respects as per relevant Drawings or as directed by Engineer.

10.15.2.4(b) Basis of Payment

Payment will be made for the number of sluice (gate) or check valves measured as above at the Contract Unit Price for each unit and shall constitute full compensation for providing, handling, fixing and jointing and all other work related to the item including construction of chamber.

Pay Item	Description	Unit
10.7	Provide & install sluice (gate) valve including all fittings as per drawings.	No.
10.7A	Provide & install sluice (gate) valve including all fittings and construction of chamber as per drawings:	No.
10.7B	Provide & install check valve including all fittings as per drawings.	No.
10.7C	Provide & install check valve including all fittings and construction of chamber as per drawings.	No.

10.15.2.5 Fire Hydrants

10.15.2.5(a) Method of Measurement

Measurement shall be made for the number of fire hydrants acceptably provided & installed complete in all respects as per relevant Drawings or as directed by the Engineer.

10.15.2.5(b) Basis of Payment

Payment will be made for the number of fire hydrants measured as above at the Contract Unit Price for each unit and shall constitute full compensation for providing, handling, fixing and jointing and all other work related to the item including construction of chamber.

Pay Item	D e s c r i p t i o n	Unit
10.8	Provide and install fire hydrant including all fittings and construction of chamber as per drawings.	No.

10.15.2.6 Indication Plates

10.15.2.6(a) Method of Measurement

Measurement will be made for the number of indication plates acceptably provided & installed complete in all respects as per relevant drawings.

10.15.2.6(b) Basis of Payment

Payment will be made for the number of indication plates measured as above at the contract unit price for each unit and shall constitute full compensation for providing handling, fixing and all other work related to the item.

Pay Item	D e s c r i p t i o n	Unit
10.9	Provide and install indication plates as per drawing.	No.

10.15.2.7 Washouts

10.15.2.7(a) Method of Measurement

Measurement will be made for the number of washouts acceptably provided & installed complete in all respects and as approved by the Engineer.

10.15.2.7(b) Basis of Payment

Payment will be made for the number of washouts measured as above at the contract unit price for each unit and shall constitute full compensation for providing, handling, fixing and all other work related to the item including construction of chamber.

Pay Item	D e s c r i p t i o n	Unit

10.10	Provide & install washouts with all fittings for draining out the lines including construction of chamber as shown on the drawing or as directed by Engineer.	No.

10.15.2.8 Air Valves

10.15.2.8(a) Method of Measurement

Measurement will be made for the number of air valves acceptably provided & installed complete in all respects and as approved by the Engineer.

10.15.2.8(b) Basis of Payment

Payment will be made for the number of air valves measured as above at the contract unit price for each unit and shall constitute full compensation for providing handling,fixing and jointing related to the item including construction of chamber.

Pay Item	D e s c r i p t i o n	Unit
10.11	Provide install test and commission double acting air valve and all fittings including construction of chamber complete in all respects.	No.

10.15.2.9 Sand Cushion

10.15.2.9(a) Method of Measurement

Measurement will be made for the number of cubic feet of sand acceptably provided & placed under road crossing complete in all respects and as approved by the Engineer.

10.15.2.9(b) Basis of Payment

Payment shall be made for the number of cubic foot of sand measured as provided above at the contract unit price per cu.ft and shall constitute full compensation for all work related to the item.

Pay Item	D e s c r i p t i o n	Unit
10.12	Sand filling in trenches for pipe.	Cft.

SECTION - 11

SEWER PIPE LAYING AND APPURTENANCES

11.0 SANITARY SEWERAGE

11.1 SCOPE

The work covered by this section of the specifications consists of furnishing all reinforced concrete pipes, plant, labour, equipment, appliances and materials and of 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.

11.2 MATERIALS

All materials used in the manufacture of reinforced cement concrete pipes for use under this contract shall conform ASTM Designation C-76-91 or latest revision and also with the following specifications.

11.2.1 Cement

The sulphate resistant cement to be used in the manufacture of reinforced concrete pipes shall conform to the requirement of ASTM's relevant Designation C 150 (latest revision).

11.2.2 Aggregates

The coarse/fine aggregate to be used in the manufacture of concrete pipes to be furnished and installed under this contract shall be generally in accordance with the provisions of section of these specifications.

11.2.3 Water

Water to be used in the manufacture of pipes shall be approved by the Engineer.

11.2.4 Steel Reinforcement

The material shall conform to the specifications contained in Section 2 of these specifications.

11.2.5 Brick Ballast

Brick ballast shall have a maximum gauge of 1 1/2 inch and shall be graded down to 3/4 inch and shall not contain more than 10% which will pass through screen made of 1/4 in. diameter bars spaced at 3/4 in. centre to centre.

11.3 CLASSES OF PIPE

The reinforced cement concrete pipes to be furnished and installed under this contract 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 applicable variation order, all reinforced cement concrete pipes under this contract shall comply with the Wall B design requirements as set forth in said Table 1 to 5 of ASTM Designation C-76-91 or latest revision.

Pipe less than 12" diameter shall confirm to ASTM C-14.

11.4 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-76-91 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.

11.5 PIPE DIMENSIONS

The internal diameters and wall thicknesses of reinforced concrete pipes under this contract shall be as set forth in ASTM Designation C-76-91 or latest revision in Tables 1 to 5 for "Wall B" pipes as required and shown on the Drawings.

The lengths of reinforced concrete pipes under this contract 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. Only one laying length shall be permitted for each size of reinforced concrete pipe under this contract and pipes not of the approved uniform laying length shall not be used in the work. 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-Load to produce a 0.01 in crack = 1000 pounds
D-Load to produce the ultimate load = 1500 pounds

Lift holes in the walls of reinforced cement concrete pipes will not be permitted under this contract for the purpose of handling and laying. Other approved lifting methods shall be employed.

11.6 CERTIFIED DRAWINGS AND DATA SHEETS

The Contractor shall submit in triplicate, for approval by the Engineer 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 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.

11.7 JOINTS FOR CONCRETE PIPE SEWERS

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 tolerance 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 ex-filtration limits set forth hereinafter.

The groove end of tongue and groove of 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 to the pipe 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" or larger diameter in accordance with the recommendations of the rubber gasket manufacturer. Pipes of 8"/9" 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.

11.8 HOUSE CONNECTIONS

House Connections shall be made through manholes as indicated in the drawings or as directed by the Engineer.

House connection shall be provided individually for each plot by means of a 8"/9" dia R.C.C. sewer pipe and a dead end, laid at an average depth of 2.0 feet below N.S.L. 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.

The inlet of each house connection shall be plugged with brick masonry 4 1/2 inch thick in 1:6 cement sand mortar both in the manhole and the pipe in the plot.

11.9 GULLY GRATING

Gully grating shall be made through manholes as indicated in the drawings or as directed by the Engineer.

Gully grating shall be provided on the road junctions as mentioned in the drawings by means of a 8"/9" dia RCC sewer pipe connecting the nearest manhole with the chamber of size 1'-6"x1'-6". 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 the relevant section of this contract. Approved grating shall be fixed at the top.

11.10 INSTALLATION

11.10.1 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's opinion may cause defective joints, shall be sufficient cause for the rejection of any concrete pipe.

11.10.2 Excavation and Backfill

The excavation and backfill for sewer installations shall be as specified in applicable provisions of these technical specifications and will be paid for under separate contract items as classified and as per applicable variation orders.

11.10.3 Placing of Bedding

11.10.3.1 Brick Ballast Bedding

The brick ballast shall be clean material of 1 to 1 1/2 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 or 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 hammers until the full thickness as shown on the drawings for the particular pipe size has been built up and finished not more than 1/2" 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's Representative.

11.10.3.2 Crushed Stone Bedding

Crushed stone bedding shall be from an approved source. 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 1/2" and shall be graded down to 3/4". When shifted through a screen made of 1/4" diameter bars spaced 3/4" center to center, it shall yield no more than 10 percent by volume of fine materials.

11.10.4 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 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 1/2 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 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.

11.11 TESTING OF SEWER LINES

11.11.1 General

All sewer built under this contract shall be tested for infiltration or ex-filtration as specified below. The tests shall be made at times selected or approved by the Engineer. 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 labour, 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.

11.11.2 Infiltration Tests

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 and in a manner approved by the Engineer. The duration of the tests shall be only long enough to establish the true rate of infiltration. The amount of leakage over a 24 hour period will then be calculated from the result of the measured true rate of infiltration.

11.11.3 Ex-filtration Tests

The sewers which are constructed with the ground water level below the invert level of the pipe shall be tested for ex-filtration by isolating a section of sewers between manholes by means of approved temporary type of water tight bulk heads. The method of testing for ex-filtration shall be generally as follows:

1. After isolation of sewer section, it shall be filled with water to a level which is 3' above the crown of the pipe at the higher end of the isolated section under test. The level will not be more than 6 ft. above the invert level of the sewer pipe at its lower end.

2. The duration of the ex-filtration test shall be one hour after the filling with water has been completed.

3. Determination of the amount of ex-filtration shall be made by measuring the total loss of volume of water in the manholes.

4. The amount of ex-filtration over a 24 hour period will then be calculated from the measured loss of volume during the test observation period.

11.11.4 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 permissible maximum stated above.

11.11.5 Cleaning of Sewer Lines

The contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Employer.

11.12 MEASUREMENT AND PAYMENTS

Measurement and payment for sanitary sewers will be made in accordance with the provisions given hereafter.

11.12.1 Bedding

11.12.1.1 Method of Measurement

The quantity to be paid for under this item will be the number of cubic foot of bedding material acceptably provided & placed under sewers complete in all respects as per relevant drawings.

11.12.1.2 Basis of Payment

Payment shall be made for the number of cubic feet of bedding material measured as provided above at the Contract Unit Price per cubic foot and shall constitute full compensation for all work related to the item.

Pay Item	D e s c r i p t i o n	Unit
11.1	Provide & place bedding as per drawing.	Cu.ft.

11.12.2 Sewers

11.12.2.1 Method of Measurement

Measurement shall be made at site of the actual lengths of reinforced concrete pipes of different sizes and strength supply, installed and tested, as authorized for payment under this contract. The measurement will be made along the centre line of the pipe and between the inside walls of manholes or junction chambers. The unit of measurement will be linear foot.

11.12.2.2 Basis of Payment

The unit rate quoted in the priced B.O.Q. for supplying, laying and joining cement concrete sewerage pipes shall include full compensation for the cost of pipes, charges for their carriage to site and testing before and after laying, labour charges for laying, jointing, cleaning of sewer lines etc. and cost of all incidentals for completion of this item of work as per specifications laid down in this section.

Pay Item	D e s c r i p t i o n	Unit
11.2	Supply, lay, joint and test R.C.C pipes of various sizes complete in all respects:	L.ft.

11.12.3 House Connections

11.12.3.1 Method of Measurement

Measurement shall be made for the number of units of house connections provided & installed at site as per specifications & drawings complete in all respects.

11.12.3.2 Basis of Payments

Payment will be made for the number of units of House connections as measured above at the contract unit price for each unit and will constitute full compensation for supply, lay and joint 8"/9" dia R.C.C. Pipe for house connection including all excavation, backfilling, testing and all other works related to complete the item in accordance with lines and grades as shown in the drawings or as directed by the Engineer.

Pay Item	Description	Unit
11.3(a)	Provide and construct chamber for house connection including excavation, bedding, sand filling, backfilling including 8" dia RCC pipe complete in all respects.	No.
11.3(b)	Provide and construct chamber for house connection including excavation, bedding, sand filling, backfilling including 9" dia RCC pipe complete in all respects.	No.

11.12.4 Gully Grating

11.12.4.1 Method of Measurement

Measurement shall be made for the number of units of gully grating provided & installed at site as per drawings complete in all respects.

11.12.4.2 Basis of Payments

Payment will be made for the number of units of Gully grating measured as above at the contract unit prices and will constitute full compensation for supply, lay and joint 8"/9" dia RCC Pipe for gully grating including all excavation, backfilling, testing and all other works related to complete the item in accordance with lines and grades as shown in the drawings or as directed by the Engineer.

Pay Item	Description	Unit
11.4(a)	Construction of chamber with grating and 8" dia RCC pipe complete in all respects as per drawings or as directed by the Engineer.	No.
11.4(b)	Construction of chamber with grating and 9" dia RCC pipe complete in all respects as per drawings or as directed by the Engineer.	No.

SECTION - 12

CONSTRUCTION OF MANHOLES

12.1 SCOPE

The work consists of constructing manholes for sewerage at positions shown on the plans or where otherwise directed by the Engineer, and in accordance with the Detailed Drawings supplied from time to time, complete in all respects. The Contractor shall furnish all plant, labour equipment and materials in performing all operations in connection with the construction of manholes.

The various items of work involved in the construction of manholes shall be carried out strictly in accordance with respective technical specifications laid down for the item of work in these tender documents.

12.2 MATERIALS

Brick/block masonry, Portland cement concrete, and other materials shall meet the specified requirements of the relevant sections of the specifications. Cast iron frame shall conform to the specifications as per BS 497. Manhole steps shall be of galvanized mild steel.

12.3 CONSTRUCTION REQUIREMENTS

Manholes shall be constructed with brick masonry laid in 1:3 cement sand mortar, built on Class D concrete. The cover slab shall be of Class B reinforced cement concrete, fitted with cast iron frame which shall have reinforced cement concrete cover as shown in the plans. Reinforcement and concrete shall conform to the requirements of Section "CONCRETE". The outside and inside of the walls shall be plastered (1/2 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 centre line 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 ring 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.

12.3.1 Drop Manhole

The Contractor shall construct drop manholes wherever shown in the drawings or ordered by the Engineer. The Contractor shall make the drop connection as shown on the drawings or ordered by the Engineer's Representative.

12.4 MEASUREMENT AND PAYMENT

12.4.1 Material

Measurement and payment for various types of Manholes shall be made in accordance with the provision of this Clause specified hereafter.

12.4.1.1 Method of Measurement

Measurement shall be made for the number of manholes of various types constructed at site as per Drawings and Specifications laid down in this section and to the approval of the Engineer.

12.4.1.2 Basis of Payment

Payment shall be made for each manhole as a complete unit at the Contract Unit Price to provide and construct manhole including excavation and backfilling, covers with frame, cast iron steps, plastering, benching and all incidentals related to the item in accordance with lines and grades as shown in the Drawings or as directed by the Engineer.

Pay Item	D e s c r i p t i o n	Unit
12.1	Construction of circular masonry Manhole including manhole cover and frame.	No.
12.2	Extra over 12.1 for Drop Manholes including C.I pipes and fittings, concreting, complete in all respects.	No.

SECTION - 13

PVC PIPES

13.1 PVC Pipes Service Connections

Either metal or P.V.C. saddles, as specified, shall be used for the off take of service connections from larger bore pipes (50 mm diameter and above). The saddle consists of two half round sections of metal or P.V.C. which are bolted together or held round the pipe by wedge grips. A seal is formed between the saddle and the pipe and the under surface of the upper section. The service connection is taken from a boss on the upper section.

Conventional equipment for tapping under pressure may be used with these service connections using a special trapanning cutter to pierce the pipe wall. Ferrules shall not be screwed directly into pipes without the introduction of saddle piece.

13.2 P.V.C. Pipe-Repairs

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. In case of damage by external blows, the extent of the damage may be greater on the inner-surface.

Sometimes, pipes are damaged accidentally due to trenching operation in street repairs. Shell split or chip-out occur in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged pipe.

13.3 Laying and Jointing P.V.C. Pipes (Internal Work)

13.3.1 Clamping

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs, wherever manufactured, shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or districting the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated longitudinal temperature movement to take place without abrasion. Line or point contact with the pipe shall be avoided. Heavy components such as metal valves shall be individually supported.

13.3.2 Supports

P.V.C. pipes require supports at close interval. Recommended support spacings for unplasticised P. V.C. pipes are given in table below. This spacing may be increased by 50% for vertical run support.

Pipe Dia mm	Support spacing mm
20	700
25	750
32	825
40	975
50	975

It is essential that P.V.C pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, P.V.C. pipe shall also be checked for its alignment before clamping. The

pipe line will be wavy if the clamps are not fixed keeping the pipe plumb.

13.3.3 Connection to a Water Tap

Connection to the water tap shall be made by means of a G.I. adopter. G.I. adopter shall preferably be supplied by the same manufacturer as that of P.V.C. pipe. In any threaded coupling between P.V.C. and G.I. it is preferable that P.V.C. is fitted inside the G.I. fitting. If however greater projection is desired, same shall be achieved by joining a short piece of a G.I. pipe (Nipple)

13.3.4 Connection from Masonry/Concrete Water Tank

Solvent cement shall be coated on the section of the pipe to be embedded in concrete. Fine dry sand and cement mixture shall be sprinkled uniformly around the pipe. This shall give a rough surface which can be safely embedded in concrete; water proofing cement shall be used to close the gap properly.

13.4 PVC (Sch40 & sch80) PIPES FOR COLD WATER SUPPLY DISTRIBUTION NETWORK

PVC sch 40 / 80 plumbing system is suitable for all cold water plumbing and drinking water applications. The pipes are manufactured by extrusion process and fittings are manufactured by injection moulding process.

13.4.1 Material

The rigid PVC (Polyvinyl Chloride) compound used in the manufacture of pipes and fittings is Type 1, i.e. Grade 1 PVC 1120 as identified in ASTM D 1784. The compound contains specified amounts of pigment, stabilizers and other additives to facilitate extrusion.

13.4.2 Specifications

The system is made as per ASTM (American Society for Testing of Materials) standards. The Pipes are made as per ASTM D 1785 and Fittings are made as per ASTM D 2466 (for SCH 40 Fittings) and ASTM D 2467 (for SCH 80 Fittings). The pipes are plain ended in lengths of 3 meters in SCH 40 and SCH 80 pressure classes.

13.4.3 Pressure Rating PVC Schedule 40

Norm Size (mm)	Max. Work Pre. at 23°C (kg/cm2)
15	42.19
20	33.75
25	31.64
32	26.01
40	23.20
50	19.69
65	21.09
80	18.28
100	15.47
150	12.66

13.4.4 Pressure Rating PVC Schedule 40 PVC SCHEDULE 40 & 80 PRESSURE PIPES AND FITTINGS INSTALLATION PROCEDURES

CUT PIPE

Cut pipe square. As joints are sealed at the base of the fitting socket. An angled cut result in joint failure.

Acceptable tools include miter saw, mechanical cut off saw or wheel cutter. Wheel type cutters must employ a blade designed for plastics.

REMOVE BURR AND BEVEL
Remove all burrs from inside and outside of pipe with a knife-edge, file, or deburring tool. Chamfer (bevel) the end of the pipe 10° - 15°.

CLEAN
Remove surface dirt, grease, or moisture with a clean dry cloth.

DRY FIT
With light pressure, pipe should go one third to one half of the way into the fitting socket. Pipes and fittings that are too tight or too loose should not be used.

APPLICATOR
Use an applicator that is one half the pipe diameter.

Too large an applicator will force excessive cement into the inside of small diameter fittings. Too small an applicator will not apply sufficient cement to large diameter systems.

CEMENT
Apply a full even layer of cement to the outside of a pipe and medium layer of cement to the inside of a fitting.

JOIN PIPE AND FITTINGS
Assemble pipe and fitting socket till it contacts socket bottom. Give pipe a quarter turn. Hold pipe and fitting together until the pipe does not back out.

Remove excessive cement from the exterior. A properly made joint will show a continuous bead of cement around the perimeter.

13.4.5 PVC SCHEDULE 40 & SCHEDULE 80 PRESSURE PIPES AND FITTINGS SUPPORT SPACING FOR PVC PIPE

SUPPORT AND SPACING
All piping should be supported with an approved hanger at interval sufficiently close to maintain correct pipe alignment and to prevent sagging or geode reversal. Pipe should also be supported at all branch ends and at all changes of direction. Support traps arms as close as possible to the trap. In keeping with good plumbing practices support and brace all closet bends and fasten closet flanges.

1. Concentrated load should be supported directly so as to eliminate high stress concentrations. Should this be impractical then the pipe must be supported immediately adjacent to the load.

2. In system where large fluctuations in temperature occur, allowances must be made for expansion and contraction of the piping system. Since changes in direction in the system are usually sufficient to allow for expansion and contraction hangers must be placed so as not to restrict this movement.

3. Hangers should provide as much bearing surface as possible. To prevent damage to the pipe, file smooth any sharp edges or burrs on the hungers or supports.

Schedule – 40
Recommended Support spacing (in mm)

Nom. Pipe Size (mm)	Support Spacing (mm)
15	750
20	750
25	900
32	900
40	1000
50	1000
63	1200
75	1200
100	1350
150	1500

13.4.5 PVC SCHEDULE 40 & SCHEDULE 80 PRESSURE PIPES AND FITTINGS

JOINT CURING
Recommended initial set times

Temperature Range	Pipe Size 15 – 32 mm	Pipe Size 40 – 80 mm	Pipe Size 100 – 150 mm
15.5°C – 37.7°C	15 min.	30 min.	1 hour
4.4°C – 15.5°C	1 hour	2 hours	4 hours

Recommended initial cure times

Temperature Range	Pipe Size 15 – 32 mm	Pipe Size 40 – 80 mm	Pipe Size 100 – 150 mm
15.5°C – 37.7°C	6 hours	12 hours	24 hour
4.4°C – 15.5°C	12 hour	24 hours	48 hours

TESTING PRESSURE SYSTEM

1. Conduct pressure testing with water. DO NOT USE AIR OR OTHER GASES for pressure testing.

2. The piping system should be adequately anchored to limit movement. Water under pressure exerts thrust forces in piping systems. Thrust blocking should be provided at changes of direction, change in size and at dead ends.

3. Refer tables given for initial set & cure times before pressure testing.

4. The piping system should be slowly filled with water, taking care to prevent surge and air entrapment. The flow velocity should not exceed 1 feet per second.

5. All trapped air must be slowly released. Vents must be provided at all high points of the piping system. All valves and air relief mechanisms should be opened so that the air can be vented while the system is extremely dangerous and it must be slowly and completely vented prior to testing.

6. The piping system can be pressurized to 125% of its designed working pressure. However, care must be taken to ensure the pressure does not exceed the working pressure of the lowest rated component in the system (valves, unions, flanges, threaded parts etc.)

7. The pressure test should not exceed one hour. Any leaking joints or pipe must be cut out and replaced and the line recharged and retested using the same procedure.

UNDERGROUND INSTALLATION

PVC pipes and fittings can be installed underground, since these piping systems are flexible systems, proper attention should be given to burial conditions. The stiffness of the piping system is affected by sidewall support, soil compaction, and the condition of the trench, Trench bottoms should be smooth and regular in either undisturbed soil or a layer of compacted backfill. Pipe must lie evenly on this surface throughout the entire length of its barrel.

TRENCHING

The following trenching and burial procedures should be used to protect the piping system.

1. The trench should be excavated to ensure the sides will be stable under all working conditions.

2. The trench should be wide enough to provide adequate room for the following:

- Jointing the pipe in the trench.
- Snaking the pipe from side or side to compensate for expansion and contraction.
- Filling and compacting the side fills.

The space between the pipe and trench wall must be wider than the compaction equipment used in the compaction of the backfill. Minimum width shall not be less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches. Trench width may be different if approved by the design engineer.

3.The trench bottom should be smooth, free of rocks and debris, continuous, and provide uniform support. If ledge rock, hardpan or large boulders are encountered, the trench bottom should be padded with bedding of compacted granular material to a thickness of at least 4 inches. Foundation bedding should be installed as required by the engineer.

4. Trench depth is determined by the pipe's service requirements. Plastic pipe should always be installed at least below the frost level. The minimum cover for lines subject to heavy overhead traffic is 24 inches.

5. A smooth, trench bottom is necessary to support the pipe over its entire length on firm stable material. Blocking should be used charge pipe grade or to intermittently support pipe over low sections in the trench.

BEDDING AND BACKILLING

1. Even though sub-soil conditions vary widely from place to place, the pipe backfill should be stable and provide protection for the pipe.

2. The pipe should be surrounded with a granular material which is easily worked around the sides of the pipe Backfilling should be performed in layer of 6 inch. With each layer being sufficiently compacted to 85% to 95% compaction.

3. A mechanical tamper is recommended for compacting sand and gravel backfill which contain a significant proportion of fine grained material, such as

silt and clay. If a tamper is not available, compacting should be done by hand.

4. The trench should be completely filled. The backfill should be placed and spread in fairy uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, frozen clods, or other large debris should be removed. Heavy tampers or rolling equipment should only be used to consolidate only the final backfill.

5. Handling

The pipe should be handled with reasonable care. Because thermoplastic pipe is much lighter in weight than metal pipe. There is sometimes a tendency to throw it around. This should be avoided.

The pipe should never be dragged or pushed from a truck bed. Pallets for pipe should be removed with a fork lift. Loose pipe can be rolled down timbers, as long as the pieces do not fall on each other or on any hard or uneven surface. In all cases, severe contact with any sharp objects (rocks, angle irons, forks on forklifts, etc.) should be avoided.

STORING

If possible, pipe should be stored inside. When this is not possible, the pipe should be stored on level ground which is dry and free from sharp objects. If different schedules of pipes are stacked together, the pipe with the thickest walls should be at the bottom.

The pipe should be protected from the sun and be in an area with proper ventilation. This will lessen the effects of ultraviolet rays and help prevent heat built-up. If the pipe is stored in racks, it should be continuously supported along its length. If This is not possible, the spacing of the supports should not exceed three feet (3').

13.5 Method of Measurement

Measurement shall be made for the number of manholes of various types constructed at site as per Drawings and Specifications laid down in this section and to the approval of the Engineer.

13.6 Basis of Payment

Payment shall be made for these pipes as per lengths installed in exact meter or feet at the Contract Unit Price for provision of required pipes meeting the requirement of engineer in charge and related to the item in accordance with grades and specification as shown in the Drawings or as directed by the Engineer.

SECTION - 14

PVDF PIPES

14.1 Scope

This specification covers requirements for the PVDF Piping System intended for a wide range of applications including water, wastewater and effluent treatment as well as a wide range of chemical applications. The components of the PVDF piping systems must be in accordance with the following standards and/or requirement of engineer in charge.

14.2 Material Specification & Characteristics

PVDF pipes, fittings and valves must be manufactured from polyvinylidene fluoride resin material, unpigmented and opaque, of which pipes and fittings designed for 25 years of operational life with water at 20°C. The raw material used must be designed for use with pressure bearing piping systems with long term hydrostatic properties in accordance with EN ISO 10931. The characteristics of the PVDF must conform to the following standards:

Characteristics	PVDF	Units	Standards
Density	~ 1.78	g/cm3	EN ISO 1183-1/ ASTM D792
Yield stress at 23°C	≥ 48	N/mm2	EN ISO 527-1
Tensile E-modulus at 23°C	≥ 1800	N/mm2	ISO 527-1/ ASTM D 638
Charpy notched impact strength at 23 °C	≥ 8	kJ/m2	EN ISO 179/1eA
Charpy notched impact strength at 0°C	≥ 7	kJ/m2	EN ISO 179/1eA
Heat distortion temperature HDT A 1.80 Mpa	≥ 104	°C	EN ISO 75-2
Crystallite melting point	≥ 168	°C	DIN 51007
Thermal expansion coefficient	0.12 - 0.18	mm/mK	DIN 53752
Heat conductivity at 23°C	0.19	W/mK	EN 12664
Water absorption at 23°C/24 h	≤ 0.04	%	EN ISO 62
Colour	opaque		
Limiting oxygen index (LOI)	≥ 43	%	ISO 4589-1
Inner surface finish for injection moulded and extruded components	d≤ 315, Ra ≤ 0.5 *d355-450, Ra ≤ 0.65	µm	ISO 4287/ 4288
Temperature range in °C	-20 - +140	°C	

14.3 Pipes

All PVDF pipes must be manufactured in accordance with the requirements of EN ISO 10931. Furthermore, the pipes must be manufactured stress free and thermally annealed (max. internal stress of 2.5 N/mm2), without any voids, allowing a high grade of roundness, high degree of straightness and an extreme smooth surface. Testing will be done in accordance with EN 10204.

Outer diameter, ovality and wall thickness are defined according to tables below:

Pipe Measurements SDR21 / PN16

Nominal outer dia	Min. wall thickness	Tolerance limit of outer dia	Maximum deviation for ovality	Tolerance limit of wall thickness	Standard Dimension Ratio
dn	emin			a	SDR
16	1.9	+0.3	0.2	+0.4	9
20	1.9	+0.3	0.3	+0.4	11
25	1.9	+0.3	0.4	+0.4	13.6
32	2.4	+0.3	0.5	+0.5	13.6
40	2.4	+0.3	0.5	+0.5	17
50	3.0	+0.3	0.6	+0.6	17
63	3.0	+0.4	0.8	+0.6	21
75	3.6	+0.4	0.9	+0.6	21
90	4.3	+0.4	1.1	+0.7	21
110	5.3	+0.5	1.3	+0.8	21
125	6.0	+0.6	1.5	+0.9	21
140	6.7	+0.8	1.7	+0.9	21
160	7.7	+1.0	1.9	+1.0	21
200	9.6	+1.2	2.4	+1.2	21
225	10.8	+1.4	2.7	+1.3	21
250	11.9	+1.6	3.0	+1.4	21
280	13.4	+1.8	3.4	+1.5	21
315	15.0	+2.0	3.8	+1.6	21

(Dimensions in millimeters)

Pipe Measurements SDR33 / PN10

Nominal outer dia	Min. wall thickness	Tolerance limit of outer dia	Maximum deviation for ovality	Tolerance limit of wall thickness	Standard Dimension Ratio
dn	emin			a	SDR
75	2.3	+0.4	0.9	+0.5	33
90	2.8	+0.4	1.1	+0.5	33
110	3.4	+0.5	1.3	+0.6	33
125	3.9	+0.6	1.5	+0.6	33
140	4.3	+0.8	1.7	+0.7	33
160	4.9	+1.0	2.0	+0.7	33
200	6.2	+1.2	2.4	+0.9	33
225	6.9	+1.4	2.7	+0.9	33
250	7.7	+1.6	3.0	+1.0	33
280	8.6	+1.8	3.4	+1.1	33
315	9.7	+2.0	3.8	+1.2	33

(Dimensions in millimeters)

The mean outer diameter (dem) is the average value which results from the measurements of the outer diameter at an interval of dn and 0.1 dn to the end of the test piece. It is determined by measuring the circumference to 0.1 mm accuracy with a measuring tape.

The minimum and maximum wall thickness is determined to 0.1 mm, whereby

the measurement points should be distributed on the pipe circumference as evenly as possible. All measured values must be within the allowable tolerance limit.

Ovality is the difference between the measured maximum and the measured minimum external diameter (de) at the same cross-section. It is calculated to 0.1 mm and measured immediately after production. The ovality requirement applies to the timepoint of manufacture.

14.4 Fittings

All PVDF fittings should either as butt fusion type, metric sizes d20 (1/2") – d315 (12”) or socket fusion type, metric size d16 (3/8”) – d63 (2”). Both must be manufactured in accordance with EN ISO 10931 and they need to be tested according to EN 10204. The fittings are to be manufactured with an extreme smooth surface (Ra-value ≤ 0,5 µm for all injection moulded items). All threaded connections have pipe threads in accordance with the requirements of ISO.

All butt fusion fittings should have optimal lengths designed for use with fusion machine or bead and crevice free welding machines.

14.5 Accessories

14.5.1 Backing Flanges

Backing flanges in metric sizes DN15-400 shall be designed according to ISO 9624, in a thermo plastic-oriented design, consisting of 100% glass fibre reinforced polypropylene, PP-GF30, graphite black and UV stabilized. These flanges must be manufactured in a seamless technology injection moulding process. The flange should be optimized with a V-groove in the inner diameter to ensure an evenly distributed force on the thermo plastic flange adapter. The backing flanges shall be marked with dimension, PN-value, standards, brand and lot number.
Connecting dimensions’ metric according to ISO 7005, EN 1092; Bolt circle diameter PN10; Inch: ANSI B 16.5, BS 1560; class 150 (1/2” – 12”). As an alternative backing flanges in metric sizes DN15-400 shall be designed according to ISO 9624, in a thermo plastic-oriented design, consisting of glass fibre reinforced polypropylene, PP-GF30, graphite black and UV stabilized with steel inserts. The backing flanges shall be marked with dimension, PN-value, standards, brand and lot number. Connecting dimension metric according to ISO 7005, EN 1092; Bolt circle diameter PN10 (DN15-400) + PN16 (DN15-400); Inch: ANSI B 16.5, BS 1560; class 150 (1/2” – 8”). As an alternative backing flanges ANSI sizes d355 DN350 14” – d450 DN450 18” shall be designed in a thermo plastic-oriented design, consisting of PVDF coated steel. Connecting dimensions Inch ANSI B16.5, BS1560, class 150 (14”-16”).

14.5.2 Gaskets

Gaskets in metric sizes DN10–450 shall consist of elastomeric material according to EN681, designed with or without metal reinforcement for use with flange adaptors according ISO 10931. Gaskets with reinforcement shall be designed to be centred by the outer diameter. Gaskets without reinforcement >DN100 shall provide fixation aids to fit on the flange bolts.

Valves

All PVDF valves shall be metric sizes manufactured or equal in accordance with EN ISO 16135, 16136, 16137, 16138, tested according to the same standard.

14.6 Ball Valves

All PVDF ball valves with metric sizes DN10–100 shall be Type 546, 543, 523 with true double union design manufactured in accordance with EN ISO 16135. Incorporated into its design shall be a safety stem with a predetermined breaking point above the bottom O-ring, preventing any media leaking in the event of damage. The valve nut threads shall be buttress type to allow fast and safe radial mounting and dismounting of the valve during installation or maintenance work. Seats shall be PTFE with backing rings creating self-adjusting seals and constant operating torque. Backing rings and seals shall be EPDM or FKM. The handle shall include in its design an integrated tool for removal of the union bush. Union bushes shall have left-hand threads to prevent possible unscrewing when threaded end connectors are removed from pipe.

The following accessories shall be available:

- A Multi-Functional Model (MFM) in PPGF equipped with internal limit switches for reliable electrical position feedback, is mounted directly between the valve body and the valve handle. This MFM is also the necessary interface for later mounting of actuators.
- Mounting plate in PPGF with integrated inserts for later screw mounting on any support
- Lockable multi-functional handle

14.6.1 Electrically Actuated Ball Valves

Electric actuators shall be Types EA15 (metric sizes DN10-50), EA25 (metric sizes DN10-50), EA45 (metric sizes DN65) and EA120 (metric sizes DN80-100) shall be manufactured in accordance with EN 61010-1, EC directives 89/336/EWG-EMV and 73/23/EWG (LVD). Additionally, they need to be CE marked. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced), flame retardant with external stainless steel screws. All electric actuators shall have an integrated emergency manual override and integrated optical position indication.

All electric actuator types (with the exception of EA15) shall have the following accessories available:

Accessories:
EA15 / EA25 / EA45 / EA120 / EA250:
Failsafe return unit Battery incorporated into the housing for moving to a safe position in case of power outage (open or closed).

EA25 / EA45 / EA120 / EA250:

- Positioner for continuous valve control with 4-20mA or 0-10V and 4-20mA feedback
- Monitoring board
- Cycle time extension
- Cycle time monitoring
- Cycle counter
- Motor current monitoring
- Fieldbus connection
- Profibus DP auxiliary card
- AS interface module

14.6.2 Pneumatically Actuated Ball Valves

Pneumatic actuators shall be Types PA11 (for valve sizes DN15- 25) and PA21 (for valve sizesDN32-50). Pneumatic actuators shall be available as fail safe close, fail safe open and double acting and have an integrated optical position indication. Actuator housing shall be made of Polypropylene fibre glass reinforced (PPGF) and flame retardant. Actuators shall contain a preloaded spring assembly to ensure safe actuator operation and maintenance. Actuators shall contain integrated Namur interface (ISO 5211) for the easy mounting of positioners, limit switches and accessories. The valve shall be equipped with a Multi-functional-module for reliable electric feedback, mounted directly between the valve body and the actuator

- For valve size DN65 pneumatic actuators shall be Type PA30 (fail safe to close or open function), Type PA35 (double acting function).
- For valve size DN80 pneumatic actuators shall be Type PA35 (fail safe to close or open function), Type PA40 (double acting function).
- For valve size DN100 pneumatic actuators shall be Type PA45 (fail safe to close or open function), Type PA45 (double acting function)

Pneumatic actuators shall have an integrated optical position indicator. Actuator housing shall be made of hardened anodized aluminium. Actuators shall contain integrated Namur interface for the easy mounting of positioners, limit switches and accessories.

All pneumatically actuated ball valves shall have the following accessories available:
Pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC

- Positioner Type DSR 500-3
- Limit switch kits AgNi, Au, NPN, PNP
- Stroke limiter
- Manual override for all sizes up to DN100
- AS Interface control module with incorporated position feedback and a solenoid pilot valve

14.7 Manual Diaphragm Valves

14.7.1 Diaphragm Valves DN15 to DN100

All PVDF diaphragm valves, with metric sizes DN15-100, shall be either:

- Type 514 (true double union design, DN15-50), or
- Type 515 (spigot design, DN15-50), or
- Type 517 (flange design, DN15-50), or
- Type 519 (T-type design, DN15-15 – DN100-50)

All diaphragm valves shall be manufactured in accordance with EN ISO 16138.

The upper body shall be orange PPGF (polypropylene glass fibre reinforced) connected to the lower body with a central union avoiding exposed screws. A two coloured position indicator integrated into the hand wheel must be present to determine diaphragm position. The hand wheel shall have an integrated locking mechanism. Diaphragms are EPDM, FKM, NBR, PTFE with EPDM or FKM backing diaphragm. Following options shall be available:

- PN16 pressure rating (upper body shall be black PPS GF (polyphenylene sulphide glass fiber reinforced) for water applications only)
- Electrical feedback unit with either AgNi or AU contacts
- Pressure proof housing

The diaphragm valve shall have following KV values:

d [mm]	DN [mm]	KV [l/min @ ΔP=1 bar]
20	15	125
25	20	271
32	25	481
40	32	759
50	40	1263
63	50	1728

14.7.2 Diaphragm Valves DN65 to DN150

All PVDF diaphragm valves, with metric sizes, shall be Type 317 (flanged design, DN65-150) All diaphragm valves shall be manufactured in accordance with EN ISO 16138. The upper body shall be PPGF (polypropylene glass fibre reinforced) connected to the lower body with exposed stainless steel bolts. A position indicator integrated into the hand wheel must be present to determine diaphragm position. Diaphragms are to be EPDM, FKM, NBR, or PTFE with EPDM or FKM backing diaphragm.

14.8 Pneumatic Diaphragm Valves

14.8.1 Pneumatic Diaphragm Valves DN15 to DN100

All PVDF diaphragm valves, with metric sizes DN15-100, shall be either:

- Type 604 true double union design, DN15, or
- Type 605 spigot design, DN15
- Type 6x4 true double union design, DN15-50, or
- Type 6x5 spigot design, DN15-50, or
- Type 6x7 flange design, DN15-50, or
- Type 6x9 T-type design, DN15-15 – DN100-50

All diaphragm valves shall be manufactured in accordance with EN ISO 16138. The upper body shall be connected to the lower body with a central union avoiding exposed screws. Diaphragms are EPDM, FKM, NBR, PTFE with EPDM or FKM backing diaphragm. Following options shall be available:

The diaphragm valve shall have following KV values:

d [mm]	DN [mm]	KV [l/min @ ΔP=1 bar]
20	15	125
25	20	271
32	25	481
40	32	759
50	40	1263
63	50	1728

Pneumatic actuators shall be Type DIASTAR or Type 604/605 and available as:

- Type 604/605 for PN up to 6 bar (one side)
- DIASTAR Ten for PN up to 10 bar (one side)
- DIASTAR Ten Plus for PN up to 10 bar (both sides)

- DIASTAR Sixteen for PN up to 16 bar (one side)

The mode of operation shall be fail safe close (FC), fail safe open (FO) and double acting (DA). The valves shall have an integrated optical position indicator. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced). Actuators with FC mode shall contain a preloaded galvanised steel spring assembly to ensure safe actuator operation and maintenance. The actuator DIASTAR Ten, DIASTAR Ten Plus and DIASTAR Sixteen shall have following accessories available:

- Solenoid pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC
- Positioner Type DSR 500-1
- Feedback with following limit switches AgNi, Au, NPN, PNP, NAMUR
- Stroke limiter & emergency manual override
- ASI controller

14.8.2 Pneumatic Diaphragm Valves DN65 to DN150

All PVDF diaphragm valves with metric sizes shall be flanged design, DN65-150. All diaphragm valves shall be manufactured in accordance with EN ISO 16138. The upper body shall be connected to the lower body with exposed stainless steel bolts. Diaphragms are to be EPDM, FKM, NBR, or PTFE with EPDM or FKM backing diaphragm.

Pneumatic diaphragm actuators shall be DIASTAR Type 025. The mode of operation shall be fail safe close (FC), fail safe open (FO) and double acting (DA). The valves shall have an integrated optical position indicator. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced). Actuators with FC mode shall contain a preloaded galvanised steel spring assembly to ensure safe actuator operation and maintenance.

The actuator DIASTAR 025 shall have following accessories available:

- Solenoid pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC
- Positioner Type DSR 500-2
- Feedback with following limit switches AgNi, Au, NPN, PNP, NAMUR
- Stroke limiter & emergency manual override
- ASI Controller

14.9 Butterfly Valves

All PVDF butterfly valves with metric sizes DN50 (2") – DN300 (12") shall be Type 567/578/563 wafer/lug type with a double eccentric disc design manufactured in accordance with EN ISO 16136. Seals shall be available in both FKM and PTFE. The lever handle shall be lockable in increments of 5 degrees. There shall always be six teeth engaged between the ratchet and the index plate to ensure accurate and safe positioning of the lever. There shall be the option of fine adjustment by use of a specific hand lever, allowing the disc to be exposed at any angle between 0° und 90°. The hand lever shall be manufactured of high strength PPGF (polypropylene glass fibre reinforced).

The option of an integrated electric position indicator shall be available. Optional the valves can be actuated by gear box with hand wheel. The electric position indicator shall be integrated into the mounting flange. Butterfly valves shall have low actuation torque to enable easy operation. All butterfly valves Type 567/578 manufactured for a nominal pressure rate of 10 bar. All butterfly valves Type 563

should be designed for a nominal pressure rate of 4 bar.

14.9.1 Electrically Actuated Butterfly Valves

Electric actuators shall be Types EA45, EA120 or EA250 dependent on valve size. For valve size from DN350 - 600 with Valpes VS300, VT600 and VT1000. They shall be manufactured in accordance with EN 61010-1, as per the above specifications. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced), flame retardant and feature external stainless steel screws. All electric actuators shall have an integrated emergency manual override and integrated optical position indication. All electric actuator types shall have the following accessories available:

- Failsafe return unit: Battery incorporated into the housing for moving to a safe position in case of power outage (open or closed).
- Positioner: For continuous valve control with 4-20mA or 0-10V and 4-20mA feedback
- Monitoring board
- Cycle time extension
- Cycle time monitoring
- Cycle counter
- Motor current monitoring
- Fieldbus connection
- Profibus DP auxiliary card
- AS interface module

14.9.2 Pneumatically Actuated Butterfly Valves

Pneumatic actuators shall be Types PA 35 (metric sizes DN50-65), PA40 (metric size DN80), PA45 (metric size DN100-125), PA55 (metric size DN150-200), PA60 (metric sizes DN200 FC), PA65 (metric sizes DN250 FC) PA70 (metric sizes DN300 FC). For valve size from DN350 – 600 with Revac types. Pneumatic actuators shall be available as fail safe close, fail safe open and double acting and have an integrated optical position indication. Actuator housing shall be made of hardened anodized aluminium. Actuators shall contain integrated Namur interfaces (ISO 5211) for the easy mounting of positioners, limit switches and accessories. All pneumatically actuated butterfly valves shall have the following accessories available:

- Solenoid pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC
- Positioner Type DSR 100/101
- Feedback with following limit switches AgNi, Au, NPN, PNP, NAMUR
- Stroke limiter & emergency manual override
- ASI-controller

14.10 Check Valves

All PVDF check valves, according to EN ISO 16137, metric sizes DN10-100 metric, shall be Type 561/562 true double union design. Seals shall be FKM or FFKM. Union bushes shall have a left hand thread to prevent possible unscrewing when threaded end connectors are removed from pipe. This valve shall be suitable for mounting in a vertical and horizontal position. Type 562 shall be equipped with a spring made of stainless steel (either V2A, Nimonic 90 or V2A ECTFE coated) to allow position independent installation. The valves are designed for a nominal pressure of 16 bar.

14.10.1 Wafer Check Valves

All PVDF wafer check valves shall be Type 369, metric size DN32-300. The minimum water column of 2m is required for sealing. They must be equipped with a spring (either in 316 stainless steel or Hasteloy C) guaranteeing closure in all installation positions. Attention: A stabilizing pipe zone of at least 5 times nominal diameter (DN) (recommended 10 times nominal diameter) before and after the wafer check valve should be provided. The wafer check valves are dimensioned in metric sizes DN32-125 for nominal pressure 10 bar and in metric sizes DN150-300 for nominal pressure 6 bar.

14.11 Pressure Regulating Valves

All pressure regulating valves shall have the following characteristics:

Pressure ranges for all pressure regulating valves are the following:

- DN10–50 from 0 up to max. 10 bar
- DN65–80 from 0 up to max. 6 bar
- DN100 from 0 up to max. 4 bar

14.12 Ventilating and Bleed Valves

All PVDF ventilating- and bleed valves shall be type 591. Dimensions DN10-100 are with pressure rating PN16. They shall be equipped with a PVDF floater.

14.13 Ventilating Valves

All PVDF ventilating valves shall type 595. Dimensions DN10-100 are with pressure rating PN16. They shall be equipped with plastic coated stainless steel spring with minimal opening pressure (10-80 mbar). Optionally Nimonic / Nimonic-ECTFE can be used.

14.14 Welding and Assembly

All butt fusion fittings and valves shall also be manufactured with laying lengths designed for use with fusion machines, providing welds with increased mechanical and chemical stability than conventional welding methods (socket- and butt fusion). The IR fusion machines use non-contact radiant heating. The cooling time for is calculated on the basis of ambient temperature and the bead surface temperature for uniform reproducible weld beads for easy weld bead inspection. Only authorized welders should be allowed to perform fusion on the IR machines.

As an alternative to IR fusion, conventional butt fusion according to DVS 2207-15 may be used, preferably with automated CNC controllers and weld recorders. Special care needs to be taken to prevent the pipe ends from sticking to the heater plate. Socket fittings require the use of Socket Fusion welding tools according to DVS 2007-15, with heating bushes System B. The fusion technology joins PVDF piping components of dimensions d20-110 without any irregularities, beads or crevices. Only authorized welders should be allowed to perform fusion on the machines. The welding and the installation should be in accordance with client requirement and instructions of engineer in charge.

14.15 Product Marking

The pipes and accessories must be embossed with a permanent identification to ensure full traceability. All pipes and accessories should be marked permanently and consecutively with the following:

- Material identification: PVDF
- Diameter, wall thickness, SDR and PN
- Product standard: ISO 10931
- Manufacture date, shift and machine number
- Approvals / Conformance:
- Country of manufacture

14.16 TRENCHING

The following trenching and burial procedures should be used to protect the piping system.

1. The trench should be excavated to ensure the sides will be stable under all working conditions.

2. The trench should be wide enough to provide adequate room for the following:

- Jointing the pipe in the trench.
- Snaking the pipe from side or side to compensate for expansion and contraction.
- Filling and compacting the side fills.

The space between the pipe and trench wall must be wider than the compaction equipment used in the compaction of the backfill. Minimum width shall not be less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches. Trench width may be different if approved by the design engineer.

3.The trench bottom should be smooth, free of rocks and debris, continuous, and provide uniform support. If ledge rock, hardpan or large boulders are encountered, the trench bottom should be padded with bedding of compacted granular material to a thickness of at least 4 inches. Foundation bedding should be installed as required by the engineer.

4. Trench depth is determined by the pipe's service requirements. Plastic pipe should always be installed at least below the frost level. The minimum cover for lines subject to heavy overhead traffic is 24 inches.

5. A smooth, trench bottom is necessary to support the pipe over its entire length on firm stable material. Blocking should be used charge pipe grade or to intermittently support pipe over low sections in the trench.

BEDDING AND BACKILLING

1. Even though sub-soil conditions vary widely from place to place, the pipe backfill should be stable and provide protection for the pipe.

2. The pipe should be surrounded with a granular material which is easily worked around the sides of the pipe Backfilling should be performed in layer

of 6 inch. With each layer being sufficiently compacted to 85% to 95% compaction.

3. A mechanical tamper is recommended for compacting sand and gravel backfill which contain a significant proportion of fine grained material, such as silt and clay. If a tamper is not available, compacting should be done by hand.

4. The trench should be completely filled. The backfill should be placed and spread in fairy uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, frozen clods, or other large debris should be removed. Heavy tampers or rolling equipment should only be used to consolidate only the final backfill.

5. Handling

The pipe should be handled with reasonable care. Because thermoplastic pipe is much lighter in weight than metal pipe. There is sometimes a tendency to throw it around. This should be avoided.

The pipe should never be dragged or pushed from a truck bed. Pallets for pipe should be removed with a fork lift. Loose pipe can be rolled down timbers, as long as the pieces do not fall on each other or on any hard or uneven surface. In all cases, severe contact with any sharp objects (rocks, angle irons, forks on forklifts, etc.) should be avoided.

STORING

If possible, pipe should be stored inside. When this is not possible, the pipe should be stored on level ground which is dry and free from sharp objects. If different schedules of pipes are stacked together, the pipe with the thickest walls should be at the bottom.

The pipe should be protected from the sun and be in an area with proper ventilation. This will lessen the effects of ultraviolet rays and help prevent heat built-up. If the pipe is stored in racks, it should be continuously supported along its length. If This is not possible, the spacing of the supports should not exceed three feet (3').

14.17 Method of Measurement

Measurement shall be made for the number of manholes of various types constructed at site as per Drawings and Specifications laid down in this section and to the approval of the Engineer.

14.18 Basis of Payment

Payment shall be made for these pipes as per lengths installed in exact meter or feet at the Contract Unit Price for provision of required pipes meeting the requirement of engineer in charge and related to the item in accordance with grades and specification as shown in the Drawings or as directed by the Engineer.

SECTION - 15

STAINLESS STEEL PIPES, PIPE LAYING AND APPURTENANCES

15.1 SCOPE

The work covered by this Section of the specification consists of furnishing all plant, labour, equipment, appliances and materials and of performing all operations in connection with stainless steel pipes and appurtenances in strict accordance with this section of the specifications and the applicable Drawings.

15.2 MATERIALS

Material shall conform to the respective specifications and other requirements specified hereinafter and shall be new and unused. The stainless steel pipes should conform to AISI and ASTM standards. The AISI304, AISI316 and AISI316L pipes should meet the requirements of ASTM A312.

15.3 APPROVAL OF MATERIALS AND EQUIPMENT

As soon as practicable but within 30 days after receipt of notice to proceed and before any materials or equipment are purchased, the Contractor shall submit for approval of the Engineer a complete schedule, in triplicate, of materials and equipment to be incorporated in the work, together with the names and addresses of the manufacturers and their catalogue cuts, diagrams, drawings, and such other descriptive data as may be required by the Engineer. No consideration will be given to partial lists submitted from time to time. Approval of materials and equipment with deviations from the specifications shall not be construed as approval of the deviations unless they are specifically brought to the notice of the Engineer. Laboratory results and certifications, specified or otherwise required, shall be submitted prior to delivery of the material and equipment to site.

15.4 INSTALLATION

15.4.1 Handling

Pipe and accessories shall be handled in such a manner as to ensure their delivery to the installation place or trench in sound, un-damaged condition. If any pipe or fitting is damaged, the repair or replacement shall be made by the Contractor at his expenses in a satisfactory manner. No other pipe or material of any kind shall be placed inside of a pipe or fittings. Pipe shall be carried into position and not dragged. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being installed or lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Employer. Gaskets that are not to be installed immediately shall be stored in a cool dark place and protected against the direct rays of the sun.

15.4.2 Cutting of Pipe

This shall be done in a neat and workman-like manner without damage to the pipe. Unless otherwise authorized by the Engineer or recommended by the manufacturer, cutting shall be done with a mechanical cutter of approved type.

15.4.3 Location

Where the location of the water pipe is not clearly defined by dimensions on the Drawings, the water pipe shall be located as directed by the Engineer.

15.4.4 Deflection

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be as recommended by the manufacturer and as approved by the Engineer. If the alignment requires deflections in excess of the specified limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth, as approved.

15.4.5 Placing and Laying

Pipe and accessories shall be carefully placed on area of installation or lowered into the trench by means of derrick ropes, belt slings, or other suitable equipment. Under no circumstances shall any of the line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers shall be of wood and shall have broad flat faces to prevent damage to the pipe. Except where necessary in making connections with other lines or authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bell coupling and joints. Pipe that has the grade or the joint disturbed after laying shall be taken out and re-laid. Pipe shall not be laid in water shall be kept out of the trench until the materials in the joints have hardened or until chalking or jointing is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench fluid, earth, or other substances will enter the pipes or fittings. Where any part of a coating or lining is damaged, the repair shall be made by the Contractor at his own expense in a satisfactory manner. Pipe ends left for future connections shall be provided with valve, plugged or capped, and anchored, as shown or as directed, where connections shall be made by using specials and fittings to suit the actual conditions.

15.4.6 Jointing

a. The joints shall be in accordance with the recommendations of the manufacturer or as approved by the Engineer.

b. Connections between different types of pipes and accessories shall be made with transition fittings where recommended by the pipe manufacturer.

c. Service connections shall be made as indicated and in accordance with the recommendations of the pipe manufacturer.

15.4.7 Setting of Valves and Surface Boxes

Valves, fitting, accessories and surface boxes shall be installed as shown or directed, and shall be set plumb. Surface box shall be centered on the stems. Concrete, concrete pipe, brick, brick ballast used in chambers shall conform to the relevant clause of the Specifications. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to the satisfaction of Engineer on all sides of the box, or to the undisturbed trench face if less than 4 ft.

Valves, fittings and accessories shall have the interiors cleaned of all foreign matter before installation. Surface boxes shall be lighted and the fittings shall be inspected in open and closed positions to ensure that all parts are in working condition.

15.4.8 Thrust Blocks

Plugs, caps, tees, bends and fire hydrants shall be provided with concrete thrust blocks. Backing shall be placed between solid ground and the hydrant or fitting to be anchored. The area of bearing shall be as shown on the Drawing. The backing shall be so placed that fitting joints shall be accessible for repair. The concrete shall be of class B plain cement concrete.

15.5 FLUSHING

The Contractor shall provide facilities for flushing the line. Water/fluid for flushing the line shall be arranged by the Contractor. Flushing of line shall be done section by section. For each valved section of pipeline, the Contractor shall make a temporary hose connection between the water/fluid pipeline and the pipeline under test. Fluid shall be pumped into the section flushed. Other arrangements for storing and pumping of fluid shall be subject to the approval of Engineer. Due precautions shall be taken by the Contractor for the disposal of fluid. The pipeline shall be flushed by keeping all the branch pipes open. Flushing shall be continued until clean fluid starts flowing through the other end. Section by section, the entire pipeline shall be flushed at a minimum flushing velocity of 2.5 ft./sec.

15.6 LEAKAGE TEST

Flushing of the pipeline shall be followed by a leakage test. The Contractor shall provide facilities for performing the leakage test. Fluid and pumping facilities shall be provided by the Contractor. Before the testing of pipeline, the Contractor shall ensure that concrete backing blocks have been provided where necessary. The test shall be performed only after all concrete work in contact with pipe to be tested has set for a minimum of 72 hours. All joints shall be left exposed. Leakage test shall be performed by keeping the end of the pipeline closed by proper plugs blocked to resist 150 per cent of the actual working pressure. While filling the line all valves and openings shall be kept open and fluid shall be filled in slowly. When the pipeline is completely filled with fluid and all air expelled, fluid shall be pumped into the pipeline to a minimum pressure of 150 percent of actual working pressure and the test pressure shall be maintained for at least 30 minutes for each section of 330 feet. Each and every joint shall be inspected for leaks and for all visible leakage, a displacement leakage test shall be performed by the Contractor, for the newly laid pipeline. The pipeline shall be filled with fluid and all the air from the pipeline shall be expelled. No piping installation will be accepted until the leakage is equal or less than the number of imperial gallons per hour as determined by the formula:

L = 0.00054.ND./P
L = Leakage in Imperial Gallons
N = Number of joints
D = Nominal diameter of pipe in inches
P = Average test pressure (psi) during test

In the event of the pipeline failing the leakage test, the Contractor shall locate and repair the defective pipe, fitting or joint at his expenses. For dewatering the line for repairs the Contractor shall follow the instructions given by the Engineer for disposal of water. After repairs of the line, the Contractor shall retest the line. The line will not be accepted until it passes the leakage test.

15.7 RETESTING AFTER BACKFILL

After the pipe trench has been backfilled, the entire length shall be subjected to a leakage test as a whole unit. The Contractor shall repair the line if it fails to pass the leakage test requirements specified hereinbefore. The test shall be repeated and repairs effected until the pipeline passes the leakage test.

15.8 PIPELINE DISINFECTION

15.8.1 General

The Contractor shall furnish all equipment, labour and material for the proper disinfection of the pipeline. Disinfection shall be accomplished after the lines have been successfully tested for leakage but before they have been connected to the main system. Disinfection of the pipelines shall be done in the presence of the Engineer's representative with equipment and methods approved by him.

15.8.2 Chlorination

A chlorine and water mixture or a mixture directed by Engineer in charge shall be supplied by means of a solution feed device. The solution shall be applied at one end of the pipeline through a trap, in such a manner that as the pipeline is filled with solution, the dosage applied to the fluid entering the pipe shall be at least 25 ppm or enough to meet the requirements given hereinafter.

15.8.3 Retention Period

Disinfection solution shall be retained in the pipeline for a period of at least 24 hours. After the fluid has been retained for the required time, the residual at the pipe extremities and at such other representative points shall be at least 10 parts per million. This procedure shall be repeated until the required residual concentration is obtained.

15.8.4 Disinfection of Valves

During the process of disinfection of the pipeline, all valves or other appurtenances shall be operated while the pipeline is filled with the disinfection solution.

15.9 FINAL FLUSHING

Following complete disinfection of the pipeline, all treated fluid shall be thoroughly flushed from the pipeline at its extremities. Treated fluid and fluid used for flushing the pipelines shall be disposed of in a manner instructed by the Engineer.

15.10 SAMPLING AND TESTING

Disinfection of the pipeline and appurtenances shall be the responsibility of the Contractor. The first set of samples will be collected for analysis by the Engineer. Should the sample reveal presence of impurities, the Contractor shall again disinfect the pipeline and appurtenance and shall pay the Employer for sampling and testing for subsequent retests until coliform free samples are obtained. The charges for resampling and retesting shall be paid by the Contractor.

15.11 CLEAN-UP

Upon completion of the installation of the pipe lines, distribution system and appurtenance, all debris and surplus materials resulting from the work will be removed and disposed of in a manner satisfactory to the Engineer

15.12 INDICATION PLATES

The indication plates shall be installed in accordance with the drawings and as directed by the Engineer.

15.13 WASHOUTS

The design and locations of washouts shall be illustrated on the Drawings and to be approved by the Engineer. Exact positioning shall be determined with regard to topography and to the approval of the Engineer. At least 10 ft. of the washout pipe work, inclusive of the isolating valve, measured from the center line of the pipeline, shall be laid at the same time as the pipeline and suitably capped to prevent ingress of foreign material. The minimum gradient for the washout pipe work shall be 1 in 100.

15.14 AIR VALVES

15.14.1 Double Orifice Air Valves

These shall be designed to meet the following conditions:

i) Expulsion of air during charging of the pipeline

ii) Admit air during emptying of the pipeline to avoid the occurrence of negative pressure

iii) Expulsion of air accumulated at summit points along the pipeline under normal operating conditions

Conditions (i) and (ii) shall be met by the employment of a large orifice capable of handling large volumes of air at high flow rate, and condition (iii) by a small orifice capable of discharging small quantities of air as they accumulate.

The large orifice shall be sealed by a buoyant rigid ball and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. The small orifice shall be sealed by a buoyant ball at all pressures above atmospheric except when air accumulates in the valve chamber.

15.15 MEASUREMENT AND PAYMENT

15.15.1 Pipe work

Measurement and payment of pipe work, fittings, specials and appurtenances will be made in accordance with the provisions of this clause specified hereinafter.

15.15.1.1 Method of Measurement

Measurement will be made for the number of linear feet of required pipe acceptably provided & installed complete in all respects as per relevant Drawings and specification as directed by the Engineer.

15.15.1.2 Basis of Payment

Payment will be made for the number of linear feet of pipe work as measured above at the Contract Unit price of each unit and shall constitute full compensation to provide, handle, lay and joint pipes and including flushing, leakage testing before & after backfilling, final flushing and works related to the item.

Pay Item	Description	Unit
15.1	Supply, lay, joint and test AISI 316 pipes and accessories as per drawings and specifications or as Directed by the Engineer.	Lft
15.2	Supply, lay, joint and test other Stainless steel pipes complete in all respects as per drawings and specifications.	Lft.

15.15.2.2 Ferrule Assembly

15.15.2.2(a) Method of Measurement

Measurement shall be made for the number of ferrules acceptably provided & installed complete in all respects as per relevant Drawings or specifications.

15.15.2.2(b) Basis of Payments

Payment shall be made for the number of ferrules measured as above at the contract unit price for each unit and shall constitute full compensation for providing, tapping, drilling, fixing and all other work related to the item to make complete house connection.

Pay Item	Description	Unit
15.3	Provide & install brass ferrule assembly of approved quality including tapping, drilling, etc. including corporation cock for disconnection complete in all respects as per drawings.	No.

15.15.2.3 Pipe Fittings and Specials

15.15.2.3(a) Method of Measurement

Measurement will be made for the number of fittings and specials acceptably provided & installed complete in all respects as per relevant drawings or as directed by the Engineer.

15.15.2.3(b) Basis of Payment

Payment will be made for the number of pounds of fittings/specials as provided above at the Contract Unit Price and shall constitute full compensation for the cost of providing, handling, fixing, jointing, disinfecting, respective type of fitting/special, and all other work related to the item.

Pay Item	D e s c r i p t i o n	Unit
15.4	Provide & install fittings.	Kgs.

15.15.2.6 Indication Plates

10.15.2.6(a) Method of Measurement

Measurement will be made for the number of indication plates acceptably provided & installed complete in all respects as per relevant drawings.

15.15.2.6(b) Basis of Payment

Payment will be made for the number of indication plates measured as above at the contract unit price for each unit and shall constitute full compensation for providing handling, fixing and all other work related to the item.

Pay Item	D e s c r i p t i o n	Unit
15.5	Provide and install indication plates as per drawing.	No.

15.15.2.7 Washouts

15.15.2.7(a) Method of Measurement

Measurement will be made for the number of washouts acceptably provided & installed complete in all respects and as approved by the Engineer.

15.15.2.7(b) Basis of Payment

Payment will be made for the number of washouts measured as above at the contract unit price for each unit and shall constitute full compensation for providing, handling, fixing and all other work related to the item including construction of chamber.

Pay Item	D e s c r i p t i o n	Unit
15.6	Provide & install washouts with all fittings for draining out the lines including construction of chamber as shown on the drawing or as directed by Engineer.	No.

15.15.2.8 Air Valves

15.15.2.8(a) Method of Measurement

Measurement will be made for the number of air valves acceptably provided & installed complete in all respects and as approved by the Engineer.

15.15.2.8(b) Basis of Payment

Payment will be made for the number of air valves measured as above at the contract unit price for each unit and shall constitute full compensation for providing handling, fixing and jointing related to the item including construction of chamber.

Pay Item	D e s c r i p t i o n	Unit
15.7	Provide install test and commission double acting air valve and all fittings including construction of chamber complete in all respects.	No.

15.15.2.9 Sand Cushion

15.15.2.9(a) Method of Measurement

Measurement will be made for the number of cubic feet of sand acceptably provided & placed under road crossing complete in all respects and as approved by the Engineer.

15.15.2.9(b) Basis of Payment

Payment shall be made for the number of cubic foot of sand measured as provided above at the contract unit price per cu.ft and shall constitute full compensation for all work related to the item.

Pay Item	D e s c r i p t i o n	Unit
15.8	Sand filling in trenches for pipe.	Cft.

SIALKOT TANNERIES ASSOCIATION (GUARANTEE) LIMITED (STAGL)

ROAD AND FINISHING WORKS AT CETP
AT SIALKOT TANNERY ZONE, SIALKOT

TENDER DRAWINGS

INCONSULT (PVT) LIMITED
ENGINEERING & MANAGEMENT CONSULTANTS

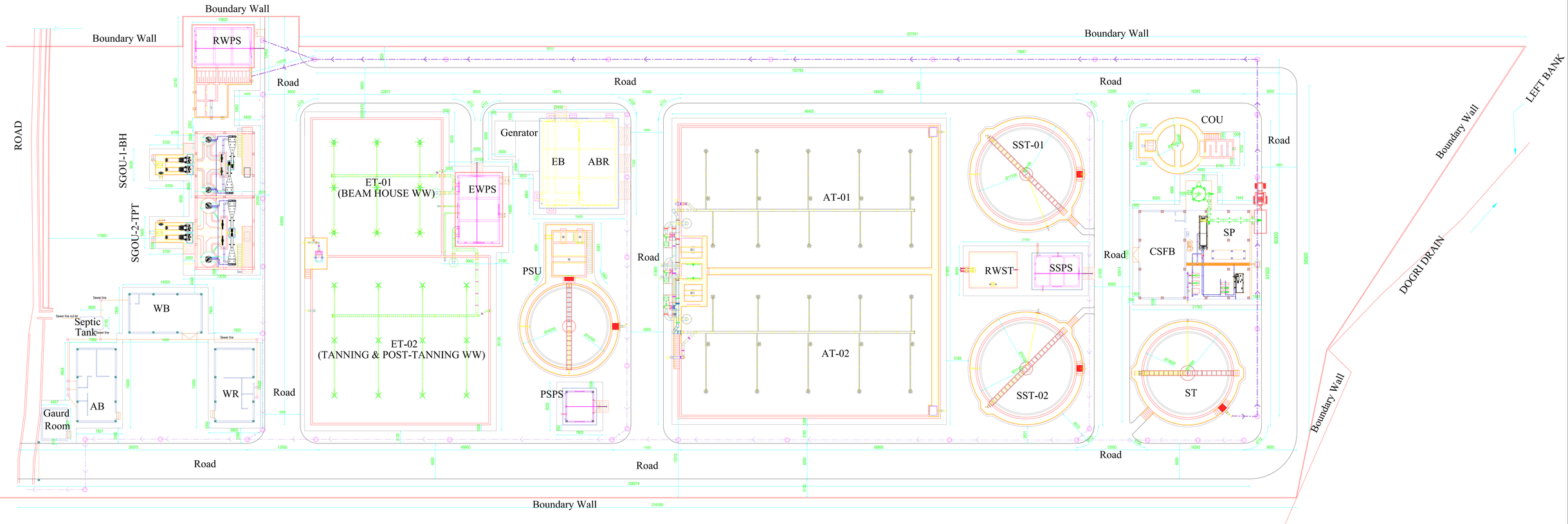
80-AURANGZEB BLOCK
NEW GARDEN TOWN LAHORE-54600
TEL:042-35869560-35832234 FAX:35869561
WEB:www.incon.com.pk
Email: info@incon.com.pk

ABBREVIATIONS

SGOU-1-BH	SCREEN, GRIT & OIL SEPARATION CHAMBERS UNIT (BEAM HOUSE WW STREAM)
SGOU-2-TPT	SCREEN, GRIT & OIL SEPARATION CHAMBERS UNIT (TANNING & POST-TANNING WW STREAM)
RWPS	RAW WASTEWATER PUMPING STATION
ET	EQUALIZATION TANK
EWPS	EQUALIZED WASTEWATER PUMPING STATION
PSU	PRIMARY SETTLING UNIT
AT	AERATION TANK
SST	SECONDARY SETTLING TANK
COU	CHEMICAL OXIDATION UNIT

ABBREVIATIONS

PSPS	PRIMARY SLUDGE PUMPING STATION
SSPS	SECONDARY SLUDGE PUMPING STATION
ST	SLUDGE THICKENER
CSFB	CHEMICALS DOSING AND SLUDGE FILTER BUILDING
ABR	AIR BLOWERS ROOM
AB	ADMIN BUILDING
WB	WORKSHOP BUILDING
EB	ELECTRICAL BUILDING
WR	WORKERS ROOM



NOTE:-

1. The Design and drawings CETP is provided by some other Consultant.
2. This drawing is Reproduction of the Original drawing for references.

REV.	DESCRIPTION	BY	DATE

INCONSULT (PVT) LIMITED
ENGINEERING & MANAGEMENT CONSULTANT
80-AURANGZEB BLOCK
NEW GARDEN TOWN LAHORE-54600
TEL:35869560-35832234 FAX:35869561

PROJECT : SIALKOT TANNERY ZONE

BUILDING TITLE: ROADS & FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE

DRAWING TITLE: LAY OUT PLAN

SCALE :	CHECKED BY	DWG. # :
NTS.	MSA	STZ-RE-CETP-01
DESIGNED BY :	DRAWN BY :	DATE :
MSA	GULFAM	11-11-2025

ABBREVIATIONS

SGOU-1-BH	SCREEN, GRIT & OIL SEPARATION CHAMBERS UNIT (BEAM HOUSE WW STREAM)
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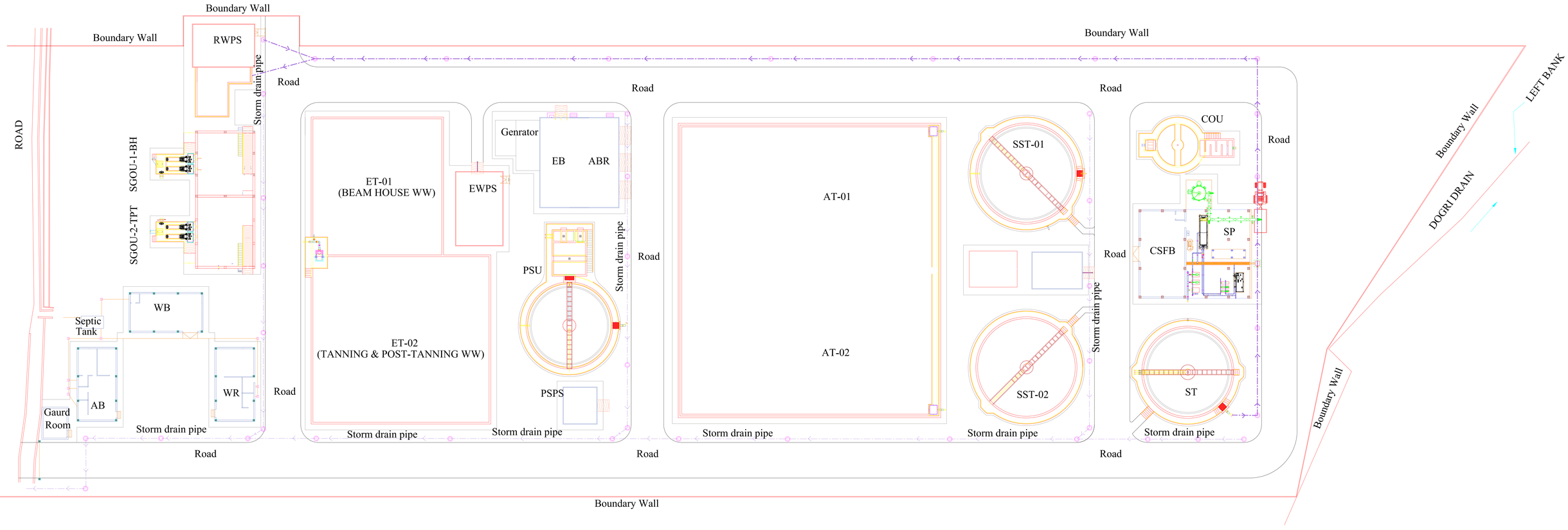

Catch pit / Manhole
Manhole Sewer
Sewer Line

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2. This drawing is Reproduction of the Original drawing for references.

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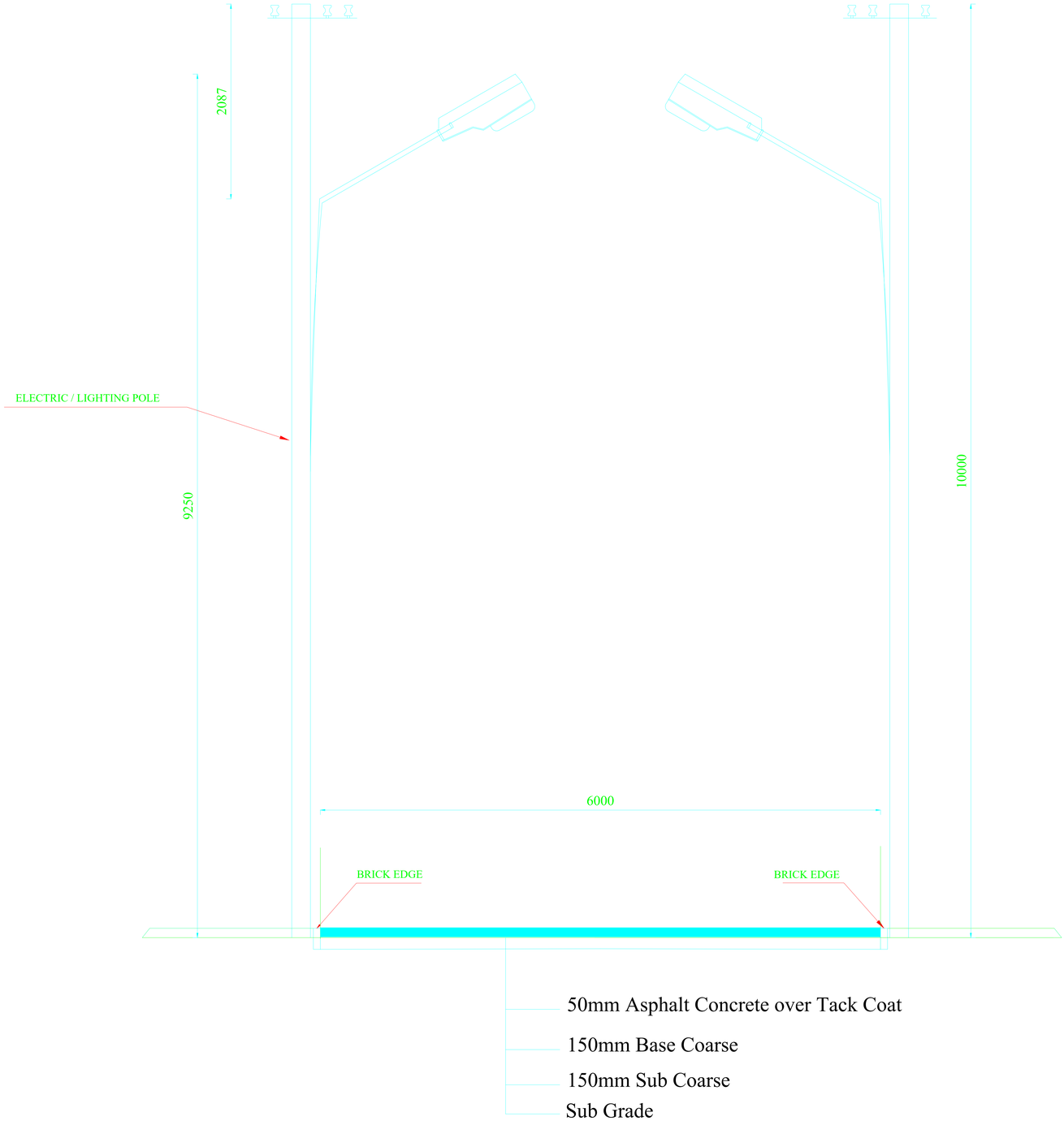
INCONSULT (PVT) LIMITED
ENGINEERING & MANAGEMENT CONSULTANT
80-AURANGZEB BLOCK
NEW GARDEN TOWN LAHORE-54600
TEL:35869560-35832234 FAX:35869561

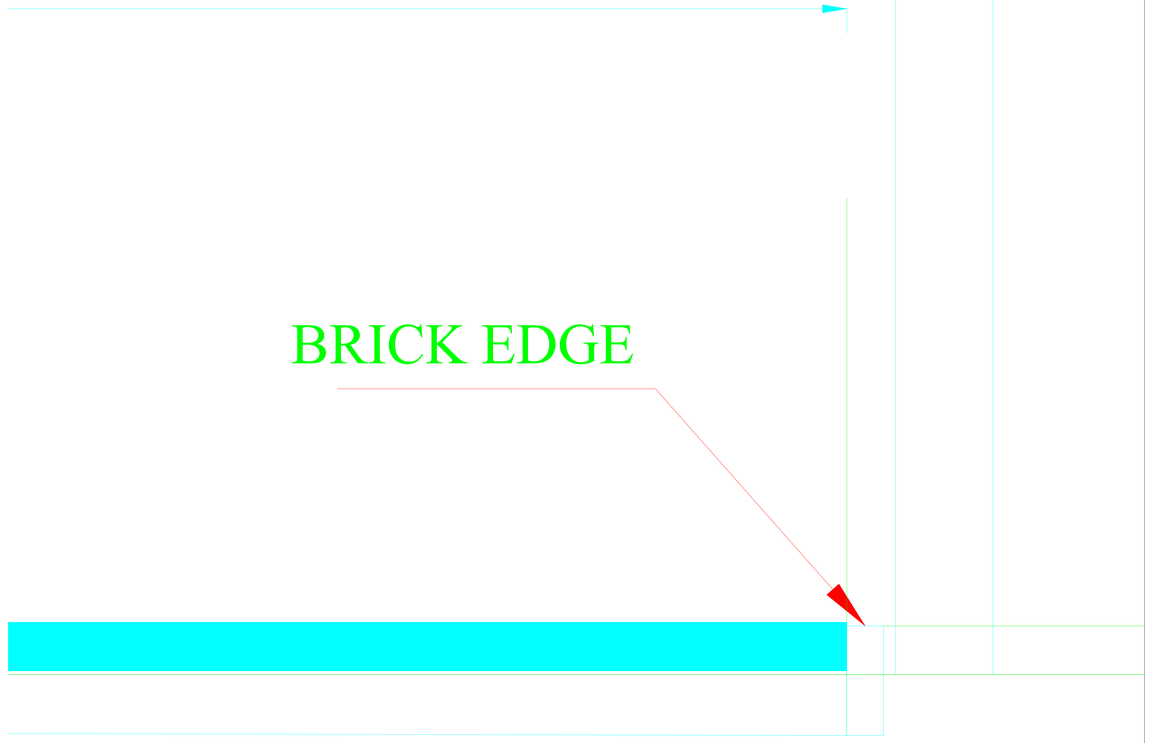
PROJECT : SIALKOT TANNERY ZONE

BUILDING TITLE: ROADS & FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE

DRAWING TITLE: STORM DRAINAGE SYSTEM

SCALE :	CHECKED BY	DWG. # :
NTS.	MSA	STZ-RE-CETP-02
DESIGNED BY :	DRAWN BY :	DATE :
MSA	GULFAM	11-11-2025





TYPICAL ROAD SECTION

FOR 5 METER AND 6 METER WIDE ROADS

REV.	DESCRIPTION	BY	DATE

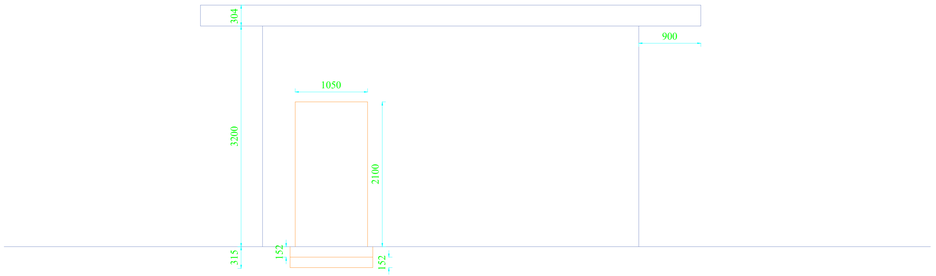
INCONSULT (PVT) LIMITED
ENGINEERING & MANAGEMENT CONSULTANT
80-AURANGZEB BLOCK
NEW GARDEN TOWN LAHORE-54600
TEL:35869560-35832234 FAX:35869561

PROJECT : SIALKOT TANNERY ZONE

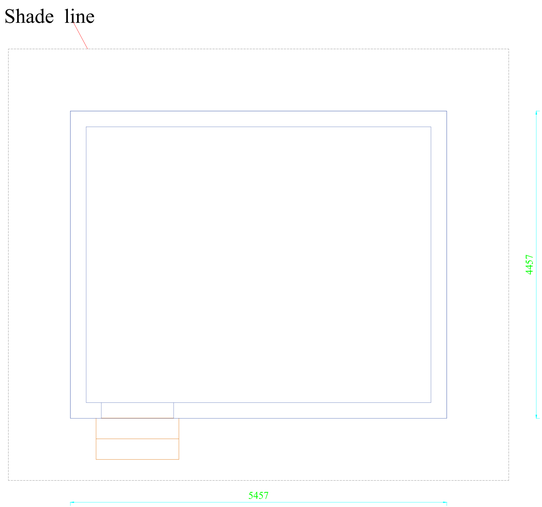
BUILDING TITLE: ROADS & FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE

DRAWING TITLE: TYPICAL ROAD SECTION

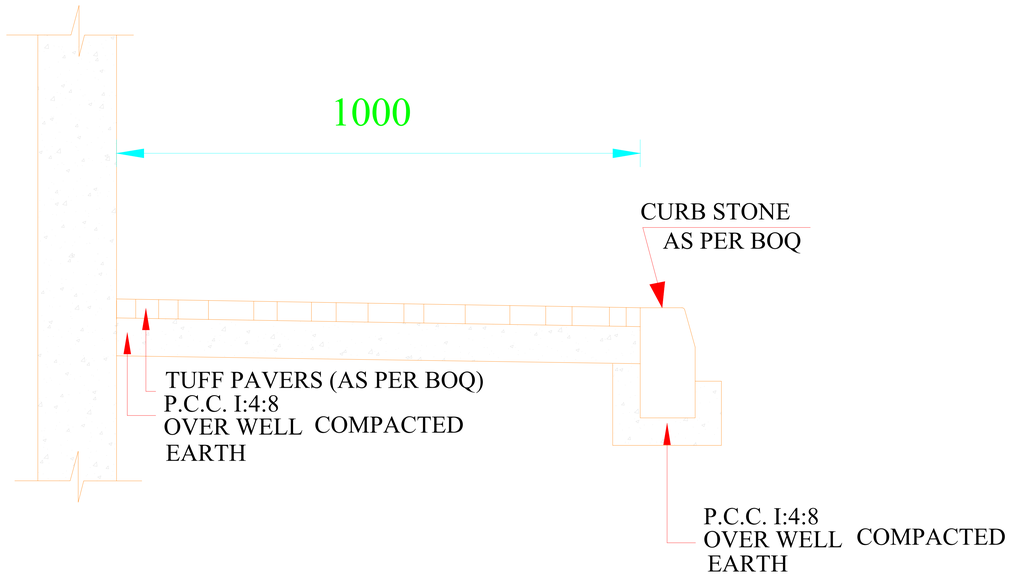
SCALE :	CHECKED BY	DWG. # :
NTS.	MSA	STZ-RE-CETP-03
DESIGNED BY :	DRAWN BY :	DATE :
MSA	GULFAM	11-11-2025



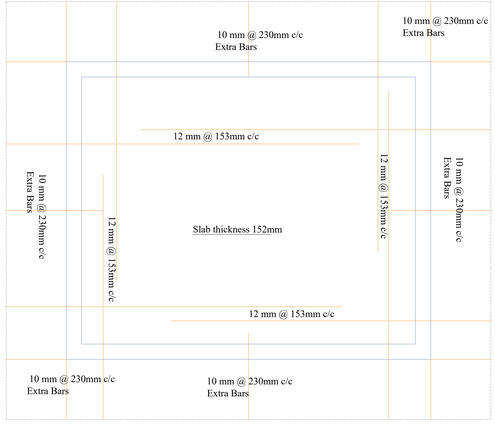
ELEVATION



GUARD ROOM PLAN



PLINTH PROTECTION DETAIL



TOP SLAB REINFORCMENT
GUARD ROOM

BASE SLAB REINFORCEMENT
GUARD ROOM

REV.	DESCRIPTION	BY	DATE

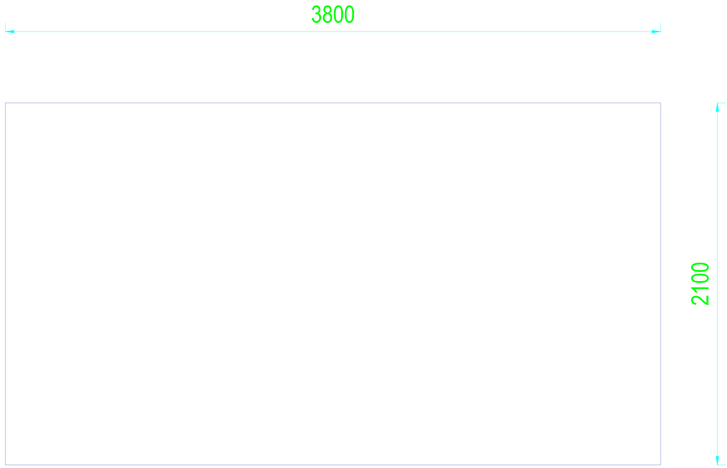
INCONSULT (PVT) LIMITED
ENGINEERING & MANAGEMENT CONSULTANT
80-AURANGZEB BLOCK
NEW GARDEN TOWN LAHORE-54600
TEL:35869560-35832234 FAX:35869561

PROJECT : SIALKOT TANNERY ZONE

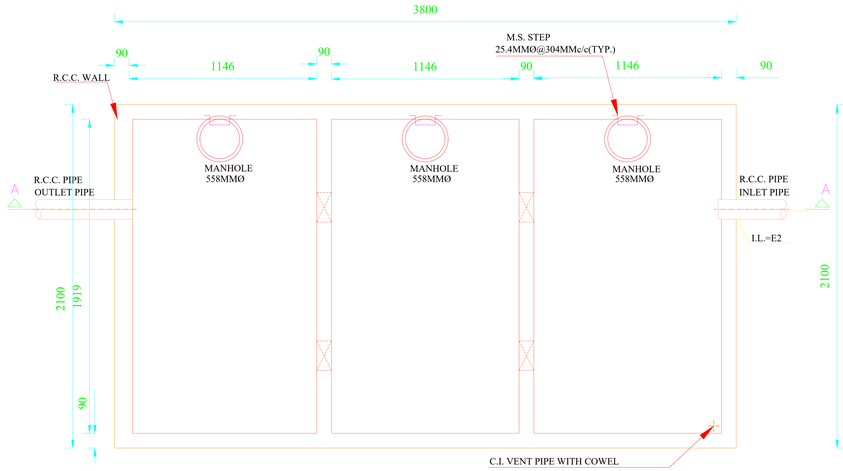
BUILDING TITLE: ROADS & FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE

DRAWING TITLE: MISCELLANEOUS

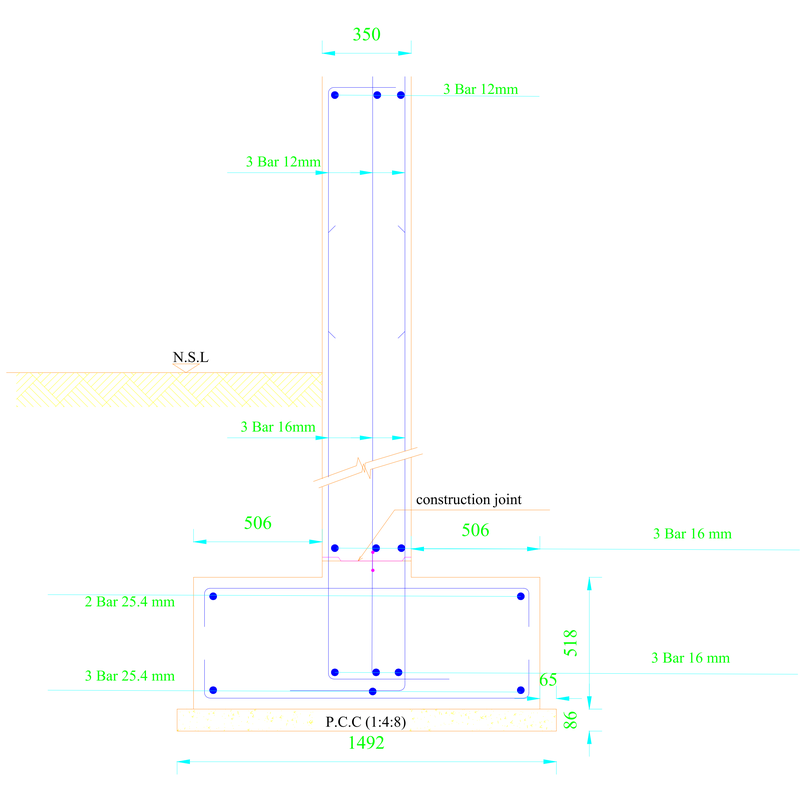
SCALE :	CHECKED BY	DWG. # :
NTS.	MSA	STZ-RE-CETP-04
DESIGNED BY :	DRAWN BY :	DATE :
MSA	GULFAM	11-11-2025



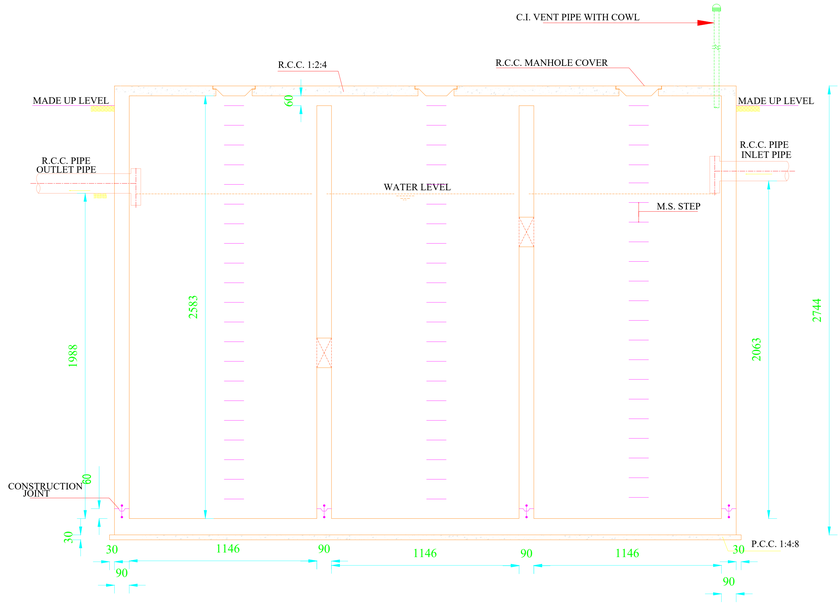
SEPTIC TANK



TOP PLAN
SEPTIC TANK



Gate Column Foundation



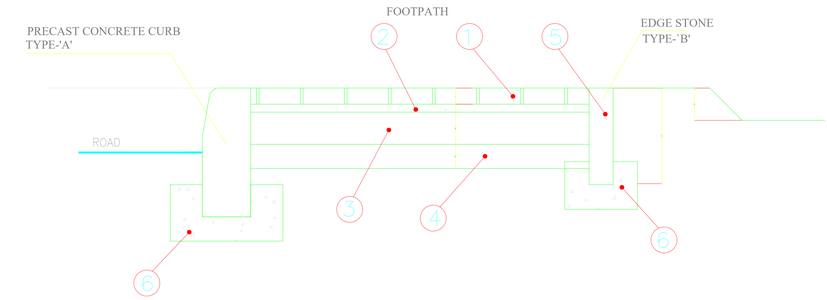
SECTION A-A

REV.	DESCRIPTION	BY	DATE

INCONSULT (PVT) LIMITED
ENGINEERING & MANAGEMENT CONSULTANT
80-AURANGZEB BLOCK
NEW GARDEN TOWN LAHORE-54600
TEL:35869560-35832234 FAX:35869561

PROJECT :	SIALKOT TANNERY ZONE
BUILDING TITLE:	ROADS & FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE
DRAWING TITLE:	SEPTIC TANK + GATE COLUMN FOUNDATION

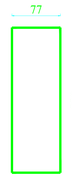
SCALE :	CHECKED BY	DWG. # :
NTS.	MSA	STZ-RE-CETP-05
DESIGNED BY :	DRAWN BY :	DATE :
MSA	GULFAM	11-11-2025



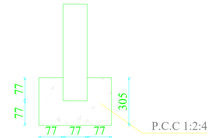
DETAIL OF FOOTPATH WITH TUFF PAVERS

LEGEND

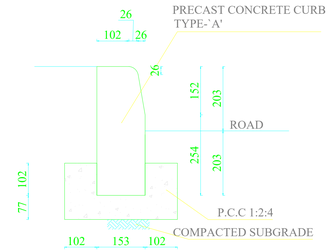
1 - 2" THICK TUFF PAVERS GROUTED WITH CEMENT SAND MOTAR 1:4.
2 - 3/4" CEMENT SAND MOTAR 1:5.
3 - 4" P.C.C. 1:4:8
4 - 3" SAND
5 - PRECAST CONCRETE EDGE STONE (CONCRETE 1:2:4)
6 - P.C.C 1:2:4 TO STABILIZE CURB.



DETAIL OF
BRICK EDGING
SCALE 1"=2'-0"

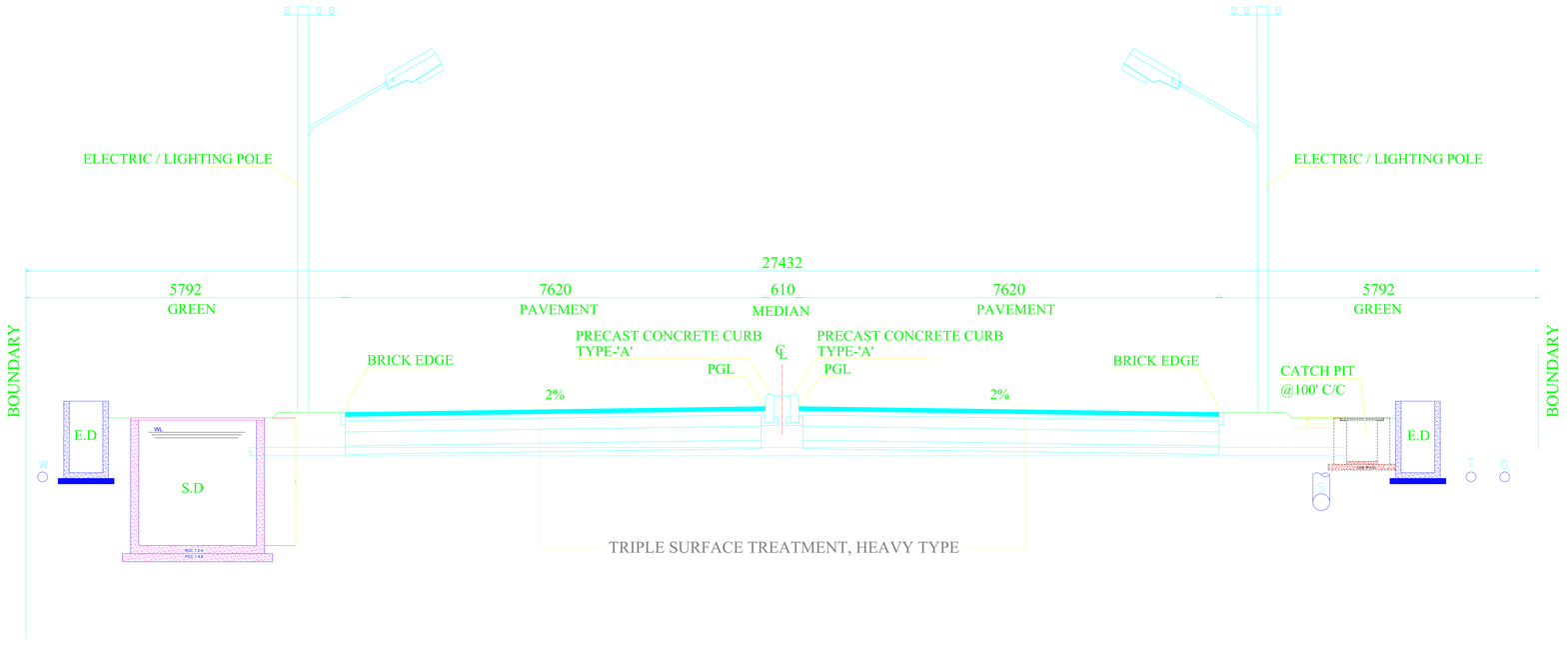


DETAIL OF EDGE STONE
TYPE-`B'
SCALE 1"=1'-0"



DETAIL OF
PRECAST CONCRETE CURB
SCALE 1"=1'-0"

TYPICAL DETAILS



PROPOSED TYPICAL CROSS SECTION OF 27432 MM (90 FEET) WIDE ROAD

REV.	DESCRIPTION	BY	DATE

INCONSULT (PVT) LIMITED
ENGINEERING & MANAGEMENT CONSULTANT
80-AURANGZEB BLOCK
NEW GARDEN TOWN LAHORE-54600
TEL:35869560-35832234 FAX:35869561

PROJECT : SIALKOT TANNERY ZONE

BUILDING TITLE: ROADS & FINISHING WORKS AT CETP AT SIALKOT TANNERY ZONE

DRAWING TITLE: TYPICAL ROAD SECTION AND DETAILS

SCALE :	CHECKED BY	DWG. # :
NTS.	MSA	STZ-RE-CETP-06
DESIGNED BY :	DRAWN BY :	DATE :
CH. REHMAT	GULFAM	11-11-2025